BACHELOR OF SCIENCE (HONOURS)
AGRICULTURE

CURRICULUM AND SYLLABUS

(For Students admitted from the academic year 2019-2020 onwards)

(Regulations 2019)

UNDER CREDIT SYSTEM

FACULTY OF AGRICULTURAL SCIENCES
SRM INSTITUTE OF SCIENCE AND TECHNOLOGY
KATTANKULATHUR - 603 203

FACULTY OF AGRICULTURAL SCIENCES
BACHELOR OF SCIENCE (Honours) AGRICULTURE
RULES, REGULATIONS AND COURSE SCHEME
(For Students admitted from the academic year 2019-2020 0nwards)

1. COURSE OBJECTIVES

The course will enable the students to

a. Learn the basics and applied concepts in the field of Agriculture and its allied divisions
b. Familiar with socio-economic conditions of the farmers and their problems
c. Impart diagnostic and remedial knowledge relevant to real field situation through practical training
d. Understand the scope, functions and job responsibilities in various sectors of agriculture and allied field
e. Develop confidence, entrepreneurial skill and competence to solve real farm problems

2. ELIGIBILITY FOR ADMISSION

H.Sc./Equivalent-Academic stream: Candidates seeking admission into B.Sc.(Hons.) degree programme must have passed the higher secondary examinations (10+2) conducted by any recognized board/University, with any one of the following subject group:

Group I Physics, Chemistry, Biology and Mathematics
Group II Physics, Chemistry and Biology
Group III Physics, Chemistry and Mathematics
Group IV Physics, Chemistry, Botany and Zoology
Group V Physics, Chemistry and Forestry
Group VI Physics, Chemistry, Biology and Agriculture
Group VII Physics, Chemistry and Agriculture

H.Sc.-Vocational Stream: Biology and Agricultural Practices as vocational subject including theory and practicals
Eligible Minimum Qualifying Marks: 50% aggregate marks

3. DURATION OF THE COURSE

The duration of the course would be of four academic years. Each academic year consists of two consecutive semesters. The duration of each semester is 105 working days. The first year of study shall be the first and second semester following student's admission. The second year of study shall be the third and fourth semesters; the third year, the fifth and sixth semesters and the fourth year, the seventh and eight semesters.

The structure of the B.Sc.(Hons.) Agriculture undergraduate programme, Academic/Ward Counsellor and Faculty Advisor, Class Committee, Registration/Enrollment for courses, Maximum duration of the programme, Temporary break of study from a programme, Discipline, Attendance, Condonation of attendance, Examinations, Assessment procedure, Registration for End Semester Examiantions, Passing requirements, Reappearance/Arrear Examination, Course-Wise grading of students, Eligibility for the award of the degree, Classification of the degree award, Review, Revision of Regulations and Curriculum, Question paper pattern would be followed as per the norms mentioned in the **"Bachelor of Science (Honours) Regulation-2019**" under the Faculty of Agricultural Sciences

SRM INSTITUTE OF SCIENCE AND TECHNOLOGY
FACULTY OF AGRICULTURAL SCIENCES
COURSEWISE CURRICULUM (2019-2023) - AGRICULTURE

COMPULSORY CORE (87 Credits)

AGROECOLOGY					
S. No.	**Course Code**	**Course Title**	**Credit Hours**	**Credit**	**Semester**
1.	AGE19101	Introduction to Agroecology	2+0	2	I
2.	AGE19102	Principles of Agronomy	2+1	3	I
3.	AGE19103	Study Tour – I	0+1	1	I
4.	AGE19104	Introduction to Microbiology	2+1	3	I
5.	AGE19201	Introduction to Agro Forestry	1+1	2	II
6.	AGE19301	Crop Production Technology -I (Kharif Crops)	1+1	2	III
7.	AGE19302	Principles of Irrigation Management	1+1	2	III
8.	AGE19401	Environmental Studies and Disaster Management	2+1	3	IV
9.	AGE19402	Crop Production Technology-II(Rabi Crops)	1+1	2	IV
10.	AGE19403	Farming System and Sustainable Agriculture	1+0	1	IV
11.	AGE19404	Introductory Agricultural Meteorology and Climate Change	1+1	2	IV
12.	AGE19405	Study Tour - II	0+1	1	IV
13.	AGE19501	Practical Crop Production-I (*Kharif Crops*)	0+1	1	V
14.	AGE19601	Rainfed Agriculture and Watershed Management	1+1	2	VI
15.	AGE19602	Principles of Organic Farming	1+1	2	VI
16.	AGE19603	Practical Crop Production -II (Rabi crops)	0+1	1	VI
17.	AGE19604	Agricultural Microbiology	1+1	2	VI

NATURAL RESOURCE MANAGEMENT					
S. No.	**Course Code**	**Course Title**	**Credit Hours**	**Credit**	**Semester**
1.	NRM19201	Fundamentals of Soil Science	2+1	3	II
2.	NRM19401	Problematic Soils and their Management	2+0	2	IV
3.	NRM19501	Manures, Fertilizers and Soil Fertility Management	2+1	3	V

CROP HEALTH					
S. No.	**Course Code**	**Course Title**	**Credit Hours**	**Credit**	**Semester**
1.	CRH19102	Introduction to Crop Physiology	2+1	3	I
2.	CRH19201	Principles of Weed Management	1+1	2	II
3.	CRH19202	Introduction to Plant Biochemistry	2+1	3	II
4.	CRH19203	Fundamentals of Plant Pathology	2+1	3	II
5.	CRH19301	Fundamentals of Entomology	2+1	3	III
6.	CRH19401	Principles of Integrated Pest and Disease Management	2+1	3	IV
7.	CRH19501	Diseases of Field and Horticultural Crops and their Management -I	2+1	3	V
8.	CRH19502	Pests of Crops and Stored Grain and their Management	2+1	3	V
9.	CRH19601	Diseases of Field and Horticultural Crops and their Management-II	2+1	3	VI
10.	CRH19602	Management of Beneficial Insects	1+1	2	VI

GENETICS AND PLANT BREEDING					
S. No.	**Course Code**	**Course Title**	**Credit Hours**	**Credit**	**Semester**
1.	GPB19101	Botany of Field Crops	2+1	3	I
2.	GPB19201	Principles of Genetics and Cytogenetics	2+1	3	II
3.	GPB19301	Fundamentals of Plant Breeding	2+1	3	III
4.	GPB19401	Principles of Seed Technology	2+1	3	IV
5.	GBP19501	Crop Improvement –I (*Kharif Crops)*	1+1	2	V
6.	GPB19502	Plant Biotechnology	2+1	3	V
7.	GPB19601	Crop Improvement-II (Rabi Crops)	1+1	2	VI

SUPPORTIVE COURSE (35 Credits)

AGRICULTURAL SOCIAL SCIENCES					
S. No.	**Course Code**	**Course Title**	**Credit Hours**	**Credit**	**Semester**
1.	AGS19101	Fundamentals of Agricultural Economics	1+1	2	I
2.	AGS19201	Rural Sociology and Educational Psychology	2+0	2	II
3.	AGS19301	Agricultural Finance and Cooperation	2+1	3	III
4.	AGS19302	Fundamentals of Agricultural Extension Education	2+1	3	III
5.	AGS19401	Agricultural MarketingTrade and Prices	2+1	3	IV
6.	AGS19501	Entrepreneurship Development and Business communication	1+1	2	V
7.	AGS19601	Farm Management, Production and Resource Economics	1+1	2	VI
8.	AGS19602	Intellectual Property Rights	1+0	1	VI

HORTICULTURE					
S.No.	**Course Code**	**Course Title**	**Credit Hours**	**Total credit**	**Semester**
1.	HOR19104	Fundamentals of Horticulture	1+1	2	I
2.	HOR19203	Production Technology of Fruit and Plantation Crops	1+1	2	II
3.	HOR19305	Production Technology for Vegetables and Spices	1+1	2	III
4.	HOR19507	Production Technology for Ornamental Crops,MAP and Landscaping	1+1	2	V
5.	HOR19605	Post Harvest Management and Value Addition of Fruits and Vegetables	1+1	2	VI
6.	HOR19606	Principles of Food Science and Nutrition	1+1	2	VI

SKILL EDUCATION					
S.No	**Course Code**	**Course Title**	**Credit Hours**	**Credit**	**Semester**
1.	SKE19101	Communication Skills and Personality Development	1+1	2	I
2.	SKE 19201	Agricultural Informatics	0+1	1	II
3.	SKE19401	Comprehension and Communication Skills in English	1+1	2	IV

SUPPLEMENTARY COURSES (13 Credits)

SUPPLEMENTARY COURSES					
S. No.	**Course Code**	**Course Title**	**Credit Hours**	**Credit**	**Semester**
1.	SUP19301	Soil and Water Conservation Engineering	1+1	2	III
2.	SUP19302	Livestock and Poultry Management	2+1	3	III
3.	SUP19401	Farm Machinery and Power	1+1	2	IV
4.	SUP19501	Renewable Energy and Green Technology	1+1	2	V
5.	SUP19502	Geoinformatics and Nano-technology and Precision Farming	1+1	2	V
6.	SUP19601	Protected cultivation and Secondary Agriculture	1+1	2	VI

ALLIED COURSES (4 Credits)

ALLIED COURSES					
S. No.	**Course Code**	**Course Title**	**Credit Hours**	**Credit**	**Semester**
1.	MAT19101	Elementary Mathematics	1+1	2	I
2.	MAT19201	Elementary Statistics	1+1	2	II

EXTENSION ACTIVITY (Non-Gradial Courses)

PHYSICAL AND HEALTH EDUCATION				
S. No.	**Course Code**	**Course Title**	**Credit Hours**	**Semester**
1.	PHE19101	Physical Education	0	I-IV
2.	PHE19102	National Service Scheme	0	I-IV
3.	PHE19103	National Cadet Corps	0	I-IV
4.	PHE19301	Yoga for Human Excellence	0	III
5.	PHE19401	Human Values and Ethics	0	IV

Student READY (41 Credits)

Student READY					
S. No.	**Course Code**	**Course Title**	**Credit hours**	**Credit**	**Semester**
1.	STR19701	Student READY - Rural Agricultural Work Experience (RAWE) and Agro-Industrial Attachment (AIA)	0+20	20	VII
2.	STR19702	All India Study Tour	0+1	1	VII
		Total	**0+21=21**		
Experiential Learning Programme					
1	STR198^{++}	Experiential Learning-I	0+10	10	VIII
		Experiential Learning-II	0+10	10	VIII
		Total	**0+20=20**		

ELECTIVE COURSE (6 Credits)

ELECTIVE COURSE (ANY ONE COURSE)					
S. No.	**Course Code**	**Course Title**	**Credits Hours**	**Total Credits**	**Semester**
1.	ELC19401	Agricultural Journalism	1+1	2	IV
2.	ELC19402	Food Safety and Standards	1+1	2	IV
3.	ELC19403	Hi-Tech. Horticulture	1+1	2	IV
1	ELC19501	Applied Microbiology	1+1	2	V
2	ELC19502	Agribusiness management	1+1	2	V
3	ELC19503	System Simulation and Agro Advisory	1+1	2	V
1.	ELC19601	Commercial Plant breeding	1+1	2	VI
2.	ELC19602	Agrochemicals	1+1	2	VI
3.	ELC19603	Landscaping	1+1	2	VI

EXPERIENTIAL LEARNING PROGRAMME ((ANY TWO COURSES)

S. No.	Course Code	Course Title	Credits Hours	Semester
1.	STR19801	Bio-inoculants Production Technology	0+10	VIII
2.	STR19802	Production Technology of Bio-control Agents	0+10	VIII
3.	STR19803	Mushroom Cultivation Technology	0+10	VIII
4.	STR19804	Commercial Beekeeping	0+10	VIII
5.	STR19805	Commercial Sericulture	0+10	VIII
6.	STR19806	Soil, Plant, Water, Manure and Fertilizers Testing	0+10	VIII
7.	STR19807	Commercial Seed Production	0+10	VIII
8.	STR19808	Commercial Horticulture	0+10	VIII
9.	STR19809	Floriculture and Landscape Architecture	0+10	VIII
10.	STR19810	Protected Cultivation of High Value Horticulture crops	0+10	VIII
11.	STR19811	Agriculture Waste Management	0+10	VIII
12.	STR19812	Food Processing	0+10	VIII
13.	STR19813	Processing of Fruits and Vegetables for value addition	0+10	VIII
14.	STR19814	Poultry Production Technology	0+10	VIII

Abstract

S:No	Career Stream	Total Credits
1.	Compulsory core	87
2.	Supportive course	35
3.	Supplementary courses	13
4.	Allied courses	4
5.	Extension activity	-
6.	Elective Course	6
7.	Student READY	41
	Total	186

SRM INSTITUTE OF SCIENCE AND TECHNOLOGY
FACULTY OF AGRICULTURAL SCIENCES
BSc. (Hons.) Agriculture Programme (2019 - 2023)
SEMESTERWISE CURRICULUM

FIRST SEMESTER						
Career Stream Title	**Course Code**	**Course Title**	**Credit Hours**			
			Theory (T)	**Practical (P)**	**Total (T+P)**	**Credit**
Compulsory core	AGE19101	Introduction to Agroecology	2	0	2	2
	AGE19102	Principles of Agronomy	2	1	3	3
	AGE19103	Study Tour I	0	1	1	1
	AGE19104	Introduction to Microbiology	2	1	3	3
	CRH19102	Introduction to Crop Physiology	2	1	3	3
	GPB19101	Botany of Field Crops	2	1	3	3
Supportive course	AGS19101	Fundamentals of Agricultural Economics	1	1	2	2
	HOR19104	Fundamentals of Horticulture	1	1	2	2
	SKE19101	Communication Skills and Personality Development	1	1	2	2
Allied	MAT19101	Elementary Mathematics	1	1	2	2
		Total	**14**	**9**	**23**	**23**

SECOND SEMESTER						
Career Stream Title	**Course Code**	**Course Title**	**Credit Hours**			
			Theory (T)	**Practical (P)**	**Total (T+P)**	**Credit**
Compulsory core	AGE19201	Introduction to Agro Forestry	1	1	2	2
	NRM19201	Fundamentals of Soil Science	2	1	3	3
	CRH19201	Principles of Weed Management	1	1	2	2
	CRH19202	Introduction to Plant Biochemistry	2	1	3	3
	CRH19203	Fundamentals of Plant Pathology	2	1	3	3
	GPB19201	Principles of Genetics and Cytogenetics	2	1	3	3
Supportive course	AGS19201	Rural Sociology and Educational Psychology	2	0	2	2
	HOR19203	Production Technology of Fruit and Plantation Crops	1	1	2	2
	SKE19201	Agricultural Informatics	0	1	1	1
Allied	MAT19201	Elementary Statistics	1	1	2	2
		Total	**14**	**9**	**23**	**23**

THIRD SEMESTER						
Career Stream Title	Course Code	Course Title	Credit Hours			
			Theory (T)	Practical (P)	Total (T+P)	Credit
Compulsory core	CRH19301	Fundamentals of Entomology	2	1	3	3
	GPB19301	Fundamentals of Plant Breeding	2	1	3	3
	AGE19301	Crop Production Technology -I (Kharif Crops)	1	1	2	2
	AGE19302	Principles of Irrigation Management	1	1	2	2
Supportive course	AGS19301	Agricultural Finance and Cooperation	2	1	3	3
	AGS19302	Fundamentals of Agricultural Extension Education	2	1	3	3
	HOR19305	Production Technology for Vegetables and Spices	1	1	2	2
Supplementary Course	SUP19301	Soil and Water Conservation Engineering	1	1	2	2
	SUP19302	Livestock and Poultry Management	2	1	3	3
Extension Activity	PHE19301	Yoga for Human Excellence	0	0	0	0
		Total	**14**	**9**	**23**	**23**

NG* - Non Gradial but compulsory course

FOURTH SEMESTER						
Career Stream Title	Course Code	Course Title	Credit Hours			
			Theory (T)	Practical (P)	Total (T+P)	Credit
Compulsory core	AGE19401	Environmental Studies and Disaster Management	2	1	3	3
	AGE19402	Crop Production Technology-II(Rabi Crops)	1	1	2	2
	AGE19403	Farming System and Sustainable Agriculture	1	0	1	1
	AGE19404	Introductory Agro-meteorology and Climate Change	1	1	2	2
	AGE19405	Study Tour – II	0	1	1	1
	NRM19401	Problematic Soils and their Management	2	0	2	2
	CRH19401	Principles of Integrated Pest and Disease Management	2	1	3	3
	GPB19401	Principles of Seed Technology	2	1	3	3
Supportive course	AGS19401	Agricultural Marketing Trade and Prices	2	1	3	3
	SKE19401	Comprehension and Communication Skills in English	1	1	2	2
Supplementary Course	SUP19401	Farm Machinery and Power	1	1	2	2
Elective Course	ELC194++	Elective Course-1	1	1	2	2
Extension Activity	PHE 19101	Physical Education*#	0	0	0	0
	PHE19102	National Service Scheme *#	0	0	0	0
	PHE19103	National Cadet Corps	0	0	0	0
	PHE19401	Human Values and ethics	0	0	0	0
		Total	**16**	**10**	**26**	**26**

NG* - Non Gradial but compulsory course

Registration in Semester-I

£Any one of the course chosen as optional by the student from the table of elective course, ++ last two digits of course code

FIFTH SEMESTER						
Career Stream Title	Course Code	Course Title	Credit Hours			
			Theory (T)	Practical (P)	Total (T+P)	Credit
Compulsory core	NRM19501	Manures, Fertilizers and Soil Fertility Management	2	1	3	3
	CRH19501	Diseases of Field and Horticultural Crops and their Management –I	2	1	3	3
	CRH19502	Pests of Crops and Stored Grain and their Management	2	1	3	3
	GBP19501	Crop Improvement –I (*Kharif Crops)*	1	1	2	2
	GPB19502	Plant Biotechnology	2	1	3	3
	AGE19501	Practical Crop Production-I (*Kharif Crops*)	0	1	1	1
Supportive course	AGS19501	Entrepreneurship Development and Business Communication	1	1	2	2
	HOR19507	Production Technology for Ornamental Crops,MAP and Landscaping	1	1	2	2
Supplementary Course	SUP19501	Renewable Energy and Green Technology	1	1	2	2
	SUP19502	Geoinformatics and Nano-technology and Precision Farming	1	1	2	2
Elective Course	ELC195++	Elective course-2	1	1	2	2
		Total	**14**	**11**	**25**	**25**

£Any one of the course chosen as optional by the student from the table of elective course,
++ last two digits of course code

SIXTH SEMESTER						
Career Stream Title	Course Code	Course Title	Credit Hours			
			Theory (T)	Practical (P)	Total (T+P)	Credit
Compulsory core	CRH19601	Diseases of Field and Horticultural Crops and their Management-II	2	1	3	3
	CRH19602	Management of Beneficial Insects	1	1	2	2
	GPB19601	Crop Improvement-II(Rabi Crops)	1	1	2	2
	AGE19601	Rainfed Agriculture and Watershed Management	1	1	2	2
	AGE19602	Principles of Organic Farming	1	1	2	2
	AGE19603	Practical Crop Production -II (Rabi crops)	0	1	1	1
	AGE19604	Agricultural Microbiology	1	1	2	2
Supportive course	AGS19601	Farm Management, Production and Resource Economics	1	1	2	2
	AGS19602	Intellectual Property Rights	1	0	1	1
	SUP19601	Protected cultivation and Secondary Agriculture	1	1	2	2
	HOR19605	Post Harvest Management and Value Addition of Fruits and Vegetables	1	1	2	2
	HOR19606	Principles of Food Science and Nutrition	1	1	2	2
Elective Course	ELC196++	Elective course-3	1	1	2	2
		Total	**13**	**12**	**25**	**25**

£Any one of the course chosen as optional by the student from the table of elective course,
++ last two digits of course code

SEVENTH SEMESTER						
Career Stream Title	Course Code	Course Title	Credit Hours			
			Theory (T)	Practical (P)	Total Credit (T+P)	Credit
Student READY	STR19701	Student READY - Rural Agricultural Work Experience (RAWE) and Agro-Industrial Attachment (AIA)	0	20	20	20
	STR19702	All India Study Tour	0	1	1	1
		Total	**0**	**21**	**21**	**21**

EIGHTH SEMESTER						
Career Stream Titl	Course Code	Course Title	Credit Hours			
			Theory (T)	Practical (P)	Total Credit (T+P)	Credit
Student READY	STR198++	Experiential Learning – I#	0	10	10	10
	STR198++	Experiential Learning – I#	0	10	10	10
		Total	**0**	**20**	**20**	**20**

Any two courses chosen as optional by the student from the table of Experiential learning programme,
++ last two digits of course code

ELECTIVE COURSE

ELECTIVE COURSE (ANY ONE COURSE)					
S. No.	Course Code	Course Title	Credits Hours	Total Credits	Semester
1.	ELC19401	Agricultural Journalism	1+1	2	IV
2.	ELC19402	Food Safety and Standards	1+1	2	IV
3.	ELC19403	Hi-Tech. Horticulture	1+1	2	IV
1	ELC19501	Applied Microbiology	1+1	2	V
2	ELC19502	Agribusiness management	1+1	2	V
3	ELC19503	System Simulation and Agro Advisory	1+1	2	V
1.	ELC19601	Commercial Plant breeding	1+1	2	VI
2.	ELC19602	Agrochemicals	1+1	2	VI
3.	ELC19603	Landscaping	1+1	2	VI

EXPERIENTIAL LEARNING PROGRAMME ((ANY TWO COURSES)

S. No.	Course Code	Course Title	Credits Hours	Semester
1.	STR19801	Bio-inoculants Production Technology	0+10	VIII
2.	STR19802	Production Technology of Bio-control Agents	0+10	VIII
3.	STR19803	Mushroom Cultivation Technology	0+10	VIII
4.	STR19804	Commercial Beekeeping	0+10	VIII
5.	STR19805	Commercial Sericulture	0+10	VIII
6.	STR19806	Soil, Plant, Water, Manure and Fertilizers Testing	0+10	VIII
7.	STR19807	Commercial Seed Production	0+10	VIII
8.	STR19808	Commercial Horticulture	0+10	VIII
9.	STR19809	Floriculture and Landscape Architecture	0+10	VIII
10.	STR19810	Protected Cultivation of High Value Horticulture crops	0+10	VIII
11.	STR19811	Agriculture Waste Management	0+10	VIII
12.	STR19812	Food Processing	0+10	VIII
13.	STR19813	Processing of Fruits and Vegetables for value Addition	0+10	VIII
14.	STR19814	Poultry Production Technology	0+10	VIII

ABSTRACT

S. No.	Semester	Credit Hours		Total Credit (T+P)
		Theory	Practical	
1.	I	14	9	23
2.	II	14	9	23
3.	III	14	9	23
4.	IV	16	10	26
5.	V	14	11	25
6.	VI	13	12	25
7.	VII	0	21	21
8.	VIII	0	20	20
	TOTAL	**85**	**101**	**186**

Total credits to be earned for the degree: 186

Course Code	AGE19101	Course Name	INTRODUCTION TO AGROECOLOGY	Course Category	C	Compulsory Core	L	T	P	C
							2	0	0	2

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Agroecology	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1 :	Paraphrase the agricultural heritage and relating it to the present day agriculture
CLR-2 :	Outline the agricultural developments in India
CLR-3 :	Summarize the domestication and voyage of different crops
CLR-4 :	Explain various agroecomodels
CLR-5 :	Awareness on various agricultural resources and holistic resource management
CLR-6 :	Outline the future prospects of Indian agriculture and SDGs

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Agriculture Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	Ability to solve scientific problems	Ability to implement knowledge gained in the applied field	Ability to understand social and ethical responsibilities
CLO-1 :	Outline the agricultural heritage	1	95	80	H			H		H	H		M	H		H	H	H	H
CLO-2 :	Describe the various development in the field of agriculture	1	90	85	M			H		H	M		L	H		H	H	H	H
CLO-3 :	Discuss the crop voyage	2	80	70	M			L			M		L	H		H	H	H	H
CLO-4 :	Discuss the scope and importance of agriculture	2	75	70	H			M	L	H	H		M	H		H	H	H	H
CLO-5 :	Explain different types of agroecomodels	2	75	65	M	L	L	L	L	M	M	M	M	H		H	H	H	M
CLO6 :	Outline the future prospects and concerns of alternative agriculture	2	75	70	M		L	M		M	H	H	M	H		H	H	H	H

		Learning Unit / Module 1	Learning Unit / Module 2	Learning Unit / Module 3	Learning Unit / Module 4	Learning Unit / Module 5
Duration (hour)		2	2	2	2	2
S-1	SLO-1	History of Agriculture	Journey of Indian agriculture and its development from past to modern era	Traditional and conventional agriculture need for sustainable food production	Natural resources for agriculture, plants and environmental factors - light; temperature; humidity, rainfall and wind	Alternative and Sustainable agriculture - Agroecological innovations – System of rice intensification
	SLO-2	Ancient agricultural practices – Global, Indian and Tamil Nadu	Crop voyage in India and world	Input-Centric Agriculture and its implications	Soil -importance of soil humus / organic matter, soil health and management; soil biofertility; root growth and interaction with soil conditions.	SWI - System of Wheat intensification
S-2	SLO-1	Relevance of heritage to present day agriculture and Past and present status of agriculture and farmers in society	Agriculture scope; Importance of agriculture	Agroecology - Agroecological Principles; Concepts and perspectives in agroecosystem	Water saving agriculture; ecological principles for resource management holistic resource management; preserving natural resources.	SSI - Sustainable Sugarcane initiative.
	SLO-2	Plant production and protection through indigenous traditional knowledge	Agricultural resources available in India	Different agroecosystems; processes within agro-ecosystems and flows of energy and materials (water, nutrients, carbon).	Soil carbon and policies; contemporary crop production practices and organic food production.	Conservation agriculture and Resilient agriculture.

S-3	SLO-1	*Agricultural Development Challenges*	*Crop significance and classifications*	*Population dynamics of organisms, Natural selection and co-evolution; Biodiversity and ecological agriculture.*	*Pollution and its impact.*	*Natural farming – Principles and concepts*
	SLO-2	*Food systems & Food security; Food sovereignty*	*National agriculture setup in India*	*Species interactions in crop communities; Agroecology and community.*	-	*Biodynamic agriculture– Principles and concepts*
S-4	SLO-1	-	*Current scenario of Indian agriculture.*	-	-	*Permaculture– Principles and concepts*
	SLO-2	-	-	-	-	*LEISA - Low external input Sustainable agriculture – Principles and concepts*
S-5	SLO-1	-	-	-	-	*Zero Budget Natural Farming (ZBNF) and Economic implications and long-term impacts of alternative systems*
	SLO-2	-	-	-	.-	

Learning Resources	1. Anil Shrestha & David Clememts. (2009). New Dimensions in Agroecology (1st ed.). Parlier, CA, USA, CRC Press. pp. 1-553. 2. Palaniappan, S.P. and Annadurai (2012). Organic Farming (1st ed.). India, Scientific Publishers. pp 1-256. 3. Stephen R.Gliessman. (1998). Agroecology: Ecological Process in Sustainable Agriculture (2 nd ed.). Chelsea, Michigan, Ann Arbor Press. pp 1-357.	4. Stephen R. Gliessman and Martha Rosemeyer. (2010). The Conversion to Sustainable Agriculture Principles, Processes, and Practices (1st ed.). CRC press, New York. pp. 1-354. *5.* Subbarao, N.S. (2020). Soil Microbiology (5th ed.). India, Oxford and Ibh publishing. pp 1-426.

	Level of Thinking	Continuous Learning Assessment (50% weightage)		End semester theory Examination (50%)
		In-Semester (40%)	Theory Internal (10%)	
Level 1	Remember	40 %	40 %	30 %
	Understand			
Level 2	Apply	40 %	40 %	40 %
	Analyze			
Level 3	Evaluate	20 %	20 %	30 %
	Create			
	Total	*100 %*	*100 %*	*100 %*

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Mr. C. Vaithilingam *Romvijay Biotech PVT LTD* *NH32, Mullodai, Kanniyakoil, Puducherry 607402*	*Dr.Norman Uphoff, Professor,* *Emeritus of Government and international Agriculture,* *Senior Advisor, SRI-Rice, International Programs/CALS,* *Cornell University, Ithaca, New York.*	*Dr. S.Kothai* *Dr. S.Geetha*

THEORY

Unit I – Agricultural Heritage

History of Agriculture, mankind and agriculture; ancient agricultural practices – Global, Indian and Tamil Nadu;relevance of heritage to present day agriculture; past and present status of agriculture and farmers in society; Plant production and protection through indigenous traditional knowledge; Agricultural Development Challenges; Food security, food systems; food sovereignty.

Unit II – Indian Agriculture

Journey of Indian agriculture and its development from past to modern era; Crop voyage in India and world; Agriculture scope; Importance of agriculture and agricultural resources available in India; Crop significance and classifications; national agriculture setup in India; Current scenario of Indian agriculture.

Unit III - Agroecology

Traditional and conventional agriculture; need for sustainable food production; Input-Centric Agriculture and its implications; Ecology, Natural ecosystems; agroecology; agroecological Principles; Concepts and perspectives in agroecosystem; different agroecosystems; processes within agro-ecosystems; Flows of energy and materials (water, nutrients, carbon); Population dynamics of organisms; Natural selection and co-evolution; Biodiversity and ecological agriculture; Species interactions in crop communities; animals in the agroecosystem; agroecology and community

Unit IV - Resource Management

Natural resources for agriculture, plants and environmental factors - light; temperature; humidity and rainfall; wind; soil -importance of soil humus / organic matter, soil health and management; soil biofertility; root growth and interaction with soil conditions; water – water for agriculture; water saving agriculture; ecological principles for resource management holistic resource management; preserving natural resources; soil carbon and policies; contemporary crop production practices and organic food production; pollution and its impact

Unit V - Agroecology Models

Alternative agriculture practices for Sustainable agriculture, agroecological innovations – SRI, SWI, SSI; conservation agriculture; resilient agriculture; Natural farming, Biodynamic agriculture ; Permaculture, LEISA, Zero Budget Natural Farming (ZBNF), economic implications and long-term impacts of alternative systems.

Theory- Lecture Schedule

1. History of Agriculture, mankind and agriculture.
2. Ancient agricultural practices – Global, Indian and Tamil Nadu.
3. Relevance of heritage to present day agriculture; past and present status of agriculture and farmers in society
4. Plant production and protection through indigenous traditional knowledge.
5. Agricultural Development Challenges.
6. Food security, food systems; food sovereignty.
7. Journey of Indian agriculture and its development from past to modern era
8. Crop voyage in India and world.
9. Scope & Importance of agriculture.
10. Agricultural resources available in India.
11. Crop significance and classifications.
12. National agriculture setup in India.
13. Current scenario of Indian agriculture.
14. Traditional and conventional agriculture; Need for sustainable food production.
15. Input-Centric Agriculture and its implications.
16. Ecology, Natural ecosystems; agroecology; Agroecological Principles; Concepts and perspectives in Agroecosystem.
17. **In-Semester Examination**
18. Different Agroecosystems; processes within agro-ecosystems; Flows of energy and materials (water, nutrients, carbon).
19. Dynamics of organisms; Natural selection and co-evolution; Biodiversity and ecological agriculture.
20. Species interactions in crop communities; animals in the Agroecosystem; Agroecology and community.
21. Natural resources for agriculture, plants and environmental factors - light; temperature; humidity, rainfall and wind.
22. Soil -importance of soil humus / organic matter, soil health and management; soil biofertility; root growth and interaction with soil conditions.
23. Water saving agriculture; ecological principles for resource management holistic resource management; preserving natural resources.
24. Soil carbon and policies; contemporary crop production practices and organic food production
25. Pollution and its impact.

26. Alternative agricultural practices for Sustainable agriculture - Agroecological innovations - System of Rice Intensification.
27. SWI – System of Wheat Intensification.
28. SSI - Sustainable Sugarcane initiative.
29. Conservation agriculture and Resilient agriculture.
30. Natural farming.
31. Biodynamic agriculture.
32. Permaculture.
33. LEISA - Low external input Sustainable agriculture.
34. Zero Budget Natural Farming and Economic implications and long-term impacts of alternative systems.

Text Books

1. Anil Shrestha & David Clememts. (2009). New Dimensions in Agroecology (1st ed.). Parlier, CA, USA, CRC Press. pp. 1-553.
2. Palaniappan, S.P. and Annadurai (2012). Organic Farming (1st ed.). India, Scientific Publishers. pp 1-256.
3. Stephen R.Gliessman. (1998). Agroecology: Ecological Process in Sustainable Agriculture (2 nd ed.). Chelsea, Michigan, Ann Arbor Press. pp 1-357.
4. Stephen R. Gliessman and Martha Rosemeyer. (2010). The Conversion to Sustainable Agriculture Principles, Processes, and Practices (1st ed.). CRC press, New York. pp. 1-354.
5. Subbarao, N.S. (2020). Soil Microbiology (5th ed.). India, Oxford and Ibh publishing. pp 1-426.

References Books

1. Agroecology: Key Concepts Principles and Practices, (2015). Publishers: Third world network, Lusaka, Zambia and Sociedad CientificaLatinoamericana de Agroecologia (SOCLA), California, U.S.A. ISBN 978-967-0747-11-8.
2. Agricultural Systems: Agroecology and Rural Innovation for Development. 2nd Edition. (2017). Agroecology and Rural Innovation for Development.Editors: Sieglinde Snapp Barry Pound. eBook ISBN: 9780128020951. Page 1-558.
3. The conversion to sustainable Agriculture. (2010) Edited by Stephen R.Gliessman. CRC press, California, Taylor & Francis Group. Pg 1-382.
4. https://kupdf.net/download/agroecology-gliessman_59c5722508bbc57e126871ad_pdf
5. https://kupdf.net/download/vertical-farming_595f6fa5dc0d6072632be308_pdf

Websites

1. http://www.fao.org/family-farming/detail/en/c/416262/
2. https://blog.forumias.com/answered-what-do-you-understand-by-the-term-agroecology-how-agroecology-is-a-better-alternative-to-other-climate-smart-agriculture-models/ https://www.researchgate.net/deref/http%3A%2F%2Fwww.tandfonline.com%2Floi%2Fwjsa20
3. https://www.ileia.org/wp-content/uploads/2016/06/FM32.3.pdf
4. https://www.cetri.be/Agroecology-as-an-alternative-to?lang=fr.https://www.agrifarming.in/profitable-crops-for-vertical-farming-a-full-guide
5. .https://www.britannica.com/science/biodiversity-loss

Journals

1. Science direct (Is vertical farming the way to a greener life
2. Journal of Ecology and Environmental Sciences
3. International Journal of Ecology
4. Global Ecology and Conservation

Course Nature: Theory only							
Total Marks (100)							
S.No.	Category	Assessment Tools					
		In- Semester Examination	*Assignment*	*Record*	*Attendance*	*End-Semester Examination*	*Marks*
1	Theory-External	-	-		-	*50*	*50*
2	Theory-Internal	*40*	*5*		*5*	-	*50*
						Grand Total	*100*

Course Code	AGE19102	Course Name	PRINCIPLES OF AGRONOMY	Course Category	C	Compulsory Core	L	T	P	C
							2	0	1	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Agronomy	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	Acquire basic knowledge on agriculture and crop production			
CLR-2 :	Discuss the effect of environment factors on crop growth and productivity			
CLR-3 :	Compare, contrast, and appraise the different cropping systems, tillage system and make recommendations for sustainable management			
CLR-4 :	Outline the concepts in agronomy in the establishment and sustainable management of agricultural crops			
CLR-5 :	Explain the application of the principles in crop production			
CLR-6 :	-			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	Summarize the competency in sustainable crop management.	2	80	75
CLO-2 :	Outline the technical and scientific principles of the cultivation of major crops and the ability to modify the factors influencing the quantity and quality of crop yield.	3	85	80
CLO-3 :	Know the cropped species, their requirements and the practices to obtain the main agricultural products.	1	90	75
CLO-4 :	Summarize the key aspects of husbandry operations required to grow the major crops successfully	3	85	70
CLO-5 :	Identify the critical management factors involved in profitable crop production	2	90	85
CLO6 :	-			

Program Learning Outcomes (PLO)														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Agriculture Knowledge	Problem Analysis	Design & Development	Analysis, Design,	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	Ability to solve scientific problems	Ability to implement knowledge gained	Ability to understand social and ethical
H		L			M	M		M	H		H	H	H	H
H				L		H		M	H		H	H	M	H
M				L	L	M		H	H		H	H	H	M
H	L		M			L		M	H	L	H	H	H	H
H			L			M		M	H		H	H	H	H

Theory		Learning Unit / Module 1	Learning Unit / Module 2	Learning Unit / Module 3	Learning Unit / Module 4	Learning Unit / Module 5
Duration (hour)		6	7	7	7	6
S-1	SLO-1	Agriculture – definition and branches	Characteristics of Seasons	Tillage: Definition, Objectives	Manures and fertilizers: definition	Harvesting concepts
	SLO-2	Development of Scientific Agriculture	Crop-wise Seasons	Characteristics of good tilth	Role of manures and fertilizers on crops	criteria for harvesting of crops
S-2	SLO-1	Agronomy definition	Season on choice of crops	Types of tillage	Classification of manures and fertilizers	Methods of harvesting
	SLO-2	Classification of crops	Agricultural seasons of Tamil Nadu &India	Tillage / Inter tillage implements	Methods of fertilizers application & INM	Implements and machineries - harvest
S-3,4	SLO-1	Lab 1. Study of wetland, garden and dry land system of farming	Lab 4. Identification of tools and implements	Lab 7. Practicing methods of land configuration for garden land crops	Lab 11. Working out manure and fertilizer requirements of crops	Lab 14. Practicing different irrigation methods in various crops
	SLO-2					
S-5	SLO-1	Major crops in India	Principles of wet and garden farming	Factors affecting the tillage operation	Weeds – definition, characters	Threshing, cleaning and drying methods
	SLO-2	Major crops in Tamil Nadu	Principles of rainfed and dryfarming	Modern concepts of tillage	Classification of weeds	Types of storage
S-6	SLO-1	Agro climatic zones – India & Tamil Nadu	Climatic factors on crop production	Characteristics of good quality seeds	Weed control methods	Objectives of post-harvest technology
	SLO-2	Agro ecological zones – India & TN	Edaphic factors on crop production	Classes of seeds	Integrated weed management	Principles of post-harvest technology
S-7,8	SLO-1	Lab 2. Identification of crops in crop cafeteria	Lab 5. Acquiring skill in handling primary and secondary tillage implements	Lab 8. Practicing different methods of seed treatments for major crops	Lab 12. Practicing methods of application: manures and fertilizers and green manures	Lab 15. Practicing harvesting operations, assessing maturity index of important crops
	SLO-2					
S-9	SLO-1	Major soils in India	Social & biotic factors on crop production	Seed germination – factors affecting	Irrigation – definition	Post-harvest processing for major crops-1
	SLO-2	Major soils in Tamil Nadu	Physiographic factors on crop production	Seed rate – factors affecting	Methods of irrigation	Post-harvest processing for major crops-2
S-10	SLO-1	Potential productivity in crop production	ICPS	Seed treatment and sowing methods	Intensive cropping: definition and types	Low cost post-harvest technology
	SLO-2	Constrains in crop production	ICPS	Plant population and crop geometry	Integrated farming system	Management of produce quality

S-11,12	SLO-1	*Lab 3. Identification of seeds, fertilizers and manures*	*Lab 6. Practicing methods of land configuration for for wetland crops*	*Lab 9. Practicing different methods of sowing techniques*	*Lab 13. Identification of weeds, weeding practices, handling of weeding tools & implements*	*Lab 16. Participation in on-going field operations during on campus/off campus visit*
	SLO-2					
S-13	SLO-1	-	*GOI Schemes to promote crop production*	*Factors affecting population and spacing*	*Crop modelling*	-
	SLO-2	-	*ICAR Institutions and their role*	*Thinning and gap filling*	*Sustainable agriculture*	-
S-14,15	SLO-1	-	-	*Lab 10. Working out seed rates and practicing thinning, gap filling and intercultural operations*	-	-
	SLO-2	-	-		-	-

Learning Resources	*1. Alabaster Jenkins. (2016). Agronomy and crop production. Syrawood publishing house, UK, pp. 1-205.* *2. Reddy. S.R. (2014). Principles of Crop Production. Kalyani Publishers, Ludhiana. pp. 1-794.*	*3. Sankaran, S. and Subbiah Mudaliar, V.T. (1997). Principles of Agronomy. The Bangalore Printing and Publishing Co. Ltd., Bangalore. pp. 1- 511.* *4. Yellamanda Reddy, T. and Sankara Reddy, G. H. (2017). Principles of Agronomy. Kalyani publishers, Ludhiana. pp. 1-685.*	

	Level of Thinking	Continuous Learning Assessment (35% weightage)		University Practical Examination (15%)	End semester theory Examination (50%)
		In semester (20%)	Practical (15%)		
Level 1	Remember	40 %	40 %	40%	40 %
	Understand				
Level 2	Apply	40 %	35 %	30%	40 %
	Analyze				
Level 3	Evaluate	20 %	25 %	30%	20 %
	Create				
	Total	100 %	100 %	100%	100 %

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Mr.P.B. Mukundan *Organic farming Progressive farmer* *H. No. 92, Rajaji, Street, Chengalpattu – 603001 Tamil Nadu.*	*Dr. M. Mohamed Amanullah, Professor (Agronomy), Maize Research Station,* *Tamil Nadu Agricultural University* *Vagarai – 624 613, Palani Taluk, Dindigul District.*	*Dr. S. Marimuthu* *Dr. N. Krishnaprabu* *Dr. D. Selvakumar*

THEORY

Unit I - Introduction to Agriculture

Agriculture: Definition, Importance, scope; Art, science and business of crop production; Branches of Agriculture; Development of Scientific Agriculture; Agronomy: relationship with other disciplines; Classification of crops and their economic importance; major crops of India and Tamil Nadu: adaptation and distribution; Agro-climatic zones of India and Tamil Nadu; Sub zones; Agro ecological zones of India; Major soils of India and Tamil Nadu; Potential productivity and Constraints in crop production.

Unit II - Seasons and System of Farming

Characteristics of Seasons; Crop-wise Seasons; Agronomic concepts of the growing seasons; Effect of season on choice of crops; Agricultural seasons of Tamil Nadu and India, Systems of farming: concepts and principles of wet, garden, rainfed and dry land farming; Factors affecting crop production: climatic, edaphic, biotic, physiographic and socio economic factors; Innovative Sustainable Crop Production Systems (ISCPS); GOI Schemes to promote crop production; ICAR Institutions and their role.

Unit III - Tillage and Sowing

Tillage: Definition, Objectives and importance; Characteristics of good tilth; Types of tilth; Types of tillage: on season, off season and special types; Tillage implements: primary, secondary, intercultural and special purpose implements; Factors affecting the tillage operation; Modern concepts of tillage; Seeds and sowing: importance and characteristics of good quality seeds; classes of seeds; factors affecting germination; Seed rate: factors affecting seed rate; seed treatment objectives and methods; methods of sowing; Optimum plant population and crop geometry; importance and factors affecting population and crop geometry; After-cultivation; Thinning and gap filling.

Unit IV - Integrated Crop Management Practices

Manures and fertilizers: definition, role of manures and fertilizers in crop production; classification; Time and methods of fertilizers; Integrated nutrient management; Weeds: definition, harmful and beneficial effect of weeds and classification of weeds; Methods of weed control; Integrated Weed management; Irrigation: time of irrigation, methods of irrigation; Intensive cropping: definition, principles and types; Crop modeling; Cropping patterns and cropping systems; Integrated farming system; Sustainable Agriculture.

Unit V - Harvest and Post-Harvest Technology

Harvesting: assessing maturity, physiological maturity and harvestable maturity; criteria for harvesting of crops; methods of harvesting; implements and machineries used for harvest, threshing: definition, principles and methods of threshing; cleaning; drying methods; types of storage; Post-harvest processing: objectives, principles and methods; Post-harvest technology of major crops; low cost post-harvest technology; management practice for produce quality.

Theory - Lecture Schedule

1. Agriculture: Definition, Importance, scope; Art, science and business of crop production; Branches of Agriculture; Development of Scientific Agriculture
2. Agronomy: relationship with other disciplines; Classification of crops and their economic importance
3. Major crops of India and Tamil Nadu: adaptation and distribution
4. Agro-climatic zones of India and Tamil Nadu and Agro ecological zones of India
5. Major soils of India and Tamil Nadu;
6. Potential productivity and Constraints in crop production.
7. Characteristics of Seasons; Crop-wise Seasons; Agronomic concepts of the growing seasons
8. Effect of season on choice of crops; Agricultural seasons of Tamil Nadu and India
9. Systems of farming: concepts and principles of wet, garden, rainfed and dry land farming
10. Factors affecting crop production - environmental factors - climatic factors – Edaphic factors
11. Factors affecting crop production - biotic, physiographic and socio-economic factors
12. Innovative Sustainable Crop Production Systems (ISCPS)
13. GOI Schemes to promote crop production; ICAR Institutions and their role.
14. Tillage: Definition, Objectives and importance; Characteristics of good tilth; Types of tilth
15. Types of tillage: on season, off season and special types; Tillage implements: primary, secondary, intercultural and special purpose implements
16. Factors affecting the tillage operation; Modern concepts of tillage
17. **In semester examination**
18. Seeds and sowing: importance and characteristics of good quality seeds; classes of seeds;
19. Factors affecting germination; Seed rate: factors affecting seed rate
20. Seed treatment objectives and methods; methods of sowing; Optimum plant population and crop geometry
21. Importance and factors affecting population and crop geometry; After-cultivation; Thinning and gap filling

22. Manures and fertilizers: definition, role of manures and fertilizers in crop production
23. Classification of fertilizers and manures; Time and methods of fertilizers; Integrated nutrient management
24. Weeds: definition, harmful and beneficial effect of weeds and classification of weeds
25. Methods of weed control; Integrated Weed management
26. Irrigation: time of irrigation, methods of irrigation
27. Intensive cropping: definition, principles and types; Cropping patterns and cropping systems; Integrated farming system
28. Crop modeling and Sustainable agriculture
29. Harvesting: assessing maturity, physiological maturity & Harvestable maturity; criteria for harvesting of crops;
30. Methods of harvesting; implements and machineries used for harvest
31. Threshing: definition; principles and methods of threshing; cleaning; drying methods; types of storage
32. Post-harvest processing: objectives, principles and methods
33. Post-harvest technology of major crops
34. Low cost post-harvest technology; management practice for produce quality.

Practical Schedule

1. Study of wetland, garden and dry land system of farming
2. Identification of crops in crop cafeteria
3. Identification of seeds, fertilizers and manures
4. Identification of tools and implements
5. Acquiring skill in handling primary and secondary tillage implements
6. Practicing methods of land configuration for raising nursery for wetland crops
7. Practicing methods of land configuration for raising nursery for garden and dryland crops
8. Practicing different methods of seed treatments for major crops
9. Practicing different methods of sowing techniques
10. Working out seed rates and practicing thinning, gap filling and intercultural operations
11. Working out manure and fertilizer requirements of crops
12. Practicing methods of application: manures and fertilizers and green manures
13. Identification of weeds, weeding practices, handling of weeding tools & implements
14. Practicing different irrigation methods in various crops
15. Practicing harvesting operations, assessing maturity index of important crops
16. Participation in on-going field operations during on campus/off campus visit
17. **University practical examination**

Text Books

1. Ahlawat, I.P.S., Om Prakash and Saini, G.S. (2010). *Scientific Crop Production in India*. Rama publishing House, Meerut. pp. 1- 680.
2. Cassius Foster. (2017). *Introduction to Agronomy.* Larsen and Keller Education Publishers, New York, USA. pp. 1- 270.
3. Reddy. S.R. (2014). *Principles of Crop Production.* Kalyani Publishers, Ludhiana. pp. 1- 794.
5. Sankaran, S. and Subbiah Mudaliar, V.T. (1997). *Principles of Agronomy.* The Bangalore Printing and Publishing Co. Ltd., Bangalore. pp. 1- 511.
4. Yellamanda Reddy, T. and Sankara Reddy, G.H. (2017). *Principles of Agronomy.* Kalyani publishers, Ludhiana. pp. 1- 685.

Reference Books

1. Alabaster Jenkins. (2016). *Agronomy and crop production.* Syrawood publishing house, UK. pp. 1- 205.
2. Crop Production Guide. (2020). Directorate of Agriculture, Chennai and Tamil Nadu Agricultural University, Coimbatore. pp.1- 460.
3. ICAR. (2011). *Handbook of Agriculture.* Indian Council of Agricultural Research, New Delhi. pp. 1- 1617.
4. Singh. S.S. (2015). *Crop management under irrigated and rainfed conditions.* Kalyani Publishers, New Delhi. pp. 1- 574.
5. Sunil Kumar Birendra Prasad. (2013). *Modern Technology for Sustainable Agriculture.* NIPA, New Delhi. pp. 1- 400.
6. Velayudham, K. and Thavaprakaash, N. (2016). *Objective Agronomy.* Kalyani publishers, Ludhiana. pp. 1- 474.

Web References

1. http://icar.res.in
2. ww.webcast.gov.in
3. ww.icar.org.in/nasm.html.
4. http://agriinfo.in/default.aspx?page=maincat&superid=1
5. http://agritech.tnau.ac.in/agriculture/agri_index.html
6. https://www.agrimoon.com.

Journals

1. Indian Journal of Agronomy
2. Journal of Agronomy and Crop science
3. Agronomy Journal
4. Advances in Agronomy
5. European Journal of Agronomy
6. Journal of Cereal Science
7. Agronomy - Open Access Journal
8. Archives of Agronomy and Soil Science

Course Nature: Theory based Practical							
Total Marks (100)							
S.No.	Category	**Assessment Tools**					
		In- Semester Examination	Assignment	Record	Attendance	End-Semester Examination	Marks
1	*Theory-External*	-	-		-	*50*	*50*
2	*Theory-Internal*	*20*	-			-	*20*
3	*Practical-External*	-	-		-	*15*	*15*
4	*Practical-Internal*	-	*5*	*5*	*5*	-	*15*
						Grand Total	100

Course Code	**Course Title**	**T**	**P**	**Credit**
AGE19103	**STUDY TOUR I**	**0**	**1**	**1**

Students will be taken for a five day trip to Hyderabad to visit ICAR-Central research Institute for Dryland Agriculture (CRIDA), National Academy of Agricultural research Management (NAARM), National Institute of Agricultural Extension Management (MANAGE), International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) for exposing themselves to learn the activities pertaining to the field of agriculture.

Course Nature: Practical			
Total Marks (100)			
S.No.	**Category**	**Assessment Tools**	**Marks**
1	Practical-Internal	*Purely internal based on the participation, involvement and contribution of students in the activities pertaining to the course and the assessment criteria be as follows,*	
		Written Test	*40*
		Behaviour (Punctuality and Discipline)	*20*
		Observation Note Book	*25*
		Viva-Voce	*10*
		Attendance	*05*
		Grand Total	*100*

Course Code	AGE19104	Course Name	INTRODUCTION TO MICROBIOLOGY	Course Category	C	Compulsory Core	L	T	P	C
							2	0	1	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Agricultural Microbiology	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	*Explain the Historical and recent developments in the field of Microbiology*			
CLR-2 :	*Describe the techniques of the staining reactions, media preparation and culturing of microorganisms*			
CLR-3 :	*Outline the principles and applications of different types of microscopy*			
CLR-4 :	*Understand the Ultra-structure, nutritional requirements and growth of the bacteria*			
CLR-5 :	*Describe the metabolism and genetics of bacteria*			
CLR-6 :	*Summarize the characteristics of Archaebacteria, algae and viruses*			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	*Differentiate prokaryotic and eukaryotic cells*	*1*	*95*	*80*
CLO-2 :	*Perform the different staining techniques*	*3*	*95*	*90*
CLO-3 :	*Apply skills on handling of microorganisms in the he laboratory*	*3*	*90*	*80*
CLO-4 :	*Describe the ultra-structure of bacteria, Archaebacteria, Algae and Virus*	*1*	*80*	*70*
CLO-5 :	*Recognize the nutritional requirements for microbial growth*	*2*	*75*	*60*
CLO-6 :	*Explain the operon concept*	*2*	*75*	*65*

Program Learning Outcomes (PLO)															
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Agriculture Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	Ability to solve scientific problems through Microbiology	Ability to implement knowledge gained in the applied field of Microbiology	Ability to understand social and ethical responsibilities of Microbiology
L								*H*	*H*		*H*	*H*	*M*	
L								*H*	*H*		*H*	*H*	*H*	
M		*M*	*M*	*L*				*H*	*H*		*H*	*H*	*H*	
M			*L*					*L*	*H*		*H*	*H*	*M*	
L	*L*							*L*	*H*		*H*	*H*	*M*	
L								*L*	*H*		*H*	*H*	*M*	

		Learning Unit / Module 1	Learning Unit / Module 2	Learning Unit / Module 3	Learning Unit / Module 4	Learning Unit / Module 5
Duration (hour)		12	14	13	14	13
S-1	SLO-1	*Scope of Microbiology*	*Microscopy-Principles*	*Bacteria-Shape*	*Bacterial metabolism-Aerobic respiration*	*Archaebacteria – Ecology & Structure*
	SLO-2	*Role of Microbes in Agriculture*	*Light Microscopy*	*Bacteria- Arrangement*	*Bacterial metabolism- Anaerobic respiration*	*Major groups of Archaebacteria*
S 2	SLO-1	*Historical Development-19th century*	*Types of light Microscope-Phase contrast*	*Bacteria-Ultra structure*	*Fermentation in bacteria-Acid fermentation*	*Algae –Structure & its classification*
	SLO-2	*Historical development-19th century-continued*	*Types of light Microscope-Fluorescent*	*Bacteria-Components*	*Fermentation in bacteria- Alcohol Fermentation*	*Cyanobacteria-Ultrastructure & Economic Importance*
S 3-4	SLO-1	*Lab 1: Microscopy-Handling of light Microscope*	*Lab 4: Isolation of microorganism-serial dilution & Plating technique*	*Lab 7: Preservation of microorganisms*	*Lab 10: Microbial Growth-Turbidometry*	*Lab 13: Isolation of bacteriophages*
	SLO-2					
S 5	SLO-1	*Historical Development-20th century*	*Electron Microscopy-Principles*	*Reproduction in bacteria*	*Bacterial photosynthesis-Green bacteria*	*Structure of virus*
	SLO-2	*Historical development-20th century-*	*Electron Microscopy- Scanning Probe Microscope*	*Bacteria-Growth Curve*	*Bacterial photosynthesis-Purple bacteria*	*Classification of viruses*
S-6	SLO-1	*Historical Development-20th century*	*Atomic force Microscopy*	*Batch culture*	*Genetic elements in bacteria-Bacterial Chromosome*	*Bacterial Virus : bacteriophages*
	SLO-2	*Historical Development-20th century-continued*	*confocal scanning laser microscopy*	*Continuous culture*	*Genetic elements in bacteria-Plasmid & Transposons*	*Multiplication cycle of bacteriophages*

S 7-8	SLO-1	*Lab 2:Aseptic Techniques*	*Lab 5: Isolation - Enrichment culture technique*	*Lab 8: Staining Techniques-Positive and Negative*	*Lab 11: Bacteria –Morphological and Physiological Characteristics*	*Lab 14: Isolation of cyanobacteria*
	SLO-2					
S 9	SLO-1	*Evolutionary relationship-living organisms*	*Staining techniques-Principles*	*Synchronous culture*	*Mutation-Principles and Types*	*Lytic phages*
	SLO-2	*Classification of microorganisms*	*Staining techniques-Types*	*Diauxic growth*	*Mutagens-Types*	*Lysogenic phages*
S10	SLO-1	*Group of Microorganisms*	*Methods of sterilization-Physical*	*Factors affecting microbial growth*	*Genetic recombination-Transformation*	-
	SLO-2	*Prokaryotes and Eukaryotes*	*Methods of sterilization-chemical*	*Measurement of growth*	*Genetic recombination- Transduction*	-
S11-12	SLO-1	*Lab3:Preparation of growth media*	*Lab 6 : Purification of bacteria, fungi and Actinobacteria*	*Lab 9: Differential Staining Technique-Gram Staining*	*Lab 12: Biochemical characterization of bacteria*	*Lab 15: Isolation of Genomic DNA*
	SLO-2					
S13	SLO-1	-	*Isolation of microorganism*	*Nutritional types of bacteria*	*Genetic recombination-conjugation*	-
	SLO-2	-	*Purification of microorganisms*	*Energetics in bacteria*	*Conjugation-Genetic Map*	-
S13	SLO-1	-	*Enrichment culture techniques*	-	-	-
	SLO-2	-	*Preservation techniques*	-	-	-
S14-15	SLO-1	-		-	-	*Lab 16: Isolation of bacterial mutants-UV irradiation*
	SLO-2					

Learning Resources	1. *Dubey, R. C., & Maheshwari, D. K. (2013). A textbook of Microbiology(4th Edn,)., New Delhi, India: S. Chad and Company ISBN-10: 9788121926201. pp:1-1056.* 2. *Pelczar, M.J.,Jr, Chan, E.C.S. and Krieg, N.R. (1997). Microbiology, Concepts and Application(6th edn.). United States: McGraw Hill. ISBN-10: 0070492581. pp :1-896.* 3. *Tauro, P., Kapoor, K.K. and Yadav, K.S. (2019). Introduction to Microbiology(3rd Edn.,). United States: John Wiley & Sons, pp:1-424.*

	Level of Thinking	Continuous Learning Assessment (35% weightage)		Universityl Practical Examination (15%)	End semester theory Examination (50%)
		In semester (20%)	Practical (15%)		
Level 1	*Remember*	60 %	30 %	35%	60 %
	Understand				
Level 2	*Apply*	30 %	40 %	35%	30 %
	Analyze				
Level 3	*Evaluate*	10 %	30 %	30%	10 %
	Create				
	Total	100 %	100 %	100%	100 %

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Mr. Kooriraja Muniyasamy Yadav *Microbiologist- Senior Excecutive, SGS India PVT LTD.* *Chennai 58*	*Dr.Ejilane* *Associate Professor* *Department of Agricultural Microbiology* *Tamil Nadu Agricultural University*	*Dr. Anbukarasi K* *Dr. Melvin Joe M*

THEORY

Unit I - Microbial World

Scope of Microbiology: Role of microbes in Agriculture, food and environment; Contributions of Antonie Van Leeuwenhoek, Refutation of abiogenesis, Louis Pasteur, John Tyndall, Robert Koch, Edward Jenner, Joseph Lister, Alexander Fleming and Waksman; Landmark achievements in 20th century: proposal of one gene one enzyme hypothesis, discovery of double helix structure of DNA, discovery of recombinant DNA technology; Development of Microbiology in India; Evolutionary relationship among the living organisms: Classification of microorganism, Whittaker's Five Kingdom and Carl Woese systems; Groups of Microorganisms, Differentiate between prokaryotes and eukaryotes.

Unit II - Microbiological Techniques

Microscopy: General principles of light microscopy, optical, dark field, Phase Contrast, fluorescence Microscopy; electron microscopes; three dimensional imaging: Stereo Microscope, Scanning Probe Microscope, Atomic force and confocal scanning laser microscopy; Stains and staining: Staining techniques; principle and types of stains: simple, negative, differential and structural staining; Sterilization and disinfection techniques: principles and methods of sterilization; Isolation, enrichment and purification techniques of bacteria, yeast, moulds and actinobacteria; Preservation of microbial culture.

UNIT III - Bacteria: Structure, Growth and Nutrition

Bacteria: size, shape and arrangement, cell structure and its components, reproduction in bacteria, Bacterial growth: growth cycles of Population, Batch and continuous culture, synchronous culture, Diauxic growth and measurement of growth; Environment on growth: temperature, oxygen, pH and salts; Nutritional types of bacteria.

Unit IV - Bacteria: Metabolism and Genetics

Bacterial metabolism: Aerobic respiration: glycolysis, TCA cycle, Entner Doudoroff pathway, pentose phosphate pathway, electron transport chain and anaerobic respiration; Fermentation in bacteria; bacterial photosynthesis: green and purple bacteria; Genetic elements of bacteria: bacterial chromosomal DNA, plasmid and transposons; Mutation and its types; Mutagen: physical and chemical; Genetic recombination: Transformation, transduction and conjugation.

Unit V - Archaebacteria, Algae and Viruses

Achaea: ecology, cell wall, cell membrane and Major Groups of archaea; Algae: ultrastructure and classification of algae, reproduction of algae, General structure of cyanobacteria and its economic importance in Agriculture; Viruses: General properties of viruses, bacterial viruses; overview of bacteriophages, morphology and multiplication cycles of bacteriophages, lytic and temperate phages.

Theory -Lecture Schedule

1. Scope of Microbiology- Role of microbes in Agriculture, food and environment.
2. Contributions of Antonie Van Leeuwenhoek, Refutation of abiogenesis, Louis Pasteur
3. John Tyndall, Robert Koch, Edward Jenner, Joseph Lister, Alexander Fleming and Waksman.
4. Landmark achievements in 20th century: proposal of one gene one enzyme hypothesis: discovery of double helix structure of DNA: discovery of recombinant DNA technology
5. Evolutionary relationship - concepts and developments in classification of microorganisms
6. Groups of Microorganisms, Differentiate between prokaryotes and eukaryotes.
7. Microscopy; principles – resolving power and magnification. Light microscopy
8. Different types of microscopes - UV, Dark Field, Phase Contrast, Fluorescence
9. Electron Microscopes; Atomic and Confocal Scanning Laser Microscopy
10. Staining techniques - principle and types of stains, staining techniques- simple, negative, differential and structural methods
11. Sterilization – principle – physical agents and chemical methods
12. Isolation, Purification and enrichment culture techniques; preservation techniques
13. Bacteria: size, shape and arrangement,
14. Bacteria: Cell structure and its components
15. Reproduction in bacteria - Bacterial growth, population growth and growth cycle– generation time and specific growth rate
16. Batch and continuous culture -chemostat and turbidostat; synchronous culture, Diauxic growth
17. **In-Semester Examination**
18. Factors influencing growth -temperature requirements - aerobes and anaerobes –methods of assessment of growth
19. Nutritional types of bacteria; Energetics in bacteria. Metabolic pathways of bacteria
20. Aerobic respiration and Anaerobic respiration
21. Fermentative mode of respiration

22. Bacterial photosynthesis; green and purple bacteria
23. Genetic elements in bacteria – Bacterial chromosome and plasmid
24. Transposons and its types
25. Mutation in bacteria – principles and types,
26. Mutagens – physical, chemical and biological
27. Genetic recombination – Transformation
28. Genetic recombination -Transduction – generalized and specialized
29. Genetic recombination –Conjugation
30. Achaea: ecology, cell wall, cell membrane and Major Groups of archaea
31. Algae: Ultra structure and classification of algae, reproduction of algae.
32. General structure of cyanobacteria and its economic importance in Agriculture
33. Viruses: General properties of viruses: Structure and classification of virus
34. Bacterial viruses, overview of bacteriophages; Lytic and lysogenic cycles; lytic and temperate phages.

Practical Schedule

1. Safety in Microbiology laboratory: Microscopy-Handling of light Microscope
2. Aseptic Techniques: Working with equipments and apparatus
3. Preparation of growth media for bacteria, fungi and actinobacteria
4. Isolation of microorganisms by serial dilution and plating technique
5. Isolation of microorganisms by Enrichment culture technique
6. Purification of bacteria, fungi and Actinobacteria
7. Preservation of bacteria, fungi and Actinobacteria
8. Staining Technique: Positive and Negative Staining
9. Staining Technique: Differential and Capsule Staining
10. Assessment of microbial growth by Turbidometry
11. Morphological and Physiological characteristics of bacteria
12. Biochemical Characterization of bacteria
13. Isolation of bacteriophages
14. Isolation of Cyanobacteria
15. Isolation of Genomic DNA from bacteria
16. Isolation of bacterial mutants by UV irradiation
17. **University Practical Examination**

Text Book

1. Dubey, R. C., & Maheshwari, D. K. (2013). A textbook of Microbiology(4th Edn,)., New Delhi, India: S. Chad and Company,. ISBN-10: 9788121926201. pp:1-1056.
2. Pelczar, M.J.,Jr, Chan, E.C.S. and Krieg, N.R. (1997). Microbiology, Concepts and Application(6th edn.). United States: McGraw Hill. ISBN-10: 0070492581. pp :1-896.
3. Tauro, P., Kapoor, K.K. and Yadav, K.S. (2019). Introduction to Microbiology(3rd Edn.,). United States:John Wiley & Sons, pp:1-424.

Reference Books

1. Atlas, R.M. (1997). Microbiology: Fundamentals and Applications (2nd ed.). London : Collier Macmillan, (ISBN 02 3045507) pp:1-879.
2. Madigan, M.T, Martinko, J. M., Dunlap, P.V., Clark ,D.P.,(Ed.)(2008).Brock Biology of Microorganisms(12th Edn.,).United States:Benjamin-Cummings Pub Co, ISBN-10: 032164963X. pp:1-1043.
3. Pommerville. J.C. (2016).Fundamentals of Microbiology(3rd Edn.,) .Burlington, Canada :Jones & Barlett Learning**.** ISBN-13: 978-1-284-05709-6. pp: 1-944.
4. Shors.T. (2017.) Understanding Viruses(3rd Edn.,pp1-944). Burlington, Canada **:** Jones & Barlett Learning., ISBN 9781284025927.pp:1-776.
5. Stanier, R.Y., Adelberg, E.D. and Ingraharg, J.L. (1976). General Microbiology (5th Edn,), U.S.A. MacMillan Publishers, ISBN-10: 0333220145. pp.1-876.
6. Willey, J. M., Sherwood, L., Woolverton, C.J. (2016). Prescott's Microbiology (10th Edn.). U.S.A: McGraw-Hill, ISBN-10: 1259281590. pp. 1-1104.

Web Sources

1. http://ecoursesonline.iasri.res.in/Courses/Agricultural%20Microbiology/AMBE101/Start%20to%20read%20the%20Course.html
2. https://ecourses.icar.gov.in/e-Leaarningdownload3_new.aspx?Degree_Id=01
3. http://www.microbes.info
4. http://microbelibrary.com
5. https://www.nature.com/nmicrobiol/
6. https://microbiologyonline.org/
7. https://5f1a1942-a-62cb3a1a-s-sites.googlegroups.com/site/igcascellbiology/practicals/Microscopy.pdf?attachauth=ANoY7cplFpYU6njm2aG6EtSE9Im7GZ8rVjvmw7Ur

Journals

1. Indian Journal of Microbiology
2. Annals of Microbiology
3. FEMS Microbiology Reviews
4. Journal of Applied Microbiology
5. Annual reviews of Microbiology

Course Nature: Theory based Practical							
Total Marks (100)							
S.No.	Category	**Assessment Tools**					
		In- Semester Examination	Assignment	Record	Attendance	End-Semester Examination	Marks
1	Theory-External	-	-		-	*50*	*50*
2	Theory-Internal	*20*	-			-	*20*
3	Practical-External	-	-		-	*15*	*15*
4	Practical-Internal	-	*05*	*05*	*05*	-	*15*
						Grand Total	*100*

Course Code	CRH19102	Course Name	INTRODUCTION TO CROP PHYSIOLOGY	Course Category	C	Compulsory Core	L	T	P	C
							2	0	1	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Crop Physiology	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	Explain the functions of water in the plant system			
CLR-2 :	Outline the Classification of minerals and mechanism of absorption			
CLR-3 :	Describe the role of mineral nutrition in plant health			
CLR-4 :	Understand the Photosynthetic mechanisms and hormonal biosynthetic pathways			
CLR-5 :	Demonstrate the physiological response of plant under abiotic stress			
CLR-6 :	Obtain knowledge on abiotic stress tolerance mechanism and adaptation			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Agriculture Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	Ability to solve scientific problems	Ability to implement knowledge gained	Ability to understand social and ethical responsibilities
CLO-1 :	Explain the various plant water relations in whole plant level	2	85	80	H	L	L	M	M	L	M	M	H	H	L	H	H	H	H
CLO-2 :	Analyze the various nutritional deficiencies and disorders	3	85	80	H	H	M	H	M	L	H	L	H	H	M	H	H	H	H
CLO-3 :	List the plants based on carbon metabolism	2	80	70	M	L	L	M	M	L	L	M	H	H	L	H	H	H	H
CLO-4 :	Demonstrate the role of PGR in growth and development in plants	2	85	75	M	H	L	M	H	L	M	L	H	H	M	H	H	H	H
CLO-5 :	Recall the knowledge of plant hormone in the formulation and application methods	3	85	75	H	H	L	H	L	M	M	L	H	H	L	H	H	H	H
CLO-6 :	Recall the abiotic stress physiology in crop management	3	80	75	H	H	M	M	M	L	M	L	H	H	L	H	H	H	H

		Learning Unit / Module 1	Learning Unit / Module 2	Learning Unit / Module 3	Learning Unit / Module 4	Learning Unit / Module 5
Duration (hour)		13	10	13	18	11
S 1	SLO-1	Importance of Crop Physiology	Mineral nutrition of plants	Light reaction of photosynthesis	Phases of growth	Physiological of changes during drought
	SLO-2	Cell and cell organelles	Mechanism of nutrient uptake	Photophosphorylation - Z scheme	Factors affecting growth	Compatible osmolytes and alleviation
S 2	SLO-1	Structure and role of water	Physiological functions of macronutrients	Dark Reaction of photosynthesis	Biosynthetic pathway and role of auxins	Physiological of changes during high and low temperature stress
	SLO-2	Water potential and its components	Physiological disorders of macronutrients	C3, C4 and CAM pathways and differences	Biosynthetic pathway and role of gibberellins	Membrane properties and adaptation
S 3-4	SLO-1	Lab-1: Preparation of solutions	Lab-5: Measurement of water imbibition by seed mass test	Lab-8: Measurement of transpiration and photosynthesis by IRGA	Lab-11: Estimation of relative water content	Lab-14: Bioassay for gibberellin and cytokinin
	SLO-2					
S 5	SLO-1	Mechanisms of water absorption	Physiological functions of micronutrients	Factors affecting photosynthesis	Biosynthetic pathway and role of cytokinin	Physiological of changes during salt stress
	SLO-2	Pathways of water movement	Physiological disorders of micronutrients	Photorespiration pathway	Biosynthetic pathway and role of ethylene and ABA	Compartmentalization and alleviation
S 6	SLO-1	Translocation of water	Root feeding and fertigation	Phloem transport	Biosynthetic pathway and role of Brassinosteroids and salicylic acid	Physiological of changes during Flooding stress
	SLO-2	mechanisms of xylem transport	Soilless culture and aeroponics	Source and sink strength and their manipulations	New Generation PGRs , Growth retardants and inhibitors, commercial uses	Physiological of changes during UV radiation stress
S 7-8	SLO-1	Lab-2: Study of leaf epidermal, xylem and phloem cells	Lab-6: Estimation of Photosynthetic pigments	Lab-9: Diagnosis of nutritional and physiological disorders in crops	Lab-12: Measurement of osmosis and plasmolysis	Lab-15: Estimation of chlorophyll stability index
	SLO-2					
S 9	SLO-1	Transpiration and its significance	-	Respiration, Glycolysis	Photoperiodism	Global warming and greenhouse gases
	SLO-2	Stomatal physiology	-	TCA cycle	Chailakhyan's theory of flowering	Physiological effects on crop productivity

S 10	SLO-1	-	-	*Photo and oxidative phosphorylation*	*Forms of phytochrome*	-
	SLO-2	-	-	*Electron transport chain and energy budgeting*	*Pr and Pfr,regulation of flowering*	-
S 11-12	SLO-1	*Lab-3: Determination of stomatal index and stomatal frequency*	*Lab-7: Determination of photosynthetic efficiency in crops*	*Lab-10: Rapid tissue test for mineral nutrients*	*Lab-13: Growth analysis*	*Lab-16: Estimation of proline content*
	SLO-2					
S 13	SLO-1	-	-	*Fatty acid synthesis*	*Theories of vernalization*	-
	SLO-2	-	-	*Fatty acid breakdown*	*Lysenko and Hormonal theories*	-
S 14	SLO-1	-	-	-	*Physiological aspects of growth*	-
	SLO-2	-	-	-	*Physiological aspects of development*	-
S 15-16	SLO-1	*Lab-4: Measurement of plant water potential*	-	-		-
	SLO-2					
S 17	SLO-1	-	-	-	*Growth analysis*	-
	SLO-2	-	-	-	*Physiological growth parameters*	-
S 18	SLO-1	-	-	-	*Seed germination*	
	SLO-2	-	-	-	*seed dormancy and breaking method*	-
S 19-20	SLO-1	-	-	-		-
	SLO-2					
S 21	SLO-1	-	-	-	*Physiological and biochemical changes of Senescence*	-
	SLO-2	-	-	-	*Physiological and biochemical changes of abscission*	-
S 22	SLO-1	-	-	-	*Physiology of fruit ripening*	-
	SLO-2	-	-	-	*Factors affecting ripening and manipulations*	-

Learning Resources	1. *Jain, V.K. (2017). Fundamentals of Plant Physiology (19th ed., pp.), New Delhi, S.Chand & Company Ltd. Pp.1-736.* 2. *Taiz, L. & Zeiger, E. (2014). Plant Physiology (6th ed.,). Massachusetts, USA, Oxford University Press, Sinauer Associates, Inc. pp.1-761.*

	Level of Thinking	Continuous Learning Assessment (35% weightage)		University Practical Examination (15%)	End semester theory Examination (50%)
		In semester (20%)	Practical (15%)		
Level 1	Remember	40 %	30 %	35%	30 %
	Understand				
Level 2	Apply	40 %	40 %	35%	40 %
	Analyze				
Level 3	Evaluate	20 %	30 %	30%	30 %
	Create				
	Total	*100 %*	*100 %*	*100%*	*100 %*

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Mr. Pandian, Bayer Crop Science, Kerala	*Dr. C.N.Chandrasekhar, Dept. of Crop Physiology, TNAU, Coimbatore*	*Dr. C. Partheeban* *Ms. P. Mohanasundari*

THEORY

Unit I - Introduction and Importance of Crop Physiology in Agriculture

Plant cell: an overview, organelles: plasma membrane, chloroplast, mitochondria, peroxisome and vacuole, Structure and role of water, water potential and its components, diffusion and osmosis; imbibition, plasmolysis, Field Capacity and Permanent Wilting Point, Absorption of water, Mechanisms of water absorption, Pathways of water movement, Apoplast and symplast, Translocation of water, ascent of sap and its mechanisms; Transpiration and Stomatal physiology: structure of stomatal pore, mechanisms of stomatal opening and closing, guttation, antitranspirants.

Unit II - Mineral Nutrition of Plants

Criteria of essentiality; classification of nutrients: macro, micro, mobile, immobile and beneficial elements; Physiological functions and deficiency symptoms of nutrients, nutrient uptake mechanism; Hidden hunger, Foliar nutrition, root feeding and fertigation, sand culture, hydroponics and aeroponics.

Unit III - Photosynthesis

Light and dark reactions, Photosystems, red drop and Emerson enhancement effect, Photolysis of water and photophosphorylation, Z scheme, C3, C4 and CAM plants; Photosynthetic pathways of C3, C4 and CAM plants, difference between three pathways, Factors affecting photosynthesis, Photorespiration pathway and its significance, Phloem transport, Munch hypothesis, Phloem loading and unloading, Source and sink strength and their manipulations. Respiration: Glycolysis, TCA cycle and electron transport chain; Oxidative phosphorylation; difference between photo and oxidative phosphorylation; energy budgeting; respiratory quotient. Fat metabolism: fatty acid synthesis and breakdown.

Unit IV - Plant Growth Regulators

Physiological roles and agricultural uses; Hormones: classifications, biosynthetic pathway and role of auxins, gibberellins, cytokinins, ethylene and ABA, Novel and new generation PGRs, Brassinosteroids and salicylic acid, Growth retardants, Commercial uses of PGRs; Photoperiodism: short, long and day neutral plants, Chailakhyan's theory of flowering, Forms of phytochrome, Pr and Pfr, regulation of flowering; Vernalisation: Theories of vernalisation, Lysenko theories, Seed germination: physiological and biochemical changes, seed dormancy and breaking methods, Senescence and abscission, physiological and biochemical changes, Physiology of fruit ripening, climacteric and non-climacteric fruits, factors affecting ripening, Manipulations; Physiological aspects of growth and development of major crops; growth analysis, role of physiological growth parameters in crop productivity.

Unit V - Stress Physiology

Physiological changes and adaptations to drought, flooding, high and low temperature, salinity and UV radiation; compatible osmolytes; membrane properties; compartmentalization; stress alleviation; Global warming; greenhouse gases; physiological effects on crops; Carbon Sequestration.

Theory Lecture Schedule

1. Introduction and importance of Crop Physiology in Agriculture, an over view of Plant cell.
2. Structure and role of water, water potential and its components, Diffusion, Osmosis, imbibition, Plasmolysis, Field Capacity and Permanent Wilting Point
3. Mechanisms of water absorption, Pathways of water movement, Apoplast and symplast
4. Translocation of water, ascent of sap, mechanisms of xylem transport
5. Transpiration, significance, Stomatal physiology: structure of stomata with mechanisms of stomatal opening and closing, guttation, antitranspirants
6. Mineral nutrition of plants, criteria of essentiality, classification of nutrients, macro, micro, mobile and immobile, beneficial elements, mechanism of nutrient uptake
7. Physiological functions and disorders of macronutrients, Hidden hunger
8. Physiological functions and disorders of micronutrients
9. Foliar nutrition- root feeding and fertigation, sand culture, hydroponics and aeroponics
10. Light reaction of photosynthesis, photolysis of water and photophosphorylation - Z scheme
11. Dark Reaction of photosynthesis, C3, C4 and CAM pathways and differences.
12. Factors affecting photosynthesis, Photorespiration, pathway and its significance
13. Phloem transport, Munch hypothesis, Phloem loading and unloading, Source and sink strength and their manipulations
14. Respiration, Glycolysis, TCA cycle.
15. Photo and oxidative phosphorylation, Electron transport chain, energy budgeting, respiratory quotient.
16. Fat metabolism: fatty acid synthesis and breakdown
17. **In Semester Examination**
18. Growth, phases of growth, factors affecting growth.
19. Hormones and plant growth regulators (PGR): physiological roles and agricultural uses, Biosynthetic pathway and role of auxins and gibberellins

20. Plant growth regulators (PGR): physiological roles and agricultural uses, Biosynthetic pathway and role of cytokinin, ethylene and ABA
21. Novel growth regulators viz., Brassinosteroids and salicylic acid, New Generation PGRs, Growth retardants and inhibitors, commercial uses of PGRs
22. Photoperiodism, short, long and day neutral plants, Chailakhyan's theory of flowering
23. Forms of phytochrome, Pr and Pfr, regulation of flowering
24. Vernalisation, theories of vernalization, Lysenko and Hormonal theories, devernalization
25. Physiological aspects of growth and development of major crops
26. Growth analysis, role of physiological growth parameters in crop productivity
27. Seed germination, physiological and biochemical changes, seed dormancy and breaking methods
28. Physiological and biochemical changes of Senescence and abscission
29. Physiology of fruit ripening, climacteric and non-climacteric fruits, factors affecting ripening and manipulations
30. Drought, physiological changes, adaptation, compatible osmolytes, alleviation
31. High and low temperature stress, physiological changes, membrane properties, adaptation
32. Salt stress, physiological changes, adaptation, compartmentalization, alleviation
33. Flooding and UV radiation stresses, physiological changes and adaptation
34. Global warming, greenhouse gases, physiological effects on crop productivity, Carbon Sequestration

Practical Schedule

1. Preparation of solutions
2. Study of leaf epidermal, xylem and phloem cells
3. Determination of stomatal index and stomatal frequency
4. Measurement of plant water potential
5. Measurement of water imbibition by seed mass test
6. Estimation of Photosynthetic pigments
7. Determination of photosynthetic efficiency in crops
8. Measurement of transpiration and photosynthesis by IRGA
9. Diagnosis of nutritional and physiological disorders in crops
10. Rapid tissue test for mineral nutrients
11. Estimation of relative water content
12. Measurement of osmosis and plasmolysis
13. Growth analysis
14. Bioassay for gibberellin and cytokinin
15. Estimation of chlorophyll stability index
16. Estimation of proline content
17. **University Practical Examination**

Text Books

1. Hopkins, W.G. & Huner, N.P.A. (2008). Introduction to Plant Physiology (4th ed.,) USA, John Wiley & Sons. pp.1-523.
2. Jain, V.K. (2017). Fundamentals of Plant Physiology (19th ed.,) New Delhi, S. Chand & Company Ltd. pp.1-736.
3. Pandey, S. N. & B. K. Sinha, (2006). Plant Physiology. New Delhi, Vikas Publishing House Private Limited. pp.1-704.
4. Salisbury, B., Frank & W.C. Ross. (1992). Plant Physiology (4th ed.,) CA, Wadsworth Publishing Co., Belmont. pp.1-682.
5. Taiz, L. & Zeiger, E. (2014). Plant Physiology (6th ed.,) Massachusetts, USA, Oxford University Press, Sinauer Associates, Inc. pp.1-761.

Reference Books

1. Basra, A. S. (2004). Plant Growth Regulators in Agriculture & Horticulture. New York, HAWARTH press. pp.1-264.
2. Delvin, R.M (1986). Plant Physiology (4th ed.,), New Delhi, CBS. pp.1-577.
3. Gardner, F.P., Pearce, R.B. & Mitchell, R.L. (1984). Physiology of Crop Plants (2nd ed.,), Jodhpur. Scientific Publishers. pp.1-327.

4. Jacobs, W. P. (1979). Plant Hormones and Plant Development. Cambridge Univ. London. pp.1-339.
5. Leoplod, A.C. & P.E. Kriedermann, (1985). Plant growth and development. (3rd ed.,), New York, MC. Graw Hill. pp.1-545.
6. Ray Noggle, G. & Fritz, G. J., (1991). Introductory Plant Physiology (2nd ed.,), New Delhi, Prentice Hall of India Pvt. Ltd. pp.1-704.
7. Richard, N. Arteca. (2004). Plant Growth Substances, New Delhi, CBS. pp. 1-332

Web- Reference

1. http://www.plantphys.org
2. http://6e.plantphys.net
3. https://www.youtube.com/playlist?list=PL3BijB3Hruj8KksJrH_CVMjUYk5KyMp5O
4. https://www.frontiersin.org/journals/physiology/sections/plant-physiology
5. Plant physiology lecture, Cornell University: https://www.youtube.com/watch?v=RT-w2xHVl_E

Journals

1. Indian Journal of Plant Physiology
2. Journal of Plant Biochemistry and Biotechnology
3. Journal of Plant Physiology
4. Plant Biochemistry and Physiology
5. Plant Physiology
6. Plant Physiology and Biochemistry

Course Nature: Theory based Practical							
Total Marks (100)							
S.No.	Category	**Assessment Tools**					
		In- Semester Examination	Assignment	Record	Attendance	End-Semester Examination	Marks
1	Theory-External	-	-		-	*50*	*50*
2	Theory-Internal	*20*	-			-	*20*
3	Practical-External	-	-		-	*15*	*15*
4	Practical-Internal	-	*05*	*05*	*05*	-	*15*
						Grand Total	*100*

Course Code	GPB19101	Course Name	BOTANY OF FIELD CROPS	Course Category	S	Supportive Course	L	T	P	C
							2	0	1	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Genetics and Plant Breeding	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1 :	Acquire knowledge on classifications and morphology of crops
CLR-2 :	Learn the botanical description of poaceae
CLR-3 :	Learn the botanical description of papilionaceae
CLR-4 :	Learn the botanical description of crops of pedaliaceae, asteraceae, oleaceae, brassicaceae, euphorbiaceae, arecaceae and malvaceae families.
CLR-5 :	Learn the botanical description of crops of solanaceae, cucurbitaceae and other families.

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Agriculture Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	Ability to solve scientific problems through Plant Breeding and Genetics	Ability to implement knowledge gained in the applied field of Plant Breeding and Genetics	Ability to understand social and ethical responsibilities of Plant Breeding and Genetics
CLO-1 :	Identify and classify the crop plants	3	90	80	M								M	H		H	H	H	H
CLO-2 :	Describe the anotomical structures in flowers	1	95	85	H								L	H		H	H	H	H
CLO-3 :	Describe emasculation and its importance for artificial pollination	2	80	70	M		L	L					L	H		H	H	H	H
CLO-4 :	Describe selfing and crossing in crop plants	3	75	65	M			L	L				M	H		H	H	H	H
CLO-5 :	Explain and draw the floral formulae and floral diagrams respectively																		

		Learning Unit / Module 1	Learning Unit / Module 2	Learning Unit / Module 3	Learning Unit / Module 4	Learning Unit / Module 5
Duration (hour)		6	6	9	15	11
S-1	SLO-1	Classification of plant kingdom	Morphology of rice	Botanical description of red gram	Botanical description of gingelly	Botanical description of tobacco, potato and chilli
	SLO-2	International code of nomenclature and its major guidelines	Floral structures of rice	Botanical description of bengal gram	Botanical description of sunflower	Botanical description of tomato and brinjal
S-2	SLO-1	Author citation	Botanical description of wheat	-	-	Botanical description of cucumber, pumpkin and ashgourd
	SLO-2	Classification of agricultural crops	Botanical description of sorghum	-	-	Botanical description of jute
S-3, 4	SLO-1	Lab 1. Observing plants and theirmorphological traits	Lab 4. Dissection and morphological studies of florets: rice, sorghum and maize	Lab 7. Dissection and morphological studies of flowers: blackgram, greengram and cowpea.	Lab 10. Dissection and morphological studies of flowers: agathi, sunnhemp and sesbania.	Lab 14. Dissection and morphological studies of flowers: coconut, arecanut, oilpalm and sugar palm
	SLO-2					
S-5	SLO-1	Morphology description of plants	Botanical description of maize	Botanical description of soybean	Botanical description of safflower and chrysanthemum	Botanical description of sugar beet
	SLO-2	Modification of roots and leaf	Botanical description of pearl millet	Botanical description of black gram	botanical description of jasmine.	Botanical description of sugar beet
S-6	SLO-1	Bracts	Botanical description of Finger millet	Botanical description of green gram	Botanical description of rapeseed	Botanical description of desmanthes
	SLO-2	Inflorescence	Botanical description of and other small millets	Botanical description of cowpea	Botanical description of mustard	Botanical description of dubabul and Acacia;
S-7, 8	SLO-1	Lab 2. Observing general morphology of inflorescence	Lab 5. Dissection and morphological studies of florets: pearl millet and finger millet	Lab 8. Dissection and morphological studies of flowers lab-lab, horse gram and groundnut	Lab 11. Dissection and morphological studies of flowers: gingelly, sunflower, safflower, chrysanthemum, and jasmine.	Lab 15. Dissection and morphological studies of flowers: cotton, mesta and bhendi.
	SLO-2					

S-9	SLO-1	*Androecium*	*Botanical description of guinea grass*	*Botanical description of lablab*	*Botanical description of cabbage*	*Botanical description of mulberry*
	SLO-2	*Gynoecium*	*Botanical description of napier grass*	*Botanical description of horse gram*	*Botanical description of cauliflower*	*Botanical description of mulberry*
S- 10	SLO-1	*Placentation*	*Botanical description of Cenchrus spp.,*	*Botanical description of groundnut, Lucerne and Stylosanthes*	*Botanical description of castor*	*Botanical description of onion and oarlic*
	SLO-2	*Types of fruits*	*Botanical description of Cenchrus spp.,*	*Botanical description of lucerne and sylosanthes*	*Botanical description of jatropha and tapioca*	*Botanical description of banana and manila hemp*
S-11, 12	SLO-1	*Lab 3. Floral diagram and formula*	*Lab 6. Dissection and morphological studies of flowers: redgram, bengal gram and soybean*	*Lab 9. Dissection and morphological studies of flowers: lucerne, Stylosanthes and clitoria.*	*Lab 12. Dissection and morphological studies of flowers: rapeseed, mustard, cabbage and cauliflower*	*Lab 16. Dissection and morphological studies of flowers: tomato, brinjal and chilli*
	SLO-2					
S-13	SLO-1	-	*Morphological description of Sugarcane*	*Botanical description of citoria*	*Botanical description of coconut and arecanut*	*Botanical description of tea*
	SLO-2	-	*Floral description of sugarcane*	*Botanical description of agathi and sunhemp*	*Botanical description of Oilpalm and Sugarpalm*	*Botanical description of coffee*
S-14	SLO-1	-	-	-	*Botanical description of cotton*	-
	SLO-2	-	-	-	*Botanical description of mesta and bhendi*	-
S-15, 16	SLO-1	-	-	-	*Lab 13. Dissection and morphological studies of flowers: castor, jatropha and tapioca*	-
	SLO-2	-	-	-		-

Learning Resources	*1. Albert F. Hill & O.P. Sharma. (1996). Economic Botany. New Delhi: Tata McGraw - Hill Publishing Co. Ltd.,. pp. 1- 731.* *2. Daniel Sundararaj, D. & G. Thulasidas. (1993). Botany of field crops. New Delhi: MacMillan India Ltd.,. pp. 1- 507.*	*3. James Schooley. (1997). Introduction to botany. United States: Delmar Publishers. pp. 1-414.*

	Level of Thinking	Continuous Learning Assessment (35% weightage)		University Practical Examination (15%)	End semester theory Examination (50%)
		In semester (20%)	Practical (15%)		
Level 1	Remember Understand	40 %	30 %	35%	30 %
Level 2	Apply Analyze	40 %	40 %	35%	40 %
Level 3	Evaluate Create	20 %	30 %	30%	30 %
	Total	100 %	100 %	100%	100 %

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Dr. S M .Prabhu, Ph. D. *Senior Breeder (Paddy Breeding and Transgenic)* *R&D centre,* *Rasi Seeds (P) Ltd., Attur, Salem – 636141.*	*Dr. T. Sabesan* *Associate rofessor* *Department of Genetics and Plant Breeding* *Faculty of Agriculture, Annamalai University,* *Annamalai nagar , Chidambaram - 608 002* *sabavani@gmail.com*	*Dr. G. Selvakumar , Assistant Professor (GPB)* *Dr. R. Mahendran, Assistant Professor (GPB)* *Dr. J. Vanitha, Tutor (GPB)*

THEORY

Unit I- Classifications and Morphology of Crops
Classification of plant kingdom: Bentham and Hooker's; International code of nomenclature and its major guidelines, author citation, classification of agricultural crops; Morphology description of plants; Modification of roots and leaf; Floral morphology: bracts, inflorescence; Structure of flower, androecium, gynoecium, placentation, types of fruits.

Unit II- Botanical Description of Poaceae
Rice, Wheat, Sorghum, Maize, Pearl millet, Finger millet, list of small millets, Guinea grass, Napier grass, *Cenchrus* and Sugarcane.

Unit III- Botanical Description of Papilionaceae
Red gram, Bengal gram, Soybean, Black gram, Green gram, Cowpea, Lab lab, Horse gram, Groundnut, Lucerne, *Stylosanthes*, Clitoria, Agathi and Sunhemp.

Unit IV- Botanical Description Of Pedaliaceae, Asteraceae, Oleaceae, Brassicaceae, Euphorbiaceae, Arecaceae And Malvaceae
Pedaliaceae - Gingelly; Asteraceae - Sunflower, Safflower, Chrysanthemum; Oleaceae – Jasmine; Brassicaceae - Rapeseed and Mustard, Cabbage, Cauliflower; Euphorbiaceae: Castor; Jatropha and Tapioca; Arecaceae: Coconut, Arecanut, Oilpalm, Sugarpalm; Malvaceae: Cotton, Mesta and Bhendi.

Unit V- Botanical Description of Solanaceae, Cucurbitaceae and Other Families
Solanaceae: Tobacco, Potato, Chilli, Tomato and Brinjal; Cucurbitaceae: Cucumber, Pumpkin, Ashgourd; Tiliaceae: Jute; Piperaceae: Betelvine; Chenopodiaceae: Sugar beet; Mimosae: Desmanthes, Subabul and Acacia; Moraceae: Mulberry; Alliaceae: Onion and Garlic; Musaceae: Banana, Manila hemp; Theaceae: Tea; Rubiaceae: Coffee.

Theory - Lecture Schedule
1. Classification of plant kingdom: Bentham and Hooker's; International code of nomenclature and its major guidelines
2. Author citation and classification of agricultural crops
3. Morphology description of plants; Modification of roots and leaf
4. Floral morphology: bracts and inflorescence
5. Structure of flower- androecium and gynoecium
6. Placentation and types of fruits
7. Botanical description of Rice
8. Botanical description of Wheat and Sorghum
9. Botanical description of Maize and Pearl millet
10. Botanical description of Finger millet and other small millets
11. Botanical description of Guinea grass and Napier grass
12. Botanical description of *Cenchrus* spp.,
13. Botanical description of Sugarcane
14. Botanical description of Red gram and Bengal gram
15. Botanical description of Soybean and Black gram
16. Botanical description of Green gram and Cowpea
17. **In semester Examination**
18. Botanical description of Lab lab and Horse gram
19. Botanical description of Groundnut, Lucerne and *Stylosanthes*
20. Botanical description of Clitoria, Agathi and Sunhemp
21. Botanical description of Pedaliaceae - Gingelly; Asteraceae – Sunflower
22. Botanical description of Asteraceae Safflower, Chrysanthemum; Oleaceae – Jasmine
23. Botanical description of Brassicaceae - Rapeseed and Mustard
24. Botanical description of Brassicaceae – Cabbage and Cauliflower
25. Botanical description of Euphorbiaceae: Castor; Jatropha and Tapioca

26. Botanical description of Arecaceae: Coconut, Arecanut, Oilpalm and Sugarpalm
27. Botanical description of Malvaceae: Cotton, Mesta and Bhendi
28. Botanical description of Solanaceae: Tobacco, Potato, Chilli, Tomato and Brinjal
29. Botanical description of Cucurbitaceae: Cucumber, Pumpkin, Ashgourd; Tiliaceae: Jute
30. Botanical description of Piperaceae: Betelvine; Chenopodiaceae: Sugar beet.
31. Botanical description of Mimosae: Desmanthes, Subabul and Acacia
32. Botanical description of Moraceae: Mulberry
33. Botanical description of Alliaceae: Onion and Garlic; Musaceae: Banana, Manila hemp
34. Botanical description of Theaceae: Tea; Rubiaceae: Coffee

Practical Schedule

1. Observing plants and their morphological traits
2. Observing general morphology of inflorescence
3. Floral diagram and formula
4. Dissection and morphological studies of florets: rice, sorghum and maize
5. Dissection and morphological studies of florets: pearl millet and finger millet
6. Dissection and morphological studies of flowers: redgram, bengalgram and soybean
7. Dissection and morphological studies of flowers: blackgram, greengram and cowpea
8. Dissection and morphological studies of flowers lab-lab, horse gram and groundnut
9. Dissection and morphological studies of flowers: lucerne, *Stylosanthes* and clitoria
10. Dissection and morphological studies of flowers: agathi, sunnhemp and sesbania
11. Dissection and morphological studies of flowers: gingelly, sunflower, safflower, chrysanthemum, and jasmine
12. Dissection and morphological studies of flowers: rapeseed, mustard, cabbage and cauliflower
13. Dissection and morphological studies of flowers: castor, jatropha and tapioca
14. Dissection and morphological studies of flowers: coconut, arecanut, oilpalm and sugar palm
15. Dissection and morphological studies of flowers: cotton, mesta and bhendi
16. Dissection and morphological studies of flowers: tomato, brinjal and chilli
17. **University Practical Examination**

Text Books

1. Albert F. Hill & Sharma, O. P. (1996). *Economic Botany*. New Delhi: Tata McGraw - Hill Publishing Co. Ltd.,. pp. 1- 731.
2. Daniel Sundararaj, D. & Thulasidas, G. (1993). *Botany of field crops.* New Delhi: MacMillan India Ltd.,. pp. 1- 507.
3. James Schooley. (1997). *Introduction to botany.* United States: Delmar Publishers. pp. 1- 136.
4. Sambamurthy, A.V.S.S & Subramanian, N.S. (1989). *Text Book of Economic Botany.* New Delhi: Wiley Eastern. pp. 1- 235.
5. Singh, V. (2010). *Text Book of Botany.* Meerut, India: Rastogi Publications. pp. 1 – 1080.

Reference Books

1. Cobley, L. S. (1977). *An Introduction to the Botany of Tropical Crops.* London: Longmans. pp. 1- 371.
2. James D. Mauseth. (2017). *Botany - An Introduction to Plant Biology.* United States: Jones & Bartlett Learning. pp. 1- 829.
3. Mukerji, K. G. & Manoharachary, C. (2006). *Current Concepts in Botany.* MumbaiUnited States: I. K. International Pvt Ltd.pp. 1- 493.
4. Purseglow. (1973). *Tropical Crops – Monocotyledons.* Singapore: The English Language book Society and Longman Co. pp. 1- 272.
5. Slafer. (1993). *Genetic Improvement of Field Crops.* Florida: CRC Press (1 edition). pp. 1- 488.

Web-References

1. https://en.wikipedia.org/wiki/Botany
2. https://www.biologyonline.com/dictionary/crop
3. https://www.scribd.com/presentation/17471508/11-Definitions-for-crop-botany
4. https://bsmrau.edu.bd/cbt/under-graduate/
5. https://www.youtube.com/watch?v=xvc-KC4TyqM
6. https://www.youtube.com/watch?v=JFN0aPvQzDc&t=387s

Journals

1. Journal of Experimental Botany
2. American Journal of Botany
3. Australian Journal of Botany
4. Planta
5. Phytotaxa

Course Nature: Theory based Practical							
Total Marks (100)							
S.No.	Category	**Assessment Tools**					
		In- Semester Examination	Assignment	Record	Attendance	End-Semester Examination	Marks
1	Theory-External	-	-	-	-	50	50
2	Theory-Internal	*20*	-	-		-	*20*
3	Practical-External	-	-	-	-	*15*	*15*
4	Practical-Internal	-	*05*	*05*	*05*	-	*15*
						Grand Total	*100*

Course Code	AGS19101	Course Name	FUNDAMENTALS OF AGRICULTURAL ECONOMICS	Course Category	S	*Supportive Course*	L	T	P	C
							1	0	1	2

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Agricultural Economics*	Data Book / Codes/Standards	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1 :	*Explain the basic concepts in farm economic managements*
CLR-2 :	*Outline the economics of scale and cost of cultivation*
CLR-3 :	*Technical knowledge on farm planning and budgeting*
CLR-4 :	*Identify the basic concepts of market and its role in agriculture*
CLR-5 :	*Explain the managerial aspects of farm planning and organization*
CLR-6 :	*Explore various types of business strategies and entrepreneurship concepts that should help define the learning methods and goals.*

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning			Program Learning Outcomes (PLO)															
		1	*2*	*3*	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Agriculture Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	Ability to solve scientific problems	Ability to implement knowledge gained in the applied field of Horticulture Business Management	Ability to understand social and ethical responsibilities
CLO-1 :	*Recall the production economics principles and their applications.*	*3*	*90*	*80*	*M*	*M*	*M*	*M*	*M*	*M*	*H*	*H*	*M*	*H*	*H*	*H*	*H*	*H*	*H*
CLO-2 :	*Gain knowledge on analyzing the cost of cultivation*	*1*	*90*	*85*	*H*	*M*	*M*	*L*	*L*	*H*	*M*	*M*	*L*	*H*	*H*	*H*	*H*	*H*	*H*
CLO-3 :	*Illustrate decision making in farm management*	*2*	*75*	*70*	*M*	*H*	*L*	*M*	*M*	*H*	*M*	*M*	*H*	*H*	*H*	*H*	*H*	*H*	*H*
CLO-4 :	*Economic principles relevant for agribusiness and their applications for decision making*	*3*	*80*	*75*	*M*	*H*	*M*	*L*	*L*	*M*	*L*	*M*	*M*	*H*	*H*	*H*	*H*	*H*	*H*
CLO-5 :	*Outline the the basic guideline for preparation of project proposals*	*2*	*85*	*80*	*M*	*M*	*L*	*M*	*M*	*M*	*M*	*M*	*M*	*H*	*H*	*H*	*H*	*H*	*H*
CLO6 :	*Summarize the marketing and financial management*	*2*	*85*	*80*	*M*	*H*	*M*	*L*	*M*	*L*	*H*	*L*	*M*	*H*	*H*	*H*	*H*	*H*	*H*

		Learning Unit / Module 1	Learning Unit / Module 2	Learning Unit / Module 3	Learning Unit / Module 4	Learning Unit / Module 5
Duration (hour)		9	12	9	9	9
S-1	SLO-1	*Economics: Meaning, scope and subject matter*	*Concept of Demand*	*Laws of returns*	*Distribution theory*	*Money: Barter system of exchange and its problems*
	SLO-2	*micro and macroeconomics*	*kinds of demand*	*Law of variable proportions*	*Concepts of Rent and Quasi rent*	*classification of money*
S-2-3	SLO-1	***Lab: 1** Exercise on Law of Diminishing Marginal Utility.*	***Lab: 4** Estimation of own price, income and cross price elasticities of demand*	***Lab:8** Market Structure and Price determination*	***Lab:11** Approaches to computation of National Income*	***Lab:14** Measures of Standard of Living and Human Development*
	SLO-2					
S-4	SLO-1	*Goods and services - classification and characteristics*	*Cardinal and ordinal utility*	*Supply: Stock versus supply*	*National income*	*Agricultural and public finance*
	SLO-2	*meaning and characteristics, demand, utility,*	*law of diminishing marginal utility*	*elasticity of supply*	*concepts of national income*	*Economic systems*
S-5-6	SLO-1	***Lab:2** Exercise on Law of Equi-Marginal Utility.*	***Lab: 5** Estimation of consumer surplus.*	***Lab:9** Rent: Theories of Rent*	***Lab:12** Estimation of Growth Rate of Population*	***Lab:15** Food Grain Production*
	SLO-2					
S-7	SLO-1	*Meaning and definition of Agricultural economics*	*Consumer's equilibrium*	*Market structure*	*Population: Importance, Malthusian*	*Public revenue*
	SLO-2	*Agricultural planning and development in the country.*	*Concept of consumer surplus*	*Price determination*	*Optimum population theories,*	*Micro versus macro finance*
S-8-9	SLO-1	***Lab:3** Indifference Curve Analysis: Properties, budget line and consumer equilibrium.*	***Lab:6** Cost concepts:*	***Lab:10** Interest: Theories of Interest*	***Lab:13** Consumer price index and Wholesale price index*	***Lab:16** Physical Quality of Life Index*
	SLO-2					
S-10	SLO-1	-	*Elasticity of demand*	-	-	-
	SLO-2	-	*Factors influencing elasticity of demand*	-	-	-
S-11-12	SLO-1	-	***Lab:7** Supply: Estimation of supply elasticity*	-	-	-

	SLO-2					
Learning Resources	1. *Dewett, K, K., (2004). Modern Economic Theory, New Delhi: Syamlal Charitable Trust. pp 1- 1024* 2. *Samuelson, P., (2004). Economics, (18/e), New Delhi: Tata Mc-graw-Hill. pp 1-205*			3. *Seth, M. L., (2005). Principles of Economics, New Delhi: Lakshmi Narain Agarwal Co., Agra, pp 1- 888* 4. *Subba Reddy, S., & Raghu Ram, P., (2018). Agricultural Economics, New Delh: Oxford & IBH. pp 1-650*		

	Level of Thinking	Continuous Learning Assessment (35% weightage)		Universityl Practical Examination (15%)	End semester theory Examination (50%)
		In semester (20%)	Practical (15%)		
Level 1	Remember Understand	*40 %*	*30 %*	*30%*	*40 %*
Level 2	Apply Analyze	*40 %*	*40 %*	*40%*	*40 %*
Level 3	Evaluate Create	*20 %*	*30 %*	*30%*	*20 %*
	Total	*100 %*	*100 %*	*100%*	*100 %*

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Mr. K.Arun, Business Manager, *EDII Periyakulam Horti Business Incubation Forum,* *Periyakulam*	*Dr. Venkatesa Palanisamy, Professor and Head,* *Centre for Agricultural and Rural Development Studies* *Department of Agricultural Rural Management, TNAU, Coimbatore*	*Dr. Anbarassan A* *Dr. Periasami N*

THEORY

Unit 1- Introduction and Scope

Economics: Meaning, scope and subject matter, definitions, activities, approaches to economic analysis, micro and macro economics, positive and normative analysis; nature of economic theory, rationality assumption, concept of equilibrium, economic laws as generalization of human behavior.

Unit II- Basic Concepts of Economics

Basic concepts: Goods and services, desire, want, demand, utility, cost and price, wealth, capital, income and welfare; Agricultural economics: meaning, definition, characteristics of agriculture, importance and its role in economic development; Agricultural planning and development in the country: agricultural policies, National Institute of Agricultural Economics and Policy Research (ICAR-NIAP).

Unit III - Concepts of Demand, Consumption and Production

Demand: meaning, law of demand, schedule and demand curve, determinants, utility theory, law of diminishing marginal utility, equi-marginal utility principle, consumer's equilibrium, derivation of demand curve and concept of consumer surplus; Elasticity of demand: concept, measurement of price elasticity, income elasticity and cross elasticity; Production: definition, process, creation of utility, factors of production and input output relationship; laws of returns, law of variable proportions and law of returns to scale; Cost: concepts, short run and long run cost curves; Supply: stock v/s supply, law of supply, schedule, supply curve, determinants of supply and elasticity of supply.

Unit IV- Exchange and Theory of Distribution

Market structure: meaning and types of market, basic features of perfectly competitive and imperfect markets, price determination under perfect competition, short run and long run equilibrium of firm and industry, shut down and break-even point; Distribution theory: meaning, factor market and pricing of factors of production; concepts of rent, wage, interest and profit; Agricultural marketing reforms: APMC, e-NAM, rural markets; uzhavar sandhai; regulated markets, role and its functions.

Unit V- Macroeconomics

National income: meaning, importance, circular flow, concepts of national income accounting, approaches to measurement, difficulties in measurement; Importance of Malthusian and Optimum population theories, natural and socioeconomic determinants, current policies and programmes on population control; Money: barter system of exchange and its problems, evolution, meaning and functions of money, classification of money supply, general price index; inflation and deflation; banking: role in modern economy, types of banks, functions of commercial and central bank, credit creation policy; Agricultural and public finance : meaning, micro v/s macro finance and need for agricultural finance: NABARD: role and its function in agriculture, public revenue and public expenditure; tax: meaning, direct and indirect taxes, agricultural taxation, VAT and GST; economic systems: concepts of economy, functions, important features of capitalistic, socialistic and mixed economies and elements of economic planning.

Theory Lecture Schedule

1. Economics: Meaning, scope and subject matter, definitions, activities, approaches to economic analysis; micro and macroeconomics, positive and normative analysis. Nature of economic theory; rationality assumption, concept of equilibrium, economic laws as generalization of human behavior.
2. Goods and services - classification and characteristics, desire, want – meaning and characteristics, demand, utility, cost and price, wealth, capital, income and welfare.
3. Meaning and definition of Agricultural economics, characteristics of agriculture, importance and its role in economic development. Agricultural planning and development in the country.
4. Concept of Demand: kinds of demand, law of demand, demand schedule and demand curve, determinants.
5. Cardinal and ordinal utility; law of diminishing marginal utility, equi-marginal utility principle, Indifference curve analysis and properties, budget line: definition, assumptions, limitations and applications.
6. Consumer's equilibrium and derivation of demand curve, concept of consumer surplus and its importance.
7. Elasticity of demand: concept and measurement of price elasticity, income elasticity and cross elasticity. Factors influencing elasticity of demand, Importance of elasticity of demand. Standard of Living: Definition, Engel's Law of Family Expenditure.
8. Theory of Production: process, creation of utility, factors of production definition and characteristics - Input Output Relationship.
9. **In-semester examination**
10. Laws of returns: Law of variable proportions and law of returns to scale. Cost: Cost concepts, short run and long run cost curves.
11. Supply: Stock versus supply, law of supply, supply schedule, supply curve, determinants of supply, elasticity of supply.
12. Market structure: meaning and types of market, basic features of perfectly competitive and imperfect markets. Price determination under perfect competition; short run and long run equilibrium of firm and industry, shut down and break even points.
13. Distribution theory: meaning, factor market and pricing of factors of production. - Concepts of Rent and Quasi rent - Wages: Real wage and money wage - Interest: Pure interest and gross interest – Profit: Meaning of economic profit.
14. National income: Meaning and importance, circular flow, concepts of national income - accounting and approaches to measurement, difficulties in measurement.
15. Population: Importance, Malthusian and Optimum population theories, natural and socio-economic determinants, current policies and programmes on population control.
16. Money: Barter system of exchange and its problems, evolution, meaning and functions of money, classification of money, money supply, general price index, inflation and deflation. Banking: Role in modern economy, types of banks, functions of commercial and central bank, credit creation policy.

17. Agricultural and public finance: meaning, micro versus macro finance, need for agricultural finance, public revenue and public expenditure. Tax: meaning, direct and indirect taxes, agricultural taxation, VAT and GST. Economic systems: Concepts of economy and its functions, important features of capitalistic, socialistic and mixed economies, elements of economic planning.

Practical Schedule

1. Exercise on Law of Diminishing Marginal Utility.
2. Exercise on Law of Equi-Marginal Utility.
3. Indifference Curve Analysis: Properties, budget line and consumer equilibrium.
4. Demand schedule: Graphical derivation of individual and market demand, Measurement of Arc and Point elasticities of demand.
5. Estimation of own price, income and cross price elasticities of demand
6. Estimation of consumer surplus.
7. Law of Diminishing Marginal Returns: Relationship among TPP, APP and MPP.
8. Cost concepts: Total cost, total fixed costs, total variable cost, average costs, marginal costs and Graphical derivation of cost curves - Estimation of total revenue and profit.
9. Supply: Estimation of supply elasticity. Estimation of Producers Surplus
10. Market Structure and Price determination under Perfect market and imperfect market.
11. Rent: Theories of Rent: Ricardian and Modern Theories of Rent - Wages: Marginal Productivity Theory and Demand and Supply Theory of Wages.
12. Interest: Theories of Interest: Keynesian and Modern Theories of Interest – Profit: Risk - Bearing Theory of Profit
13. Approaches to computation of National Income: Analysis of trends in National income and study of structural changes in the economy.
14. Estimation of Growth Rate of Population and Food Grain Production
15. Consumer price index and Wholesale price index: Estimation of price indices.
16. Measures of Standard of Living and Human Development : Human Development Index – Physical Quality of Life Index – Gender Development Index
17. **University Practical Examination**

Text Books

1. Dewett, K, K., (2004). Modern Economic Theory, New Delhi: Syamlal Charitable Trust. pp 1- 1024
2. Samuelson, P., (2004). Economics, (18/e), New Delhi: Tata Mc-graw-Hill. pp 1-205

Reference Books

1. Seth, M. L., (2005). Principles of Economics, New Delhi: Lakshmi Narain Agarwal Co., Agra, pp 1- 888
2. Subba Reddy, S., & Raghu Ram, P., (2018). Agricultural Economics, New Delh: Oxford & IBH. pp 1-650

Web-References

1. www.fp.unmas.ac.id/wp-content/uploads/2018/03/principles-of-agricultural-economics.pdf
2. www.economicshelp.org/
3. www.sparknotes.com/economics/

Journals

1. American Agricultural Economic Review
2. Indian Journal of Agricultural Economics

Course Nature: Theory based Practical							
Total Marks (100)							
S.No.	Category	Assessment Tools					
		In- Semester Examination	Assignment	Record	Attendance	End-Semester Examination	Marks
1	*Theory-External*	-	-		-	*50*	*50*
2	*Theory-Internal*	*20*	-			-	*20*
3	*Practical-External*	-	-		-	*15*	*15*
4	*Practical-Internal*	-	*05*	*05*	*05*	-	*15*
						Grand Total	*100*

Course Code	HOR19104	Course Name	FUNDAMENTALS OF HORTICULTURE	Course Category	S	*Supportive course*	L	T	P	C
							1	0	1	2

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Horticulture*	Data Book / Codes/Standards		*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1 :	*Explain the scope and importance of horticulture*
CLR-2 :	*Demonstrate different propagation methods in horticulture*
CLR-3 :	*Describe the different climatic zone in horticulture crops*
CLR-4 :	*Explain the Technical knowledge on different planting system*
CLR-5 :	*Demonstrate the different irrigation and fertigation methods in horticulture*
CLR-6 :	*Demonstrate the planning and layout of orchard*

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning			Program Learning Outcomes (PLO)														
		1	*2*	*3*	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Agriculture Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	Ability to solve scientific problems through Horticulture	Ability to implement knowledge gained in the applied field of Horticulture	Ability to understand social and ethical responsibilities of Horticulture
CLO-1 :	*Demonstrate the orchard layout and use of tools and implements in Horticultural crops*	*3*	*90*	*80*	*M*								*M*	*H*		*H*	*H*	*H*	*H*
CLO-2 :	*Identify the skill for solving field problems*	*1*	*95*	*85*	*H*								*L*	*H*		*H*	*H*	*H*	*H*
CLO-3 :	*Demonstrate propagation tehniques in horticultural crops*	*2*	*80*	*70*	*M*		*L*	*L*					*L*	*H*		*H*	*H*	*H*	*H*
CLO-4 :	*Identify the specialized plant parts for propagation*	*3*	*75*	*65*	*M*			*L*	*L*				*M*	*H*		*H*	*H*	*H*	*H*
CLO-5 :	*Practice training and pruning methods in horticultural crops*	*2*	*75*	*60*	*L*	*L*							*M*	*H*		*H*	*H*	*H*	*H*
CLO6 :	*Practice irrigation, fertilizer and PGR's application in horticulture crops*	*2*	*75*	*65*	*L*						*H*		*M*	*H*		*H*	*H*	*H*	*H*

		Learning Unit / Module 1	Learning Unit / Module 2	Learning Unit / Module 3	Learning Unit / Module 4	Learning Unit / Module 5
Duration (hour)		4	2	4	4	2
S-1	SLO-1	Horticulture – definitions, divisions,	Sexual propagation – importance, advantages and disadvantages –	Asexual propagation, importance, advantages and disadvantages types	Principles of orchard establishment, methods of planting systems	Flowering, pollination, fruit set, fruit drop,
	SLO-2	Scope and importance of horticultural crops	Methods of enhancement of seed viability	Vegetative propagation - merits and demerits – cuttings	HDP and UHDP in horticultural crops	Parthenocarpy, fruit ripening and senescence
S 2-3	SLO-1	*Lab1:* Study of various features in orchard	*Lab5:* Studies on media for horticultural plants and preparation of potting mixture	*Lab9:* Propagation through cutting and layering of horticultural crops	*Lab12:* Studies on planting system and planting of horticultural crops	*Lab15:* Practicing various methods of fertilizer application in horticultural crops
	SLO-2					
S-4	SLO-1	Classification	Seed dormancy - types of dormancy	Vegetative propagation – merits and demerits – layering	Principles and methods of training in horticultural crops	Problem of unfruitfulness
	SLO-2	Nutritive value of horticultural crops	*Seed treatments*	Budding	Principles and methods of pruning in horticultural crops	Unfruitfulness remedy in horticultural crops
S 5-6	SLO-1	*Lab2:* Layout and planting of orchard	*Lab6:* Studies on seed treatment methods in horticultural crops	*Lab10:* Propagation through grafting and budding of horticultural crops	*Lab13:* Studies on training and pruning in horticulture	*Lab16:* Visit to commercial nurseries / orchard
	SLO-2					
S-7	SLO-1	Importance and role of soil in horticultural crop production	-	Vegetative propagation – merits and demerits – grafting - stock/scion relationship in fruit crops	Definition, importance of irrigation in horticultural crops	-
	SLO-2	Importance and role of climate in horticultural crop production	-	Use of specialized plant parts in propagation	Methods of irrigation in horticultural crops	-
S 8-9	SLO-1	*Lab3:* Identification of various	*Lab7:* Preparation and use of growth	*Lab11:* Studies on micro propagation in	*Lab14:* Studies on irrigation methods in	-

	SLO-2	horticultural crops	regulators in horticultural crops	horticultural crops	horticulture with special reference to microirrigation	
-S-10	SLO-1	Propagation structures - Introduction	-	Role of PGR's	Role of manures and fertilizers	-
	SLO-2	Role of propagation structures	-	Application in Horticultural crops	Method of application in horticultural crops	-
S 11-12	SLO-1	*Lab4:* Identification of horticultural tools and implements	*Lab8:* Preparation of nursery beds and portray raising of horticultural plants	-	-	-
	SLO-2				-	-

Learning Resources	1. *Jitendra Singh, (2017) Fundamental of Horticulture, Kalyani Publishers, New Delhi.* 2. *Kumar, N. (2016). Introduction to Horticulture, Oxford & IBH Publishing Co Pvt Ltd, New Delhi*.

	Level of Thinking	Continuous Learning Assessment (35% weightage)		University Practical Examination (15%)	End semester theory Examination (50%)
		In semester (20%)	Practical (15%)		
Level 1	Remember	40 %	30 %	35%	30 %
	Understand				
Level 2	Apply	40 %	40 %	35%	40 %
	Analyze				
Level 3	Evaluate	20 %	30 %	30%	30 %
	Create				
	Total	*100 %*	*100 %*	*100%*	*100 %*

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Dr. Amol Chaudhari Manager R&D Farm Jain irrigation system Ltd. Udumalpet	*Dr. A. Rameshkumar Associate Professor (Horticulture) Central University of Tamil Nadu Thiruvarur*	*Dr.B.Gopu* *K.Nivetha*

THEORY

Unit I – Introduction to Horticulture
Horticulture – definitions, divisions, scope and importance of horticulture crops - classification and nutritive value of horticultural crops – role of soil and climate in horticultural crop production - propagation structures and their role.

UNIT II – Sexual Propagation
Sexual propagation – importance, advantages and disadvantages – methods of enhancement of seed viability – types of dormancy – seed invigoration – seed treatments.

Unit III – Asexual Propagation
Asexual propagation, importance, advantages and disadvantages - asexual propagation types viz., types of cutting, layering, budding and grafting - rootstock influence – stock / scion relationship in fruit crops – use of specialized plant parts in propagation - application of plant growth regulators in horticultural crops

Unit IV– Orchard Establishment and management
Principles of orchard establishment – methods of planting systems including HDP and UHDP in horticultural crops – training, pruning, irrigation methods, role of fertilizers and their application in horticultural crops

UNIT V – Unfruitfulness and Parthenocarpy
Flowering, pollination, fruit set, fruit drop, parthenocarpy, fruit ripening and senescence – problem of unfruitfulness and their remedy in horticultural crops

Lecture Schedule
1. Horticulture – definitions, divisions, scope and importance of horticultural crops
2. Classification and nutritive value of horticultural crops
3. Role of soil and climate in horticultural crop production
4. Propagation structures and their role
5. Sexual propagation – importance, advantages and disadvantages – methods of enhancement of seed viability
6. Seed dormancy - types of dormancy – seed invigoration – seed treatments
7. Asexual propagation, importance, advantages and disadvantages - types – vegetative propagation – cuttings
8. Vegetative propagation – layering and budding
9. **In - Semester Examination**
10. Vegetative propagation – merits and demerits – grafting - stock/scion relationship in fruit crops – use of specialized plant parts in propagation
11. Principles of orchard establishment – methods of planting systems including HDP and UHDP in horticultural crops
12. Principles and methods of training and pruning in horticultural crops
13. Importance and application of plant growth regulators in horticultural crops
14. Definition, importance and methods of irrigation in horticultural crops
15. Role of manures and fertilizers and their method of application in horticultural crops
16. Flowering, pollination, fruit set, fruit drop, parthenocarpy, fruit ripening and senescence
17. Problem of unfruitfulness and their remedy in horticultural crops

Practical Schedule
1. Study of various features in orchard
2. Layout and planting of orchard
3. Identification of various horticultural crops
4. Identification of horticultural tools and implements
5. Studies on media for horticultural plants and preparation of potting mixture
6. Studies on seed treatment methods in horticultural crops
7. Preparation and use of growth regulators in horticultural crops
8. Preparation of nursery beds and portray raising of horticultural plants

9. Propagation through cutting and layering of horticultural crops
10. Propagation through grafting and budding of horticultural crops
11. Studies on micro propagation in horticultural crops
12. Studies on planting system and planting of horticultural crops
13. Studies on training and pruning in horticulture
14. Studies on irrigation methods in horticulture with special reference to microirrigation
15. Practicing various methods of fertilizer application in horticultural crops
16. Visit to commercial nurseries / orchard
17. **University practical examination**

Textbooks

1. Adams, C.R., M. P. Early, J. Brook and K. Bamford. (2014) Principles of Horticulture. Routledge,2nd edLondon. pp1-214
2. Bansil. P.C. (2008). Horticulture in India. CBS Publishers and Distributors, New Delhi. edition:1 pp 1-1051
3. Jitendra Singh, (2017) Fundamental of Horticulture, Kalyani Publishers, New Delhi.pp.462
4. Kumar.N. (2020). Introduction to horticulture Publisher: Oxford & Ibh Publ, 7th edition pp.1-415

Reference Books

1. Adams, C.R., M. P. Early, J. Brook and K. Bamford. (2014). Principles of Horticulture. Routledge, London. 5th edition pp1-416
2. Chadha, K.L. (2001), Handbook of Horticulture, ICAR, New Delhi. (PP.601) pp1-1051
3. Chattopadhyaya, P.K. (2017). A text book on Pomology (Fundamentals of fruit growing) Kalyani Publication, New Delhi.pp1-304
4. Christopher, E.P. (2015). Introductory Horticulture, Biotech Books, New Delhi. edition:2 pp1-314
5. Jitendra Singh, (2017). Fundamental of Horticulture, Kalyani Publishers, New Delhi pp1-416.
6. Hartman, H.T. and Kester, D.E. 2017. Plant propagation – Principles and Practices 9 edition – Pearson Education, Noida, Uttar Pradesh pp:321
7. Rajan, S. and B.L. Markose. (2007). Propagation of horticultural crops. New India Publishing, New Delhi. pp1-201
8. Singh, D.K. (2011). Hi-tech horticulture. Agrotech Publishing Academy, Udaipur 1st edition pp:1-321
9. Singh, N.P. (2010). Basic concepts of fruit science. International Book Distributing Co., Lucknow. pp1-290

Web-References

1. http://www/britannica.com/
2. http://aggie/horticulture/tamu.edu/propagation/propagation.html
3. http://www.horticulture.com.au/export/hmac.asp
4. http://www.horticultureworld.net/hort-india.htm
5. http://www.fao.org/

Journals

1. Acta Horticulturae
2. Chronica Horticulture
3. Hort technology
4. Indian Horticulture
5. Indian Journal of Horticulture

Course Nature: Theory based Practical							
Total Marks (100)							
S.No.	Category	Assessment Tools					
		In- Semester Examination	Assignment	Record	Attendance	End-Semester Examination	Marks
1	Theory-External	-	-		-	*50*	*50*
2	Theory-Internal	*20*	-			-	*20*
3	Practical-External	-	-		-	*15*	*15*
4	Practical-Internal	-	*05*	*05*	*05*	-	*15*
Grand Total							*100*

Course Code	SKE19101	Course Name	COMMUNICATION SKILLS AND PERSONALITY DEVELOPMENT	Course Category	C	*Supportive Course*	L	T	P	C
							1	0	1	2

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*English*	Data Book / Codes/Standards	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1 :	*Explain the appropriate communication skills across settings, purposes, and audiences.*
CLR-2 :	*Demonstrate of communication theory and application.*
CLR-3 :	*Discuss critical thinking to develop innovative and well-founded perspectives related to the students' emphases.*
CLR-4 :	*Identify healthy and effective relationships*
CLR-5 :	*Summarize the technology to communicate effectively in various settings and contexts.*
CLR-6 :	*Demonstrate appropriate and professional ethical behavior.*

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning			Program Learning Outcomes (PLO)														
		1	*2*	*3*	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Horticulture Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	Ability to become a enterpreuner in the field of Agriculure	Ability to implement knowledge gained	Ability to understand social and ethical responsibilities
CLO-1 :	*Demonstrate critical and innovative thinking.*	*1*	*95*	*85*		*H*				*H*	*M*	*H*	*H*	*H*		*H*			
CLO-2 :	*Demonstrate competence in oral, written, and visual communication.*	*2*	*80*	*75*		*H*				*H*		*H*	*H*	*H*		*H*			
CLO-3 :	*Identify the cultural communication differences.*	*3*	*80*	*86*		*M*				*H*	*M*	*H*	*H*	*H*		*H*			
CLO-4 :	*Demonstrate ethical Communication*	*3*	*75*	*85*		*M*	*H*			*H*		*H*	*M*	*H*		*H*			
CLO-5 :	*Recognise positive group communication exchanges.*	*2*	*80*	*75*		*H*	*H*			*H*		*H*	*H*	*H*		*H*			
CLO6 :	*Summarize the opportunities in the field of communication*																		

		Learning Unit / Module 1	Learning Unit / Module 2	Learning Unit / Module 3	Learning Unit / Module 4	Learning Unit / Module 5
Duration (hour)		3	3	4	3	3
S-1	SLO-1	*Structural Grammar: Introduction of Word Classes*	*Physical Attributes- Concentration, Eye contact, body language, Observation and questioning,*	*Individual and group presentations, impromptu presentation*	*Reading comprehension of general and technical articles*	*Strategies to manage the writing process*
	SLO-2	*classification of word classes, Content words and Function words*	*Task- Audio Visual Aids, Tasks involving in Talks and Lectures,*	*public speaking, Group discussion, Organizing seminars and conferences*	*Pronunciation, Vocabulary knowledge,*	*Précis Writing, Summarizing*
S-2	SLO-1	*Structure of Verb in English*	*Understanding Sentences and Dialogue;*	*Spoken English- Conversations of different situations in everyday life*	*fluency and reading speed*	*Abstracting, Creative Writing,*
	SLO-2	*Uses of Tenses; Study of Voice*	*Basic listening models- Competitive or combative listening*	*the concept of stress- stress shift in words and sentences*	*Types of reading and uses*	*Letter Writing,*
S-3	SLO-1	*Types of Conjunctions and Prepositions*	*passive and attentive listening,*	*Pronunciation - silent letters in words*	*.Skimming*	*writing for clarity*
	SLO-2	*Sentence Patterns in English, Subject verb agreement*	*Active listening*	*words with silent letters*	*Scanning*	*Hints developments, Story through images*
S-4	SLO-1	*Idioms and Phrases,*	*reflective listening*		*Extensive reading*	*Autobiography of Concrete objects*
	SLO-2	*Homophones and Homonyms*	*Barriers in Listening skills*	*the basic intonation patterns.*	*Intensive reading*	*Slogans writing*

Learning Resources	1.

	Level of Thinking	Continuous Learning Assessment (35% weightage)		Universityl Practical Examination (15%)	End semester theory Examination (50%)
		In semester (20%)	Practical (15%)		
Level 1	Remember	40 %	30 %	35%	30 %
	Understand				
Level 2	Apply	40 %	40 %	35%	40 %
	Analyze				
Level 3	Evaluate	20 %	30 %	30%	30 %
	Create				
	Total	100 %	100 %	100%	100 %

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
-	-	*Dr.U.S.Akshara Govind* *Mr. Bharath Suresh Kumar*

THEORY

Unit I - Language Components
Structural Grammar: Introduction of Word Classes; classification of word classes, Content words and Function words, Structure of Verb in English; Uses of Tenses; Study of Voice; Types of Conjunctions and Prepositions; Sentence Patterns in English, Subject verb agreement. Idioms and Phrases, Homophones and Homonyms

Unit II - Listening
Physical Attributes- Concentration, Eye contact, body language, Observation and questioning, Task- Audio Visual Aids, Tasks involving in Talks and Lectures, Understanding Sentences and Dialogue; Basic listening models- Competitive or combative listening, passive and attentive listening, Active and reflective listening, Barriers in Listening skills

Unit III - Speaking
Individual and group presentations, impromptu presentation, public speaking, Group discussion, Organizing seminars and conferences, Spoken English- Conversations of different situations in everyday life; the concept of stress- stress shift in words and sentences; Pronunciation - silent letters in words and words with silent letters, the basic intonation patterns.

Unit IV - Reading
Reading comprehension of general and technical articles, Pronunciation, Vocabulary knowledge, fluency and reading speed, Types of reading- Skimming, Scanning, Extensive reading and Intensive reading.

Unit V - Writing
Strategies to manage the writing process, Précis Writing, Summarizing, Abstracting, Creative Writing, Letter Writing, writing for clarity, Hints developments, Story through images, Autobiography of Concrete objects, slogans

Lecture Schedule
1. Structural Grammar: Introduction of Word Classes, classification of word classes, Content words and Function words
2. Structure of Verb in English, Uses of Tenses;
3. Study of Voice, Types of Conjunctions and Prepositons;
4. Sentence Patterns in English, Subject verb agreement.
5. Idioms and Phrases, Homophones and Homonyms
6. Physical Attributes- Concentration, Eye contact, body language, Observation and questioning, Task- Audio Visual Aids,
7. Tasks involving in Talks and Lectures, Understanding Sentences and Dialogue;
8. Basic listening models- Competitive or combative listening,
9. **In- semester examination**
10. Passive and attentive listening, Active and reflective listening,
11. Barriers in Listening skills
12. Individual and group presentations, Impromptu presentation, Public speaking, Group discussion,
13. Organizing seminars and conferences,
14. Spoken English- Conversations of different situations in everyday life;
15. the concept of stress- stress shift in words and sentences;
16. Pronunciation - silent letters in words and words with silent letters,
17. The basic intonation patterns.

Practicals Schedule
1. Classification of word classes , Exercises in word classes, Exercises in Content words and Function words
2. Sentence formations, Exercises in spotting the errors
3. Exercises in Conjunctions and Prepositions
4. Reading methods in general and technical aspects, Reading comprehension exercises, Fluency and speed reading exercise
5. Individual presentation ,Conversations of everyday life
6. Presentation on understanding sentences and dialogue formats

7. Impromptu and group presentation, Group discussions, Tasks involving in talks and Lectures
8. Letter writing – informal and informal, Precise Writing, Creative writing , Writing for clarity
9. Basic intonation patters practicing
10. Active and passive listening, Listening skills exercises, Observation and questioning
11. Hints developments, Summarizing and abstracting exercises
12. Non-verbal Communication Practices, Public speaking practices
13. Autobiography of concrete objects exercises
14. Vocabulary exercises.
15. Practice in creating slogans writing for the relevant concepts,
16. Exercises in story based images.
17. **University Practical Examination**

Text Books

1. Bharati,T.Hariprasad,M. and Prakasam, (2008) V.*Personality Development and Communicative English*. (3rd Ed) Neelkamal Publications Pvt. Ltd, New Delhi. PP 1-350
2. Biber, D., Conrad, S. and Leech, G. (2002) *A Longman Student Grammar of Spoken and Written English*, (2nd Ed) London, Pearson.PP 1-450
3. Eggins, S. E. and Slade, D. (1997). *Analysing Casual Conversation*, (3rd Ed) London, Cassell PP 1-500
4. Hewings, A. and Hewings, M. (2004) *Grammar and Context*, (1st Ed) London, Routledge.PP1-650
5. Mohan, K. and Meera, B. (1990). *Developing Communication Skills*. (2nd Ed) New Delhi Macmillan PP1-480
6. Wren and Martin, S.(1935) *Key to High School English Grammar and Composition*- (4th Ed)New Delhi Chand and Company Ltd PP1-700

Web Resources

1. www.reportingskills.com
2. www.writing-skills.com
3. www.negotiation.com
4. www.teachersdesk.com
5. www.flexbilelearning.net.an

Course Nature: Theory based Practical							
Total Marks (100)							
S.No.	Category	**Assessment Tools**					
		In- Semester Examination	Assignment	Record	Attendance	End-Semester Examination	Marks
1	Theory-External	-	-		-	*50*	*50*
2	Theory-Internal	*20*	-			-	*20*
3	Practical-External	-	-		-	*15*	*15*
4	Practical-Internal	-	*05*	*05*	*05*	-	*15*
						Grand Total	*100*

Course Code	MAT19101	Course Name	ELEMENTARY MATHEMATICS	Course Category	A	Allied Course	L	T	P	C
							1	0	1	2

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	MAT19201
Course Offering Department	Mathematics	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1 :	Explain the fundamental mathematical concepts and skills
CLR-2 :	explain the applications of mathematical calculations in agricultural research
CLR-3 :	Discuss the Calculations and models applicable to field trials
CLR-4 :	Describe Maxima, Minima and Definite integral in solving real time applications
CLR-5 :	Explain the applications of Matrices in problems of Agricultural science
CLR-6 :	Describe the applications of Sequences and Progressions in all problems of Agricultural sciences

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Agriculture Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	Ability to solve scientific problems through Mathematics	Ability to implement knowledge gained in Mathematics	Ability to understand social and ethical responsibilities of Mathematics
CLO-1 :	Calculate the area of the field in any shape	2	90	80	M	H	-	L	-	-	-	-	H	-	-	H	H	H	-
CLO-2 :	List out different types of straight line	2	95	85	-	M	-	-	-	-	-	-	M	-	-	H	M	-	-
CLO-3 :	Describe the circle, Find Equation of circle in different aspects and Tangent and normal to the circle.	2	85	75	-	M	-	-	-	-	-	-	H	-	-	H	L	-	-
CLO-4 :	Explain the role of Differentiation and integration in Agricultural sciences	2	70	60	H	-	-	M	-	-	-	-	H	-	-	H	H	L	-
CLO-5 :	Identify Matrices, Sequences and Progressions in problem solving	2	80	70	-	-	-	-	-	-	-	-	M	-	-	H	M	-	-
CLO6 :	Analyse -the field problems through integrated approach	2	80	70	M	-	-	-	-	-	-	-	L	-	-	H	M	L	-

		Learning Unit / Module 1	Learning Unit / Module 2	Learning Unit / Module 3	Learning Unit / Module 4	Learning Unit / Module 5
Duration (hour)		3	3	4	2	4
S-1	SLO-1	*Introduction, Distance formula, section formula (internal and external division).*	*Equation of circle whose centre and radius is known,.*	*Binomial Theorem*	*Definition of Matrices.*	*Sequences and Series.*
	SLO-2	*Equation of co-ordinate axes, Equation of lines parallel to axes.*	*General equation of a circle,*	*Derivatives of sum, difference, product and quotient of two functions*	*Addition, Subtraction, Multiplication of Matrices*	*Arithmetic Progression.*
S-2	SLO-1	*Slope-intercept form of equation of line, Slope-point form of equation of line.*	*Equation of circle passing through three given points*	*Differentiation of functions of functions (Simple problem based on it), Logarithmic differentiation (Simple problem based on it).*	*Transpose and Inverse up to 3rd order.*	*Geometric Progression.*
	SLO-2	*Two point form of equation of line - Intercept form of equation of line - General form of equation of line.*	*Equation of circle whose diameters is line joining two points (x_1, y_1) & (x_2, y_2).*	*Maxima and Minima of the functions of the form y=f (x) (Simple problems based on it)*	*Properties of determinants up to 3rd order and their evaluation.*	*Harmonic Progression.*
S-3	SLO-1	*Point of intersection of two st. lines, Angles between two st. lines, Parallel lines, Perpendicular lines.*	*Tangent and Normal to a given circle at given point (Simple problems).*	*Integration of simple functions,*	-	*Fundamental principle of counting.*
	SLO-2	*Area of triangle and quadrilateral.*	*Condition of tangency of a line y = mx + c to the given circle $x^2 + y^2 = a^2$.*	*Integration of Product of two functions*	-	*Permutations, circular permutation.*
S-4	SLO-1	-	-	*Integration by parts*	-	*Permutation with restrictions.*
	SLO-2	-	-	*Definite Integral (simple problems based on it).*	-	*Combinations*

Learning Resources	1. *Betty C. Rogers, Clifford M. Hokanson. (1999). Mathematics for agriculture (2nd ed.). USA: Pearson Education. pp. 1-317* 1. *Duraipandian. and Laxmi Duraipandiyan (2007). Analytical Geometry 2 Dimensional. Chennai: Emerald Publishers. pp. 1- 196*

	Level of Thinking	Continuous Learning Assessment (35% weightage)		University Practical Examination (15%)	End semester theory Examination (50%)
		In semester (20%)	Practical (15%)		
Level 1	Remember	40 %	30 %	30%	40 %
	Understand				
Level 2	Apply	40 %	40 %	40%	40 %
	Analyze				
Level 3	Evaluate	20 %	30 %	30%	20 %
	Create				
	Total	100 %	100 %	100%	100 %

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
-	*Dr. A. Govindarajan, Professor and Head, Department of Mathematics(E&T), SRMIST, Kattankulathur*	*Dr. M. Selva rani* *Ms. A. Muthulakshmi*

THEORY

Unit I - Straight Line

Distance formula, section formula (internal and external division), Equation of co-ordinate axes, Equation of lines parallel to axes, Slope-intercept form of equation of line, Slope-point form of equation of line, Two point form of equation of line, Intercept form of equation of line, General form of equation of line, Point of intersection of two st. lines, Angles between two st. lines, Parallel lines, Perpendicular lines, Area of triangle and quadrilateral.

Unit II - Circle

Equation of circle whose centre and radius is known, General equation of a circle, Equation of circle passing through three given points, Equation of circle whose diameters is line joining two points (x_1, y_1) & (x_2, y_2), Tangent and Normal to a given circle at given point (Simple problems), Condition of tangency of a line $y = mx + c$ to the given circle $x^2 + y^2 = a^2$.

Unit III - Calculus

Binomial Theorem, Derivatives of sum, difference, product and quotient of two functions, Differentiation of functions of functions (Simple problem based on it), Logarithmic differentiation (Simple problem based on it), Maxima and Minima of the functions of the form y=f (x) (Simple problems based on it), Integration of simple functions, Integration of Product of two functions, Integration by parts, Definite Integral (simple problems based on it),

Unit IV - Matrices and Determinants

Definition of Matrices, Addition, Subtraction, Multiplication, Transpose and Inverse up to 3rd order, Properties of determinants up to 3rd order and their evaluation.

Unit V - Progressions and Permutations

Sequences and Series, Arithmetic Progression, Geometric Progression, Harmonic Progression, Fundamental principle of counting, Permutations, circular permutation, Permutation with restrictions, combinations.

THEORY-LECTURE SCHEDULE

1. Introduction - Distance formula - section formula (internal and external division) - Equation of co-ordinate axes - Equation of lines parallel to axes.
2. Slope-intercept form of equation of line - Slope-point form of equation of line - Two point form of equation of line - Intercept form of equation of line - General form of equation of line.
3. Point of intersection of two st. lines, Angles between two st. lines, Parallel lines, Perpendicular lines, Area of triangle and quadrilateral.
4. Equation of circle whose centre and radius is known - General equation of a circle.
5. Equation of circle passing through three given points - Equation of circle whose diameter is line joining two points (x_1, y_1) & (x_2, y_2).
6. Tangent and Normal to a given circle at given point (Simple problems) - Condition of tangency of a line $y = mx + c$ to the given circle $x^2 + y^2 = a^2$.
7. Binomial Theorem - Derivatives of sum, difference, product and quotient of two functions.
8. Differentiation of functions of functions (Simple problem based on it), Logarithmic differentiation (Simple problem based on it), Maxima and Minima of the functions of the form y=f (x) (Simple problems based on it).
9. **In – semester Examination**
10. Integration of simple functions, Integration of Product of two functions
11. Integration by parts, Definite Integral (simple problems based on it).
12. Definition of Matrices, Addition, Subtraction, Multiplication of Matrices.
13. Transpose and Inverse up to 3rd order, Properties of determinants up to 3rd order and their evaluation.
14. Sequences and Series, Arithmetic Progression.
15. Geometric Progression, Harmonic Progression.
16. Fundamental principle of counting, Permutations, circular permutation, Permutation with restrictions.
17. Combinations.

Practical Schedule

1. Problems based on distance formula and section formula.
2. Problems in various forms of straight line and angle between two straight lines.
3. Problems in Equation of a Straight line.
4. Problems in Area of triangle and quadrilateral.
5. Problems based on Center and Radius of a Circle.
6. Equation of a circle passing through three given points.
7. Equation of a circle whose diameter is the line joining two points.
8. Tangent and Normal to a given circle at a given point. Condition of tangency of a line to the given circle.
9. Binomial Theorem, Derivatives of sum, difference, product and quotient of two functions, Differentiation of functions of functions (Simple problem based on it).
10. Logarithmic differentiation (Simple problem based on it), Maxima and Minima of the functions of the form y=f (x) (Simple problems based on it).
11. Integration of simple functions, Integration of Product of two functions, Integration by parts, Definite Integral (simple problems based on it).

12. Definition of Matrices, Addition, Subtraction and Multiplication of Matrices.
13. Transpose and Inverse up to 3rd order, Properties of determinants up to 3rd order and their evaluation.
14. Sequences and Series, Arithmetic Progression, Geometric Progression, Harmonic Progression.
15. Fundamental principle of counting, Permutations, Circular permutation,
16. Permutation with restrictions, Combinations.
17. **University Practical Examination**

Text Books

1. Harikishan.(2008). *A textbook of Matrices*. Delhi: Atlantic Publisher. pp.1-229
2. Narayan Shanti. (2004). *Differential Calculus*. New Delhi:S.Chand and Co. Ltd. pp. 1 - 572
3. Narayan Shanti. (2004). *Integral Calculus*. New Delhi:S.Chand and Co. Ltd. pp. 1-360
4. Narayan Shanti. (2004). *A textbook of Matrices*. New Delhi:S.Chand and Co. Ltd. pp. 1-309
5. Tim Hill. (2018). *Essential Permutations and Combinations*. California: Create space independent publishing platform. pp. 1-88

References Books

1. Harikishan.(2006). *Coordinate Geometry of two dimensions*. Delhi: Atlantic Publisher. pp. 1- 137
2. Manickavasagam, P. T. K. & Narayanan. S (1997). *Calculus*. Vol I Madras: Viswanathan Publications.pp. 1-433
3. Mehta, B. C. & G. M. K. Madnani. (2008). (9th ed.). *Mathematics for Economists*. New Delhi: Sultan Chand & Sons. pp.1 - 731
4. Sharma, A. K. (2004). *Textbook of Matrix*. New Delhi: Discovery Publishing House. pp. 1-333

Web References

1. www.mathsisfun.com
2. www.mathinsight.org
3. https://youtu.be/WEUL1v1Mxv0
4. https://youtu.be/SSyZYWDX0Mo
5. https://youtu.be/IS2vyb3Fps8
6. https://youtu.be/lvLpNG1Ncg
7. https://youtu.be/Wm5a_Sa2GNY
8. https://youtu.be/Dsi7x-A89Mw
9. https://youtu.be/iNty4CSFlpU

Journals

1. Mathematics for students of Agriculture.
2. International Journal of Mathematics and Statistics
3. Annals of Mathematics
4. Journal of Mathematical Sciences
5. International Journal of Mathematical Education in Science and Technology

Course Nature: Theory based Practical							
Total Marks (100)							
S.No.	Category	**Assessment Tools**					
		In- Semester Examination	Assignment	Record	Attendance	End-Semester Examination	Marks
1	Theory-External	-	-		-	*50*	*50*
2	Theory-Internal	*20*	-			-	*20*
3	Practical-External	-	-		-	*15*	*15*
4	Practical-Internal	-	*05*	*05*	*05*	-	*15*
						Grand Total	*100*

Course Code	PHE19101	Course Name	PHYSICAL EDUCATION	Course Category	E	Extension Activity- Non-Gradial	L	T	P	C
							0	0	0	0

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	Physical and Health education	Data Book / Codes/Standards	*Nil*		

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1:	*Perform the Body Management Skills*
CLR-2:	*Illustrate Teamwork, Sportsmanship, and Cooperation*
CLR-3:	*Identify a range of movement skills to participate in a variety of physical activities.*
CLR-4:	*Illustrate and apply the movement concepts, principles and strategies in a range of physical activities*
CLR-5:	*Demonstrate safe practices during physical and daily activities*

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Physical Knowledge	Problem Analysis	Design & Development	Analysis, Design,	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	Ability to solve scientific problems	Ability to implement knowledge gained	Ability to understand social and ethical responsibilities
CLO-1:	*Recongnize the value the benefits of living a physically active and healthy life.*	*2*	*80*	*75*	*H*				*H*	*H*	*H*	*H*	*H*	*H*		*H*	*L*	*M*	*M*
CLO-2:	*Identify health-enhancing fitness through regular participation in physical activities.*	*2*	*80*	*75*	*H*				*H*	*H*	*H*	*H*	*H*			*H*	*H*	*H*	*H*
CLO-3:	*Demonstrate safe practices during physical and daily activities with respect to themselves, others and the environment.*	*3*	*90*	*85*	*H*		*H*	*M*	*H*	*H*		*H*	*H*	*H*		*H*	*M*	*H*	*M*
CLO-4:	*Demonstrate positive personal and social behaviour across different experiences*	*3*	*85*	*70*	*H*				*H*	*H*		*H*	*H*			*H*	*M*	*M*	*M*
CLO-5:	*Summarise the rules and regulatiins of sports and games*	*2*	*90*	*85*	*H*	*M*			*H*	*H*	*H*	*H*	*H*			*H*	*H*	*H*	
CLO6:	-																		

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
	Dr. R. Mohankrishnan, *HOD/Assistant Professor* *Department of Physical Education,* *SRMIST*	*Dr. M. Senthil Kumar* *HOD/Assistant Professor* *Department of Yoga*

THEORY

Semester I - Introduction to Physical Education
Introduction to physical education: Posture, exercise for good posture, physical fitness exercises for agility: strength, coordination, endurance and speed; Rules and regulations of important games.

Semester II – Skill Development in Indoor Games I
Skill development in any of the outdoor games: football, hockey, cricket, volleyball, ball badminton, throw ball, tennikoit.

Semester III - Skill Development in Indoor Games II
Skill development in any of the indoor games: shuttle badminton, chess and table tennis

Semester IV - Skill Development in Outdoor Games II
Rules and regulations of athletic events; Skill development in any of the athletic events : broad jump, high jump, triple jump, javelin throw, discuss throw, shot put, short and long distance running; Safety education, movement education, effective way of doing day-today activities;

First Aid
First-aid training; coaching for major outdoor and indoor games, athletics. Warming up and conditioning exercises are compulsory before the commencement of each class.

Reference Books

1. Aneja, O, P., (2012).Encyclopedia of Physical education, sports and exercise science. Khel Sahitya Kendra. pp.1- 344.
2. Pintu Modak, O, P., & Sharma, D, J., (2005). Encyclopedia of Sports and Games with latest rules and regulations. New Delhi: Khel Sahitya Kendra / Ksk Pub Dist. pp.1- 450.

Web-References
1. https://thephysicaleducator.com/blog/
2. reddit.com/r/Physical Education

Journals
1. Journal of Physical Education and Sports Management
2. The Journal of Teaching in Physical Education

Course Nature: Practical			
Total Marks (100)			
S.No.	**Category**	**Assessment Tools**	**Marks**
1	Practical-Internal	*Purely internal based on the participation, involvement and contribution of students in the activities pertaining to the course*	
		Attendance	*05*
		Discipline	*25*
		Assignment I	*15*
		Assignment II	*15*
		Performance /participation	*30*
		Viva voce	*10*
		Grand Total	***100***

Course Code	PHE19102	Course Name	NATIONAL SERVICE SCHEME	Course Category	NG	Extension Activity-Non Gradial	L	T	P	C
							0	0	0	0

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Physical and Health Education	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1 :	Describe the community in which the the students work
CLR-2 :	Identify themselves in relation to their community
CLR-3 :	Identify the needs and problems of the community and involve them in problem solving process
CLR-4 :	Explain a sense of social and civic responsibility
CLR-5 :	Demonstrate a practical solution to individual and community problems

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Agriculture Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	Ability to solve scientific problems	Ability to implement knowledge gained	Ability to understand social and ethical responsibilities
CLO-1 :	Develop competence required for group living and sharing of responsibilities	1	90	85	H			H			H		M	H		H	H	H	H
CLO-2 :	Demonstrate skills in mobilizing community participation	2	95	85	H			H					H	H		H	H	H	H
CLO-3 :	Identify the leadership qualities and democratic attitude	2	80	70	M		M	M			H		H	H		H	H	H	H
CLO-4 :	Demonstrate the capacity to meet emergencies and natural disasters	3	85	75	M			H					M	H		H	H	H	H
CLO-5 :	Summarize national integration and social harmony	3	85	90	M								M	H		H	H	H	H

Practicals

Semester I

Orientation
History, objectives, principles, symbol, badge; regular programmes under NSS, organizational structure of NSS, code of conduct for NSS volunteers, points to be considered by NSS volunteers awareness about health

NSS programmes and activities
Concept of regular activities, special camping, day camps, basis of adoption of village/slums, conducting survey, analysing guiding financial patterns of scheme, youth programme/ schemes of GOI, coordination with different agencies and maintenance of diary

Understanding youth
Definition, profile, categories, issues and challenges of youth; and opportunities for youth who is agent of the social change

Community mobilization
Mapping of community stakeholders, designing the message as per problems and their culture; identifying methods of mobilisation involving youth-adult partnership

Social harmony and national integration
Indian history and culture, role of youth in nation building, conflict resolution and peacebuilding

Volunteerism and shramdan
Indian tradition of volunteerism, its need, importance, motivation and constraints; shramdan as part of volunteerism

Citizenship, constitution and human rights
Basic features of constitution of India, fundamental rights and duties, human rights, consumer awareness and rights and rights to information

Family and society
Concept of family, community (PRIs and other community based organisations) and society

Semester II

Importance and role of youth leadership
Meaning, types and traits of leadership, qualities of good leaders; importance and roles of youth leadership

Life competencies
Definition and importance of life competencies, problem-solving and decision-making, inter personal communication

Youth development programmes
Development of youth programmes and policy at the national level, state level and voluntary sector; youth-focused and youth-led organizations

Health, hygiene and sanitation
Definition needs and scope of health education; role of food, nutrition, safe drinking water, water born diseases and sanitation (Swachh Bharat Abhiyan) for health; national health programmes and reproductive health.

Youth health, lifestyle, HIV AIDS and first aid
Healthy lifestyles, HIV AIDS, drugs and substance abuse, home nursing and first aid

Semester III

Vocational skill development
To enhance the employment potential and to set up small business enterprises skills of volunteers, a list of 12 to 15 vocational skills will be drawn up based on the local conditions and opportunities. Each volunteer will have the option to select two skill-areas out of this list

Issues related environment
Environmental conservation, enrichment and sustainability, climatic change, natural resource management (rain water harvesting, energy conservation, forestation, waste land development and soil conservations) and waste management

Disaster management
Introduction and classification of disaster, rehabilitation and management after disaster; role of NSS volunteers in disaster management

Entrepreneurship development
Definition, meaning and quality of entrepreneur; steps in opening of an enterprise and role of financial and support service institution.

Formulation of production oriented project
Planning, implementation, management and impact assessment of project

Documentation and data reporting
Collection and analysis of data, documentation and dissemination of project reports

Semester IV

Youth and crime
Sociological and psychological factors influencing youth crime, cyber crime, pear mentoring in preventing crime and awareness for juvenile justice

Civil/self defence
Civil defence services, aims and objectives of civil defence; needs and training of self defence

Resource mobilisation
Writing a project proposal of self fund units (SFUs) and its establishment

Additional life skills
Positive thinking, self confidence and esteem, setting life goals and working to achieve them, management of stress including time management.

Course Nature: Practical			
Total Marks (100)			
S.No.	Category	Assessment Tools	Marks
1	Practical-Internal	*Purely internal based on the participation, involvement and contribution of students in the activities pertaining to the course*	
		Attendance	*05*
		Participation	*20*
		Activities and Involvement	*20*
		Behaviour	*15*
		Written	*40*
		Grand Total	*100*

** Registration in semester I, whereas result declaration in semester IV. Students are evaluated internally by course teacher at the end of each semester and the average would be taken for result declaration.*

Course Code	PHE19103	Course Name	NATIONAL CADET CORPS	Course Category	NG	Extension Activity-Non Gradial	L	T	P	C
							0	0	0	0

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department		Data Book / Codes/Standards		Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning	Program Learning Outcomes (PLO)

CLR-1 :	To develop character, comradeship, discipline, secular outlook, spirit of adventure
CLR-2 :	Understand the ideals of selfless service amongst the youth of the country.
CLR-3 :	Identify the needs and problems of the community and involve them in problem solving process
CLR-4 :	Develop among themselves a sense of social and civic responsibility
CLR-5 :	To create a human resource of organized, trained and motivated youth

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	1 Agriculture Knowledge	2 Problem Analysis	3 Design & Development	4 Analysis, Design, Research	5 Modern Tool Usage	6 Society & Culture	7 Environment & Sustainability	8 Ethics	9 Individual & Team Work	10 Communication	11 Project Mgt. & Finance	12 Life Long Learning	13 Ability to solve scientific problems	14 Ability to implement knowledge gained i	15 Ability to understand social and ethical responsibilities
CLO-1 :	To provide leadership in all walks of life and always available for the service of the nation.	1	90	85	H	H		H			H	H	M	H		H	H	H	H
CLO-2 :	Gain skills in mobilizing community participation	2	70	85	H	M		H		M	H	H	H	H		H	H	H	H
CLO-3 :	Acquire leadership qualities and democratic attitude	2	75	95	M	M	M	M		M	H	H	H	H		H	H	H	H
CLO-4 :	To provide a suitable environment to motivate the youth to take up a career in the Armed Forces.	3	90	80	M	M	H	H		M	H	M	M	H		H	H	H	H
CLO-5 :	Practice national integration and social harmony	3	85	85	M	H		M		M	H	M	M	H		H	H	H	H

SEMESTER I

Orientation

Aims, objectives, organization of NCC and NCC song; DG's cardinals of discipline; Drill- aim, general words of command, attention, stands at ease, stand easy and turning; Sizing, numbering, forming in three ranks

NCC Activities

Open and close order march and dressing; Saluting at the halt, getting on parade, dismissing and falling out

Understanding Youth

Marching, length of pace, and time of marching in quick/slow time and halt; Side pace, pace forward and to the rear; Turning on the march and wheeling. Saluting on the march

Community Mobilization

Marking time, forward march and halt; Changing step, formation of squad and squad drill; Command and control, organization, badges of rank, honours and awards.

SEMESTER II

Parade

Arms Drill- Attention, stand at ease, stand easy, Getting on parade, Dismissing and falling out, Ground/take up arms, examine arms; Shoulder from the order and vice-versa,

Characteristics of rifle

Present from the order and vice-versa; Saluting at the shoulder at the halt and on the march; Short/long trail from the order and viceversa; Guard mounting, guard of honour, Platoon/Coy Drill; Characteristics of rifle (.22/.303/SLR), ammunition, fire power, stripping, assembling, care, cleaning and sight setting; Loading, cocking and unloading.

Safety precautions

The lying position and holding; Trigger control and firing a shot, Range Procedure and safety precautions, Aiming and alteration of sight; Theory of groups and snap shooting, Firing at moving targets, Miniature range firing; Characteristics of Carbine and LMG.

SEMESTER III

Field Defenses Obstacles

Introduction to map, scales and conventional signs; Topographical forms and technical terms; Grid system - Relief, contours and gradients, Cardinal points and finding north. Types of bearings and use of service protractor; Prismatic compass and its use; Setting a map, finding north and own position, Map to ground and ground to map; Knots and lashings, Camouflage and concealment, Explosives and IEDs; Field defenses obstacles, mines and mine lying; Bridging, waterman ship, Field water supplies, tracks and their construction; Nuclear, Chemical and Biological Warfare (NCBW); Judging distance.

Types of Communication

Description of ground and indication of landmarks, Recognition and description of target; Observation and concealment; Field signals; Section formations; Fire control orders, Fire and movement, Movement with/without arms; Section battle drill; Types of communication, media, latest trends and developments.

SEMESTER IV

Nation Building

Nation Building- cultural heritage, religions, traditions and customs of India; National integration; Values and ethics, perception, communication, motivation, decision making, discipline and duties of good citizen; Leadership traits, types of leadership.

Personality Development

Character/personality development; Civil defense organization, types of emergencies, fire fighting, protection; Maintenance of essential services, disaster management, aid during development projects; Basics of social service, weaker sections of society and their needs, NGO's and their contribution, contribution of youth towards social welfare and family planning; Structure and function of human body, diet and exercise, hygiene and sanitation;

Environmental Conservation

Preventable diseases including AIDS, safe blood donation, first aid, physical and mental health; Adventure activities; Basic principles of ecology, environmental conservation, pollution and its control; Precaution and general behaviour of girl cadets, prevention of untoward incidents, vulnerable parts of the body, self defense.

Course Nature: Practical			
Total Marks (100)			
S.No.	Category	Assessment Tools	Marks
1	Practical-Internal	*Purely internal based on the participation, involvement and contribution of students in the activities pertaining to the course*	
		Attendance	*05*
		Participation	*20*
		Activities and Involvement	*20*
		Behaviour	*15*
		Written	*40*
		Grand Total	*100*

** Registration in semester I, whereas result declaration in semester IV. Students are evaluated internally by course teacher at the end of each semester and the average would be taken for result declaration*

Course Code	AGE19201	Course Name	INTRODUCTION TO AGRO FORESTRY	Course Category	C	*Compulsory Core*	L	T	P	C
							1	0	1	2

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Forestry*	Data Book / Codes/Standards	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1 :	*Describe the forest cover of India and the role of forests in providing tangible and intangible benefits to human societies*
CLR-2 :	*Demonstrate the concept of forest regeneration, tending and other forestry operations.*
CLR-3 :	*summarize the information on the important tree species in agroforestry systems*
CLR-4 :	*Discuss the technical knowledge on the various practices in agroforestry*
CLR-5 :	*Review the importance of Social forestry along with knowing the different social forestry schemes across India and Tamil Nadu*

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning			Program Learning Outcomes (PLO)													
		1	*2*	*3*	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Agriculture Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	Ability to solve scientific problems	Ability to implement knowledge gained	Ability to understand social and ethical responsibilities
CLO-1 :	*Identify important tree species along with their seeds and seedlings*	*1*	*90*	*80*	*M*								*M*	*H*		*H*	*H*	*H*	*H*
CLO-2 :	*Demonstrate production of saplings of important agroforestry trees such as Teak, Melia dubia etc in a nusery.*	*3*	*95*	*85*	*H*								*L*	*H*		*H*	*H*	*H*	*H*
CLO-3 :	*Identify the constraints and on -field challenges of an agroforestry system*	*2*	*80*	*70*	*M*		*L*	*L*					*L*	*H*		*H*	*H*	*H*	*H*
CLO-4 :	*Demonstrate the estimation of girth, height and volume of agroforestry trees using mensuration techniques*	*3*	*90*	*80*	*M*			*L*	*L*				*M*	*H*		*H*	*H*	*H*	*H*
CLO-5 :	*Illustrate Agroforestry models suitable for the local region*	*3*	*75*	*60*	*L*	*L*							*M*	*H*		*H*	*H*	*H*	*H*

		Learning Unit / Module 1	Learning Unit / Module 2	Learning Unit / Module 3	Learning Unit / Module 4	Learning Unit / Module 5
Duration (hour)		9	9	9	12	9
S-1	SLO-1	*Definitions, scope, classification of forests*	*Agroforestry: definition, objective and potential.*	*Management practices of Teak*	*Agroforestry practices for arid and semi-arid regions*	*Social forestry: Definition, objectives*
	SLO-2	*Forest types of Tamil Nadu*	*Planning for agroforestry*	*Management practices of Sandal*	*Agroforestry practices for salt affected soils, waterlogged areas.*	*History of social forestry*
S-2,3	SLO-1	*Identification of major farm grown tree species*	*Nursery technology of Casuarina equisetifolia*	*Studies on contract tree farming practices in Tamil Nadu*	*Visit to social forestry plantations: railway line plantations*	*Rapid assessment of farmers needs for green manure, fodder*
	SLO-2	*Identification of seeds and seedlings of multipurpose tree species*	*Nursery technology of Eucalyptus hybrid*		*Visit to social forestry plantations: canal plantations*	*Rapid assessment of farmers needs for fuel wood*
S-4	SLO-1	*Role of forests*	*Classification of agroforestry systems*	*Management practices of neem, eucalyptus*	*Soil and water conservation through agroforestry approaches.*	*Components of social forestry*
	SLO-2	*Forestry, Silvics and Silviculture*	*Shifting cultivation; taungya; alley cropping etc*	*Management practices casuarina*	*Carbon sequestration through agroforestry approaches*	*Benefits of social forestry*
S-5,6	SLO-1	*Design and Layout of Tree Nursery*	*Nursery technology of Azadirachta indica,*	*Visit to agro-forestry fields: silvipastoral, alley cropping*	*Visit to social forestry plantations: roadside plantations*	*Rapid assessment of farmers needs for green manure, fodder*
	SLO-2	*Seed sowing and treatment*	*Nursery technology of Melia dubia and Ailanthus excelsa*	*Visit to agro-forestry fields: horti-silviculture*	*Visit to social forestry plantations: industrial plantations and shelterbelts*	*Rapid assessment of farmers needs for fuel wood*
S-7	SLO-1	*Forest regeneration- natural and artificial*	*Agroforestry systems for different agro climatic zones of Tamil Nadu.*	*Management practices of rose wood, red sanders*	*Agroforestry projects: national, overseas*	*social forestry schemes*

	SLO-2	*Tending operations*		*Management practices Ailanthus, Melia dubia*	*National Agroforestry policy.*	*JFM, TAP*
S-8,9	SLO-1	*Nursery technology of Tectona grandis*	*Nursery technology of Red Sanders*	*Visit to agro-forestry fields: agro-silvipasture*	*Preparation of two agroforestry models for the region*	*Economics and marketing of products raised in agro-forestry systems*
	SLO-2	*Nursery technology of Santalum album*	*Nursery technology of Dalbergia sissoo and Acacia species.*	*Visit to agro-forestry fields: fuel and fodder blocks*		-
S-10	SLO-1	-	-	-	*Girth, height and volume measurement*	-
	SLO-2	-	-	-	*Timber transit rules*	-
S-11,12	SLO-1	-	-	-	*Estimation of girth, height*	-
	SLO-2	-	-	-	*Estimation of volume*	-

Learning Resources	1. *Alain Atangana, Damase Khasa, Scott Chang, Ann Degrande . Tropical Agroforestry 2014th Edition.* 2. *Divya, M.P., K.T. Parthiban, K. Srinivasan, K. Vanangamudi and M. Govinda Rao. 2008. A text book on Social Forestry and Agroforestry. Satish Publishers, Delhi.*

	Level of Thinking	Continuous Learning Assessment (35% weightage)		UniversityPractical Examination (15%)	End semester theory Examination (50%)
		In semester (20%)	Practical (15%)		
Level 1	Remember	40 %	30 %	35%	30 %
	Understand				
Level 2	Apply	40 %	40 %	35%	40 %
	Analyze				
Level 3	Evaluate	20 %	30 %	30%	30 %
	Create				
	Total	100 %	100 %	100%	100 %

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Dr Mayavel, Contract farming *Institute of Forest Genetics and tree breeding,* *Coimbatore 641002*	*Dr. Vennila, Assistant professor, Forest college and research institute , Tamil Nadu Agricultural University, Coimbatore 641003*	*Ms. Sri Ranjni T.S*

THEORY

Unit I - Introduction to Forestry

Introduction to forests and forestry: Definitions, scope, classification of forests - Forest types of Tamil Nadu; Forest cover of India; Role of forests- Tangible and intangible benefits. Silvics and Silviculture. Branches in forestry Salient features of Indian forest policy. Forest regeneration, Natural regeneration natural regeneration from seed and vegetative parts, coppicing, pollarding, root suckers; Artificial regeneration

Unit II - Agroforestry

Agroforestry: definition, objective and potential. National Agroforestry policy. Planning for agroforestry – constraints, diagnosis and design methodology, selection of tree crop species for agro-forestry. Classification of agroforestry systems- agri-silviculture, silvipastoral, horti-silviculture, horti-silvipastora shifting cultivation; taungya; alley cropping, wind breaks and shelter belts; home gardens, energy plantation. Agroforestry systems for different agro climatic zones of Tamil Nadu. Agroforestry projects: national, overseas.

Unit III - Tree Species in Agroforestry

MPTS and management practices: Silvicultural characters; Regeneration techniques, Tending, Rotation, Yield and Uses and economics of cultivation of *Tectona grandis, Santalum album, Casuarina equisetifolia, Eucalyptus hybrid, Azadirachta indica, Melia dubia, Ailanthus excelsa, Dalbergia sissoo*, and *Pterocarpus santalinus*

Unit IV - Practices in Agroforestry

Agroforestry practices for arid and semi-arid regions, salt affected soils, waterlogged areas, soil and water conservation, wasteland development and Carbon sequestration; Forest Mensuration - definition, objectives, diameter, girth and height measurement methods; standard rules governing breast height measurement; volume estimation in standing and felled trees; Timber transit rules for farm grown trees.

Unit V - Social Forestry

Social forestry: Definition, history, objectives; Components - Farm forestry, Extension forestry, Community forestry, Recreation forestry, Urban forestry; Benefits of social forestry; Important social forestry schemes implemented in India; Interface forestry, Joint forest management (JFM); Tamil Nadu Afforestation Project (TAP)

Theory Lecture Schedule

1. Definitions, scope, classification of forests - Forest types of Tamil Nadu; Forest cover of India.
2. Role of forests; Tangible and intangible benefits; Forestry, Silvics and Silviculture - definition and objectives, relation with other branches of forestry.
3. Forest regeneration, Natural regeneration natural regeneration from seed and vegetative parts, coppicing, pollarding, root suckers; Artificial regeneration – objectives, choice between natural and artificial regeneration, essential preliminary considerations. Crown classification.
4. Tending operations – weeding, cleaning, thinning –mechanical, ordinary, crown and advance thinning.
5. Forest Mensuration - definition, objectives, diameter, girth and height measurement methods; standard rules governing breast height measurement.Volume estimation in standing and felled trees; Timber transit rules for farm grown trees.
6. Agroforestry: definition, objective and potential. National Agroforestry policy.
7. Planning for agroforestry – constraints, diagnosis and design methodology, selection of tree crop species for agro-forestry.
8. Classification of agroforestry systems- shifting cultivation; taungya; alley cropping; Wind breaks and shelter belts; home gardens, energy plantation.
9. **In - Semester examination**.
10. Agroforestry systems for different agro climatic zones of Tamil Nadu.
11. MPTS and management practices: Silvicultural characters; Regeneration techniques, Tending, Rotation, Yield and Uses of Tectona grandis, Santalum album.
12. Silvicultural characters; Regeneration techniques, Tending, Rotation, Yield and Uses of Casuarina equisetifolia, Eucalyptus hybrid, Azadirachta indica.
13. Silvicultural characters; Regeneration techniques, Tending, Rotation, Yield, Economics of cultivation and Uses of Melia dubia, Ailanthus excelsa, Dalbergia sissoo, and Pterocarpus santalinus.
14. Agroforestry projects: national, overseas; National Agroforestry policy.
15. Social forestry: Definition, history, objectives.
16. Components of social forestry- Farm forestry, Extension forestry, Community forestry, Recreation forestry, Urban forestry; Benefits of social forestry.
17. Important social forestry schemes implemented in India; Interface forestry, Joint forest management (JFM); Tamil Nadu Afforestation Project (TAP).

Practicals Schedule

1. Identification of major farm grown tree species, seeds and seedlings of multipurpose tree species
2. Design and Layout of Tree Nursery
3. Nursery technology of *Tectona grandis*, *Santalum album*
4. Nursery technology of *Casuarina equisetifolia* and *Eucalyptus hybrid*
5. Nursery technology of *Azadirachta indica*, *Melia dubia and Ailanthus excelsa*
6. Nursery technology of Red Sanders- *Pterocarpus santalinus, Dalbergia sissoo* and *Acacia species.*
7. Studies on contract tree farming practices in Tamil Nadu

8. Visit to agro-forestry fields to study the compatibility of MPTS with agricultural crops: silvipastoral, alley cropping, horti-silviculture, agro-silvipasture, fuel and fodder blocks.
9. Visit to agro-forestry fields to study the compatibility of MPTS with agricultural crops: silvipastoral, alley cropping, horti-silviculture, agro-silvipasture, fuel and fodder blocks.
10. Visit to social forestry plantations – railway line plantations, canal plantations, roadside plantations, industrial plantations and shelterbelts
11. Visit to social forestry plantations – railway line plantations, canal plantations, roadside plantations, industrial plantations and shelterbelts
12. Estimation of girth, height and volume of trees in agroforestry
13. Preparation of two agroforestry models for the region
14. Rapid assessment of farmers needs for green manure, fodder, fuel wood in selected villages
15. Rapid assessment of farmers needs for green manure, fodder, fuel wood in selected villages
16. Economics and marketing of products raised in agro-forestry systems
17. **University Practical examination**

Text Books

1. Alain Atangana, Damase Khasa, Scott Chang, Ann Degrande. (2014th Edition). Tropical Agroforestry pp 1-380.
2. Antony Joseph Raj and S.B.Lal (2014). Agroforestry-Theory and Practices. Scientific Publishers (India), Jodhpur. Pp 1-356
3. Divya, M.P., K.T. Parthiban, K. Srinivasan, K. Vanangamudi and M. Govinda Rao (2008). A text book on Social Forestry and Agroforestry. Satish Publishers, Delhi. pp 1-315
4. Khanna, L.S (2010). Principles and Practices of Silviculture. Khanna Bavdhu Publishers, Dehra Dun.pp 1-56
5. Louise E. Buck, James P. Lassoie, Erick C.M. Fernandes (1998). Agroforestry in Sustainable Agricultural Systems (Advances in Agroecology).
6. Nair, P.K.R (1993). An introduction to Agroforestry. Kluwer Academic Publishers, Dordrecht. pp 25-230
7. Patra A.K (2013). Agroforestry - Principles and Practices, New India Publishing Agency, New Delhi.pp 1-78
8. Ramesh Umrani and Jain C.K (2010). Agroforestry - Systems and Practices. Oxford Book Company, Jaipur.
9. Reddy, SR., C. Nagamani (2017). Introduction to Forestry. Kalyani publishers. pp 1-120

Web Resources

1. www.worldagroforestry.org
2. www.fao.org/forestry/9469/en
3. www.fsi.org.in
4. www.silviculture.com
5. www.global-saf.com
6. www.agroforestry.net.au
7. www.nac.unl.edu/documents/insideagroforestry/vol16issue2.pdf

Journals

1. Agroforestry Systems
2. International Journal of Agroforestry and Silviculture
3. World Agroforestry
4. Applied Vegetation Science
5. Annals of Forest Science
6. Forest Science

Course Nature: Theory based Practical							
Total Marks (100)							
S.No.	Category	**Assessment Tools**					
		In- SemesterExamination	Assignment	Record	Attendance	End-SemesterExamination	Marks
1	Theory-External	-	-		-	*50*	*50*
2	Theory-Internal	*20*	-			-	*20*
3	Practical-External	-	-		-	*15*	*15*
4	Practical-Internal	-	*05*	*05*	*05*	-	*15*
						Grand Total	*100*

Course Code	NRM19201	Course Name	FUNDAMENTALS OF SOIL SCIENCE	Course Category	C	Compulsory Core	L	T	P	C
							2	0	1	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Soil Science	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1 :	*Define soil and its properties*
CLR-2 :	*List out the physical properties of soil*
CLR-3 :	*Describe the chemical properties of soil*
CLR-4 :	*Explain the biological properties of soil*
CLR-5 :	*Predict the soil health and planning the land use.*

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Agriculture Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	Ability to solve scientific problems through Soil science	Ability to implement knowledge gained in the applied field of Soil science	Ability to understand social and ethical responsibilities of Soil science
CLO-1 :	*Outline the soil formation.*	*1*	*90*	*85*	*H*			*H*			*H*		*M*	*H*		*H*	*H*	*H*	*H*
CLO-2 :	*Identify the soil physical parameters.*	*2*	*95*	*85*	*H*			*H*					*L*	*H*		*H*	*H*	*H*	*H*
CLO-3 :	*Interpret the chemistry of soil with nutrient availability.*	*2*	*80*	*70*	*M*		*M*	*M*			*H*		*L*	*H*		*H*	*H*	*H*	*H*
CLO-4 :	*Explain the importance of soil biology in soil fertility.*	*3*	*85*	*75*	*M*			*H*					*M*	*H*		*H*	*H*	*H*	*H*
CLO-5 :	*Determine the soil health for better crop growth.*	*3*	*85*	*90*	*M*								*M*	*H*		*H*	*H*	*H*	*H*

		Learning Unit / Module 1	Learning Unit / Module 2	Learning Unit / Module 3	Learning Unit / Module 4	Learning Unit / Module 5
Duration (hour)		9	7	6	6	5
S-1	SLO-1	*Origin of Earth, theories*	*Soil texture definition, classes*	*Soil pH: acidity & alkalinity*	*Soil ecology: organisms*	*Soil survey types*
	SLO-2	*Composition of Earth's crust*	*Methods of analysis*	*Effect on nutrient availability*	*Classifications*	*Soil survey uses*
S-2	SLO-1	*Rocks: definition, classification, formation*	*Soil structure definition, classification*	*EC, base saturation*	*Synergism effects*	*NBSSLUP*
	SLO-2	*Minerals: definition, classification, formation*	*Formation and evaluation*	*Effect on nutrient availability*	*Antagonism effects*	*ISSS*
S-3,4	SLO-1	*Lab.1. Introduction to basic laboratory practices and analytical techniques*	*Lab. 5. Determination of bulk density by wax coating method*	*Lab. 8. Determination of soil colour*	*Lab.11. Determination of soil moisture content*	*Lab.14. Determination of soil CEC*
	SLO-2					
S-5	SLO-1	*Weathering: Physical*	*Soil density*	*Soil organic, inorganic colloids*	*Soil organic matter: composition*	*Land use planning classification*
	SLO-2	*Weathering: Chemical, biological*	*Factors influencing*	*Properties and functions*	*Soil organic matter: properties*	*Land use planning – uses*
S-6	SLO-1	*Fundamental pedogenic process*	*Soil consistency, plasticity*	*Silicate clays 1:1, 2:1, 2:2*	*Soil organic matter*	*Soil pollution – behaviour of pesticides*
	SLO-2	*Specific pedogenic process*	*Soil colour*	*Properties*	*Its influence on soil properties*	*Inorganic contaminants*
S-7,8	SLO-1	*Lab.2. Identification of soil sampling tools; profile study; sample collection and processing*	*Lab. 6. Soil textural analysis – feel method*	*Lab. 9. Determination of soil temperature*	*Lab.12. Determination of soil pH and EC*	*Lab. 15. Soil and Land use maps*
	SLO-2					
S-9	SLO-1	*Active soil forming factor*	*Soil aeration: composition*	*Source of charges*	*Humus formation theories*	*Soil pollution prevention*
	SLO-2	*Passive soil forming factor*	*Gaseous exchange*	*Its functions*	*Nature and properties*	*Soil pollution mitigation*
S-10	SLO-1	*Soil profile development*	*Soil temperature: source, amount flow of heat*	*Cation exchange capacity*	*Soil enzymes classification*	*Lab. 16. Field visit – different types of soil*
	SLO-2	*Horizon formation*	*Effect on plant growth*	*Anion base capacity and base saturation*	*Soil enzymes importance*	

S-11,12	SLO-1	*Lab.3. Study of soil forming rocks and minerals*	*Lab. 7. Soil textural analysis – international pipette method*	*Lab. 10. Study of soil moisture content, potential and water movement in soil*	*Lab.13. Estimation of soil OC*	-
	SLO-2					-
S - 13	SLO-1	*Soil definition, concepts*	*Soil water & classification*	-	-	-
	SLO-2	*Components and functions*	*Soil water constants*	-	-	-
S - 14	SLO-1	*Soil taxonomy – USDA*	-	-	-	-
	SLO-2	*Classification*	-	-	-	-
S–15,16	SLO-1	*Lab.4. Determination of B.D, P.D, Porosity by cylinder method*	-	-	-	-
	SLO-2		-	-	-	-
S-17	SLO-1	*Soil of India and TN*	-	-	-	-
	SLO-2	*Soil quality*	-	-	-	-

Learning Resources	1. *Brady, N.C and Raymond C. W. (2013). The Nature and Properties of Soils (15th ed.). Pearson Education. pp. 1 - 1035.* 2. *Indian Society of Soil Science. (2012). Fundamentals of Soil Science (2nd ed.), New Delhi: ISSS, IARI.*

	Level of Thinking	Continuous Learning Assessment (35% weightage)		University Practical Examination (15%)	End semester theory Examination (50%)
		In semester (20%)	Practical (15%)		
Level 1	Remember	40 %	30 %	35%	30 %
	Understand				
Level 2	Apply	40 %	40 %	35%	40 %
	Analyze				
Level 3	Evaluate	20 %	30 %	30%	30 %
	Create				
	Total	100 %	100 %	100%	100 %

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Mr. S. Suresh *Senior Agricultural Officer, STL, Kanchipuram.*	*Dr. M.V. Sriramachandrasekharan* *Professor (SSAC), Annamalai University, Annamalainagar – 608002.*	*Dr. R. Angelin Silviya* *Dr. S.N.Chikkaraju*

THEORY

Unit I – Soil Genesis

Soil genesis: Origin of Earth and Universe, soil forming rocks and minerals, its definition, classification and formation; Weathering, processes and factors of soil formation; Soil profile and horizon formation; Soil as a natural body, definition, pedological and edaphological concepts, components and functions; Elementary knowledge on USDA soil taxonomical classification; Soils of India and Tamil Nadu; Soil quality indicators and assessment.

Unit II - Soil Physical Properties

Soil Texture and Classes, use of textural triangle, Methods of Analysis, Assumptions and limitations, ; Soil Structure and classification, Factors influencing soil structures; Soil density: Bulk density, particle density and porosity – capillary and non-capillary porosity, factors influencing; Soil consistency, Plasticity, Atterberg's constant, Soil colour, definition, its significance, colour variable, value hue and chroma. Munsell Colour chart, factors influencing, parent material, soil moisture, organic matter; Soil aeration: composition, gaseous exchange, problem and plant growth; Soil temperature: source, amount, flow of heat in soil and its effect on plant growth; Soil Water and classification; Soil water constants, soil water potential, measurement of soil water and soil water movement, infiltration, percolation, drainage and runoff

Unit III - Soil Chemical Properties

Soil reaction: pH, soil acidity and alkalinity, buffering and its effect on nutrient availability; Soil colloids: Organic and Inorganic soil colloids; Silicate clays: 1:1, 2:1 and 2:2 silicate clays and their properties; Source of charges; ion exchange: cation exchange capacity, anion exchange capacity and base saturation.

Unit IV - Soil Biological Properties

Soil Ecology: Soil Organisms, classification and Synergism/Antagonism effects; Soil Organic matter: Composition, properties and its influence on soil properties; Humus formation, humic substances – nature and properties; Soil enzymes: classification and importance.

Unit V – Soil Resource Inventory

Soil Resource Inventory: soil survey, types, uses and objectives of soil science research institutes in India; Land Use planning: classifications and uses; Soil pollution – behaviour of pesticides and inorganic contaminants, prevention and mitigation.

Theory - Lecture schedule

1. Soil genesis: Origin of Earth and Universe, its concepts and theories; Composition of Earth's crust.
2. Soil forming rocks and minerals: definition, classification and formation.
3. Soil weathering: Physical, Chemical and Biological weathering.
4. Soil forming processes: fundamental and specific pedogenic processes.
5. Soil forming factors: active and passive factors.
6. Soil profile and horizon formation.
7. Soil as a natural body, definition, pedological and edaphological concepts, components and functions.
8. Elementary knowledge on soil taxonomical classification (USDA).
9. Soils of India and Tamil Nadu; Soil quality indicators and assessment.
10. Soil Texture and Classes: use of texture triangle, methods of analysis, assumptions and limitations.
11. Soil Structure and classification, Factors influencing soil structures, its formation and evaluation.
12. Soil density: Bulk density, particle density and porosity – capillary and non-capillary porosity, factors influencing.
13. Soil consistency, plasticity, Atterberg's constant; Soil colour: definition, significance, colour variable, value, hue and chroma, Munsell colour chart, factors influencing.
14. Soil aeration: composition, gaseous exchange, problem and plant growth.
15. Soil temperature: source, amount, flow of heat in soil and its effect on plant growth.
16. Soil Water & classification; Soil water constants; Soil water potential; Measurement of soil water & movement, infiltration, percolation, drainage and runoff.
17. **In-semester Examination**
18. Soil reaction: pH, soil acidity and alkalinity, its effect on nutrient availability.
19. Soil reaction: EC, base saturation and its effect on nutrient availability.
20. Soil colloids: Organic and Inorganic soil colloids, its properties and functions.
21. Silicate clays: 1:1, 2:1 and 2:2 silicate clays and their properties.

22. Source of charges in soil colloids.
23. Soil ion exchange: cation exchange capacity, anion exchange capacity and base saturation.
24. Soil Ecology: soil organisms, its classifications
25. Soil organisms: synergism/antagonism effects.
26. Soil organic matter: composition and properties.
27. Soil organic matter, its influence on soil properties.
28. Humus formation theories; Humic substances, nature and properties.
29. Soil enzymes: classification and importance.
30. Soil Resource Inventory: soil survey, types and uses.
31. Objectives of Soil Science Research institutes in India (NBSS&LUP, ISSS etc.).
32. Land use planning: classifications and uses.
33. Soil pollution – behaviour of pesticides and inorganic contaminants
34. Soil pollution – prevention and mitigation.

Practical schedule

1. Introduction to basic laboratory practices and analytical techniques.
2. Identification of soil sampling tools; Study of soil profile in field; collection of representative soil sample, its processing and storage.
3. Study of soil forming rocks and minerals.
4. Determination of Bulk density, Particle density and porosity by cylinder method.
5. Determination of Bulk density by wax coating method.
6. Soil textural analysis – feel and Bouyoucos method.
7. Soil textural analysis – international pipette method.
8. Determination of soil colour.
9. Determination of soil temperature.
10. Study of soil moisture content, potential and water movement in soil.
11. Determination of soil moisture content – gravimetric and instrumentation methods.
12. Determination of soil pH and EC.
13. Estimation of soil OC.
14. Determination of soil CEC.
15. Soil and Land use maps.
16. Field visit – different types of soil.
17. **University practical examination.**

Textbooks

1. Biswas, T.D. and Mukherjee S.K. (2017). Text Book of Soil Science (2nd ed.). New Delhi: Tata McGraw Hill Publishing Co. Ltd. pp. 1 - 433.
2. Chopra, S.C and Kanwar J.S. (2014). Analytical Agricultural Chemistry. Ludhiana: Kalyani publishers.
3. Das, D.K. (2015). Introductory Soil Science (4th ed.). Ludhiana: Kalyani Publisher
4. Indian Society of Soil Science. (2012). Fundamentals of Soil Science (2nd ed.). New Delhi: ISSS, IARI.
5. Sehgal, J. (2015). A textbook of pedology: Concepts and Applications. New Delhi: Kalyani Publishers.

Reference books

1. Brady, N.C. and Raymond, C. W. (2013).The Nature and Properties of Soils (15th ed.). Pearson Education. pp. 1 - 1035.
2. Epstein, E. and Bloom, A.J. (2005). Mineral Nutrition of Plants: Principles and perspectives (2nd ed.). Sunderland, MA: Sinauer Associates. pp. 1 - 380.
3. Jackson, M.L. (2012). Soil chemical analysis: Advanced course, Scientific Publisher.
4. John, L. H., Beaton J.D, Tisdale S.L and Nelson W.L. (2016). Soil Fertility and Fertilizers - An Introduction to Nutrient Management. (2nd ed.). New Delhi: PHL Learning Pvt. Ltd. pp. 1 - 433.
5. Tan K.H. (2018). Principles of Soil Chemistry, Special Indian edition (4th ed.). Taylor & Francis.

Web references

1. https://www.usda.gov/
2. https://www.springer.com/gp/environmental-sciences/soil-science
3. https://www.soils.org.uk/students
4. https://youtu.be/zrjL5J_U1iE
5. https://youtu.be/OcEuG-NzmqQ

Journals

1. Journal of the Indian Society of Soil Science (ISSS)
2. Soil Science and Plant Nutrition
3. International journal of Plant and Soil Sciences
4. Journal of soil and water conservation
5. Journal of soils and crops

Course Nature: Theory based Practical							
Total Marks (100)							
S.No.	Category	Assessment Tools					
		In- Semester Examination	Assignment	Record	Attendance	End-Semester Examination	Marks
1	Theory-External	-	-		-	*50*	*50*
2	Theory-Internal	*20*	-			-	*20*
3	Practical-External	-	-		-	*15*	*15*
4	Practical-Internal	-	*05*	*05*	*05*	-	*15*
						Grand Total	*100*

Course Code	CRH19201	Course Name	PRINCIPLES OF WEED MANAGEMENT	Course Category	C	*Compulsory Core*	L	T	P	C
							1	0	1	2

Pre-requisite Courses	Nil	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Agronomy*	Data Book / Codes/Standards	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1 :	*Describe the weed species*
CLR-2 :	*Outline the weed ecology*
CLR-3 :	*Demonstrate Crop weed interactions for various resources*
CLR-4 :	*Explain different weed control methods*
CLR-5 :	*Discuss the mode of action of herbicides*

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning			Program Learning Outcomes (PLO)													
		1	*2*	*3*	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Agriculture Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	Ability to solve scientific problems	Ability to implement knowledge gained	Ability to understand social and ethical responsibilities
CLO-1 :	*Identify different weed species*	*1*	*90*	*85*	*H*			*H*			*H*		*M*	*H*		*H*	*H*	*H*	*H*
CLO-2 :	*Illustrate different weed control methods*	*2*	*95*	*85*	*H*			*H*					*L*	*H*		*H*	*H*	*H*	*H*
CLO-3 :	*Illustrate selection of herbicides and methods of application*	*2*	*80*	*70*	*M*		*M*	*M*			*H*		*L*	*H*		*H*	*H*	*H*	*H*
CLO-4 :	*Describe the translocation of herbicides and persistence*	*3*	*85*	*75*	*M*			*H*					*M*	*H*		*H*	*H*	*H*	*H*
CLO-5 :	*Explain herbicide residue and its management*	*3*	*85*	*90*	*M*								*M*	*H*		*H*	*H*	*H*	*H*

		Learning Unit / Module 1	Learning Unit / Module 2	Learning Unit / Module 3	Learning Unit / Module 4	Learning Unit / Module 5
Duration (hour)		4	4	3	2	3
S-1	SLO-1	*Weed introduction and harmful effects*	*Weed control methods-Prevention*	*Herbicides classifications*	*Herbicide selectivity*	*Weed management in major field crops*
	SLO-2	*Beneficial effects of weeds*	*Weed control-eradication and physical methods*	*Herbicide characteristics*	*Herbicide absorption and translocation*	*Weed management in major horticultural crops crops*
S-2,3	SLO-1	*Field/Lab.1.Identification, classification and characterization of terrestrial weeds*	*Field/Lab.5.Study on biology of nut sedge and Bermuda grass, parthenium and celosia*	*Field/Lab.9. Practicing skill development on spray equipment 's and spray fluid calibration*	*Field/Lab.12. Study on phyto-toxicity symptoms of herbicides in different crops*	*Field/Lab.15. Economic analysis of different weed management methods in crops and cropping systems*
	SLO-2					
S-4	SLO-1	*Classifications of weeds*	*Weed control – cultural methods*	*Herbicide formulations*	*Compatability of herbicides and other agro-inputs*	*Weed shift and weed control in non-cropped areas*
	SLO-2	*Propagation and disseminations of weeds*		*Herbicide application methods*	*Mode of action of herbicides*	*Aquatic and problematic weeds-Control*
S-5,6	SLO-1	*Field/Lab.2. Identification, classification and characterization of aquatic weeds*	*Field/Lab.6. Practicing skill development on cultural and non-chemical weed management*	*Field/Lab.10. Practicing skill development on chemical weed management in lowland, upland and rainfed ecosystems*	*Field/Lab.13. Herbicide residue determination by bioassay techniques*	*Field/Lab.16. Visit to Problem and parasitic weed infestation areas/ herbicide industries*
	SLO-2					
S-7	SLO-1	*Weed biology and ecology*	*Weed control-Chemical methods*	*Herbicide equipment's and their accessories*	*Herbicide residue management*	-
	SLO-2	*Crop weed association and weed seed bank*	*Weed control- Biological Methods*	*Adjuvants*	*Persistence and degradation of herbicides*	-
S-8,9	SLO-1	*Field/Lab.3.Identification, classification and characterization of problematic and parasitic weeds*	*Field/Lab. 7. Identification, classification and characterization of herbicides*	*Field/Lab.11. Calculation of herbicide quantity and recommendation for different ecosystems*	*Field/Lab.14. Herbicide residue determination by volumetric, spectro-photometric methods and chromatographic methods.*	--
	SLO-2					

S-10	SLO-1	*Crop weed competition*	*Non-chemical weed management*	*Herbicide mixtures*	*Herbicides resistant weeds*	--
	SLO-2	*Allelopathy*	*Integrated weed Management*	*Advantages and limitations of herbicide usage in India*	*Herbicide resistant GM crops*	--
S-11	SLO-1	*Field/Lab.4.Weed survey and weed vegetation analysis - density, frequency, SDR and IVI*	*Field/Lab.8. Practicing skill development on herbicide application techniques*	--	--	--
	SLO-2					--

Learning Resources	1. *Das, T.K. (2008). Weed Science - Basics and Applications. Jain Brothers, New Delhi. pp. 1-901.* 2. *Gupta, O.P. (2011). Weed Management - Principles and Practices. Agrobios. pp. 1- 324.*	3. *Jayakumar, R. and Jagannathan, R. (2007). Weed Science Principles. Kalyani Publishers, Ludhiana. pp. 1- 379.* 4. *Mandal, R.C. (1990). Weed, Weedicides and Weed Control - Principles and Practices. Agro- Botanical Publ. pp. 1- 263*

	Level of Thinking	Continuous Learning Assessment (35% weightage)		University Practical Examination (15%)	End semester theory Examination (50%)
		In semester (20%)	Practical (15%)		
Level 1	Remember	40 %	30 %	35%	30 %
	Understand				
Level 2	Apply	40 %	40 %	35%	40 %
	Analyze				
Level 3	Evaluate	20 %	30 %	30%	30 %
	Create				
	Total	100 %	100 %	100%	100 %

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Mr. D. Velmurugan *Associate Territory Manager* *Dhanuka Agritech Ltd., Puthukkottai.*	*Dr. C. Chinnamuthu* *Professor and Head* *Department of Agronomy* *Tamil Nadu Agricultural University, Coimbatore.*	*Dr. N. Krishnaprabu* *Dr. D. Selvakumar* *Dr. S. Marimuthu*

THEORY:

Unit I – Introduction to Weeds

Weeds: Introduction, harmful and beneficial effects, classification, propagation and dissemination - Weed biology and ecology - Weed seed dormancy - Weed seed bank - Crop weed association - Crop weed competition and allelopathy effect.

Unit II – Weed Control Methods

Concepts of weed prevention, control and eradication - Methods of weed control: physical, cultural, chemical and biological methods - Non chemical weed management - Integrated weed management (IWM).

Unit III – Herbicides

Herbicides: Classification, characteristics, formulations, methods of application, advantages and equipment – Adjuvants – Herbicide mixture - Advantages and limitation of herbicide usage in India.

Unit IV – Herbicide Selectivity

Selectivity of herbicides; Herbicide absorption and translocation - Compatibility of herbicides and other agro inputs - Mode of action of herbicides and their selectivity - Herbicide residue management - Persistence and degradation of herbicides in soil and plants - Herbicide resistant weeds - Herbicide resistant GM crops.

Unit V – Weed Management in Crops

Weed management in major field and horticultural crops - weed shift - weed control in non-cropped areas - aquatic and problematic weeds and their control. Weed management in major field and horticultural crops - weed shift - weed control in non-cropped areas - Parasitic, aquatic and problematic weeds and their control.

Theory - Lecture Schedule

1. Weeds - Definition, classification and characteristics, harmful and beneficial effect of weeds.
2. Weed biology and ecological adaptation to different agro ecosystems.
3. Classification and characteristics of weeds of different agro ecosystems-lowland weeds, irrigated upland and rainfed land weeds.
4. Classification and characteristics of weeds - Aquatic, parasitic and obnoxious weeds.
5. Life cycle of weeds, weed migration, weed seed distribution, dormancy, germination, establishment and perennation of weeds in different ecosystems.
6. Crop weed interactions - Critical crop weed competition, competitive and allelopathic effects of weeds and crops.
7. Principles and methods of weed management: Preventive, cultural, mechanical.
8. **In- semester examination.**
9. Principles and methods of weed management: chemical, biological and alternate methods.
10. Classification and characteristics of herbicides and herbicide formulations - History and Development.
11. Herbicide Use Efficiency - Adjuvants, herbicide protectants and antidotes - Herbicide and herbicide mixtures in India - Interaction with moisture, fertilizer and other agrochemicals.
12. Mode of action of herbicides and their selectivity - Mechanism of action of herbicides and their selectivity.
13. Herbicide persistence and degradation in plants and soils-Herbicide residue and management.
14. Herbicide resistant weeds and their impact on weed management.
15. IWM in crops and cropping systems-Agricultural Crops, Horticultural Crops.
16. Weed shift: Causes and management options for weed shift in crop production.
17. **Final theory examination**

Practical Schedule

1. Identification, classification and characterization of terrestrial weeds
2. Identification, classification and characterization of aquatic weeds
3. Identification, classification and characterization of problem and parasitic weeds
4. Weed survey and weed vegetation analysis - density, frequency, SDR and IVI
5. Study on biology of nutsedge and Bermuda grass, parthenium and celosia
6. Practicing skill development on cultural and non-chemical weed management
7. Identification, classification and characterization of herbicides
8. Practicing skill development on herbicide application techniques
9. Practicing skill development on spray equipment ‘s and spray fluid calibration

10. Practicing skill development on herbicide weed management in lowland, upland and rainfed ecosystems
11. Calculation of herbicide quantity and recommendation for different eco systems
12. Study on phyto-toxicity symptoms of herbicides in different crops
13. Herbicide residue determination by bioassay techniques
14. Herbicide residue determination by volumetric, spectro-photometric methods and chromatographic methods.
15. Economic analysis of different weed management methods in crops and cropping systems
16. Visit to problematic and parasitic weed infestation areas/ herbicide industries
17. **Practical examination**

Text Books

1. Das, T. K. (2008). *Weed Science - Basics and Applications.* Jain Brothers, New Delhi. pp. 1-901.
2. Gupta, O.P. (2011). *Weed Management - Principles and Practices.* Agrobios. pp. 1- 324.
3. Jayakumar, R. and Jagannathan, R. (2007). *Weed Science Principles.* Kalyani Publishers, Ludhiana. pp. 1- 379.
4. Mandal, R.C. (1990). *Weed, Weedicides and Weed Control - Principles and Practices.* Agro- Botanical Publ. pp. 1- 263

Reference Books

1. Bhagirath S. Chauhan, Gulshan Mahajan. (2014). *Recent advances in weed management.* Springer. pp. 1-407.
2. Rao, V.S. (2000). *Principles of Weed Science.* Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi. pp. 1- 555.
3. Walia, U.S. (2003). *Weed Management.* Kalyani Publishers, Ludhiana. pp.1-396.

Web Sources

1. http://erec.ifas.ufl.edu/weeds/powerpoints/Basic%20Principles%20of%20Weed%20Management.pdf.
2. http://www.agrisk.umn.edu/cache/ARL02964.htm
3. http://www.eolss.net/sample-chapters/c10/E1-05A-31-00.pdf
4. http://www.fao.org/docrep/006/y5031e/y5031e00.htm#Contents
5. http://www.fao.org/docrep/006/y5031e/y5031e0j.htm
6. http://www.omafra.gov.on.ca/english/crops/pub811/12crop.htm

Journals

1. Indian Journal of weed science
2. Indian Journal of Agronomy
3. Weed technology
4. Weed science
5. Journal of crop and weed
6. Weed biology and management
7. Weed research

Course Nature: Theory based Practical							
Total Marks (100)							
S.N.	Category	**Assessment Tools**					
		In- Semester Examination	*Assignment*	*Record*	*Attendance*	*End-Semester Examination*	*Marks*
1	Theory-External	-	-		-	*50*	*50*
2	Theory-Internal	*20*	-			-	*20*
3	Practical-External	-	-		-	*15*	*15*
4	Practical-Internal	-	*05*	*05*	*05*	-	*15*
						Grand Total	*100*

Course Code	CRH 19202	Course Name	INTRODUCTION TO PLANT BIOCHEMISTRY	Course Category	C	Compulsory Core	L	T	P	C
							2	0	1	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Biochemistry	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1 :	Outline the scope and importance of Biochemistry.
CLR-2 :	Discuss biomolecules.
CLR-3 :	Discuss the role of ezymes and hormones in plant growth.
CLR-4 :	Explain the metabolic pathways occurring in plants.
CLR-5 :	Describe the structure of nucleic acids.
CLR-6 :	

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)													
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Biochemistry Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	Ability to solve scientific problems	Ability to implement knowledge gained	Ability to understand social and ethical responsibilities
CLO-1 :	Explain the role of biochemistry in agricultural sciences.	1	95	85	H			M					H	M		H	H	H	H
CLO-2 :	Recall the knowledge on the various biomolecules that make up a plant.	2	80	75	H								M	M		H	H	H	H
CLO-3 :	Outline the importance of enzymes and hormones in plant growth.	3	75	65	M			H					M	H		H	H	H	H
CLO-4 :	Illustrate the various metabolic pathways of plants.	3	75	65	M			H					M	H		H	H	H	H
CLO-5 :	Describe the nucleic acids that compose the life.	2	80	75	H			M					H	H		H	H	H	H
CLO-6 :	Demonstrate the qualitative analysis and separation techniques of biomolecules..	1	85	80	H								M	H		H	H	H	H

		Learning Unit / Module 1	Learning Unit / Module 2	Learning Unit / Module 3	Learning Unit / Module 4	Learning Unit / Module 5
Duration (hour)		7	7	6	5	8
S-1	SLO-1	.Importance of Biochemistry.	Importance and Classification of lipids.	Importance and Classification of Proteins.	General properties and Classification of Enzymes.	Glycolysis.
	SLO-2	Carbohydrates - Importance and Classification .	Structure and properties of fatty acids, Rancidity.	Amino acids - Classification and structure.	Mechanisms of enzyme action.	TCA-cycle.
S-2	SLO-1	Structure of Monosaccharides, Reducing and oxidizing properties of Monosaccharides.	Plant Pigments.	Amphoteric nature and Isomerism of Amino acids	Michaelis & Menten and Line Weaver Burk equation & plots.	Glyoxalate cycle.
	SLO-2	Mutarotation, Isomerism, Optical activity.	Plant Pigments.	Color reactions of Amino acids	Allosteric enzymes, Co-factors, Co-enzymes.	Electron transport chain.
S-3	SLO-1	Structure of Disaccharides and Polysaccharides.	Sterols	Structure of Proteins - Primary and Secondary structure	Plant growth hormones.	Beta oxidation.
	SLO-2	Osazone formation.	-	Structure of Proteins - Secondary and Tertiary structure	-	Biosynthesis of Fatty acids
S-4	SLO-1	-	-	-	-	Structure of Nucleotides – DNA
	SLO-2	-	-	-	-	RNA - Types and Structure

Learning Resources	1. *Buchanan, B. B., Gruissem, W. and Jones, R. L. 2002. Biochemistry and molecular biology of plants. 2ndEd., Blackwell publications, UK.* 2. *Lehninger, Nelson, D. L. and Michael, M. C. 2004. Principles of Biochemistry. Freeman Publishers*

	Level of Thinking	Continuous Learning Assessment (35% weightage)		University Practical Examination (15%)	End semester theory Examination (50%)
		In semester (20%)	Practical (15%)		
Level 1	Remember	40 %	30 %	35%	30 %
	Understand				
Level 2	Apply	40 %	40 %	35%	40 %
	Analyze				
Level 3	Evaluate	20 %	30 %	30%	30 %
	Create				
	Total	100 %	100 %	100%	100 %

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
-	*Dr. (Prof). S. Subramanian, UGC BSR Faculty Fellow, Department of Biochemistry, University of Madras, Guindy Campus, Guindy, Chennai – 600112*	*Dr. V. Devika* *Dr. G. Jayanthy*

THEORY

Unit I - Carbohydrates

Importance of Biochemistry. Properties of water, pH and buffer. Carbohydrates: Importance and classification. Structures of Monosaccharides, Reducing and oxidizing properties of Monosaccharides, Mutarotation, Isomersim, Optical activity; Structure of Disaccharides and Polysacharides; Osazone formation.

Unit II - Lipids

Lipids: Importance and Classification; Structure and properties of fatty acids; Rancidity; Storage lipids and membrane lipids. Plant pigments: structure and function of chlorophyll and carotenoids; Sterols - Basic structure, Role of brassino sterols in plants.

Unit III - Proteins

Proteins: Importance and Classification; Amino acids – Classification and Structure, Properties of amino acids - Physical properties - Amphoteric nature and Isomerism, Chemical Properties - Color reactions,; Structure of Proteins – Primary, Secondary, Tertiary and Quaternary structure.

Unit IV – Enzymes and Hormones

Enzymes: General properties; Classification; Mechanism of action; Michaelis & Menten and Line Weaver Burk equation & plots; Introduction to allosteric enzymes; Co-factors and Co-enzymes; Plant growth hormones - Auxins, Gibberelins, Cytokinins.

Unit V – Metabolic Pathways

Carbohydrate metabolism – Glycolysis, TCA-cycle, Glyoxlate cycle, Electron Transport Chain; Metabolism of lipids: Beta oxidation, Biosynthesis of fatty acids. Nucleic acids: Importance and classification; Structure of nucleotides, A, B & Z DNA; RNA: Types and secondary and tertiary structure.

Theory –Lecture Schedule

1. Importance of Biochemistry. Properties of water, pH and buffer.
2. Importance and classification of Carbohydrates.
3. Structure of Monosaccharides.
4. Reducing and Oxidizing properties of Monosaccharides.
5. Mutarotation, Optical activity, Isomerism.
6. Structure of Disaccharides and Polysaccharides..
7. Osazone formation.
8. Importance and classification of lipids.
9. Structure and properties of fatty acids.
10. Rancidity of lipids.
11. Storage lipids - Functions, Examples.
12. Membrane lipids - Functions, Examples.
13. Structure and functions of chlorophyll and carotenoids..
14. Brassino sterols.
15. Importance and classification of Proteins.
16. Amino acids – Classification and Structure.
17. **In-Semester Examination**

18. Physical properties of Amino acids - Amphoteric nature and Isomerism.
19. Color reactions of amino acids.
20. Structure of Proteins
21. General properties and classification of Enzymes.
22. Mechanisms of enzyme action.
23. Michaelis & Menten and Line Weaver Burk equation & plots.
24. Introduction to allosteric enzymes; Co-factors and Co-enzymes.
25. Plant growth hormones.
26. Glycolysis - Preparative phase, Payoff phase, Energetics.
27. TCA cycle - Reaction steps, Energetics.
28. Glyoxalate cycle - Reaction steps.
29. Electron Transport Chain - Reaction steps, Energetics.
30. Beta Oxidation of Fatty acids
31. Biosynthesis of Fatty acids .
32. DNA - Structure and Types
33. RNA - Structure
34. RNA- Types.

Practical Schedule

1. Preparation of standard solutions and reagents
2. Qualitative analysis of carbohydrates - Reducing sugars
3. Qualitative analysis of carbohydrates - Non - Reducing sugars
4. Quantitative estimation of glucose
5. Qualitative analysis of amino acids
6. Color reactions of amino acids
7. Quantitative estimation of proteins
8. Sorenson's formal titration of amino acid
9. Titration methods for the estimation of lipids
10. Determination of iodine number of vegetable oils
11. Effect of pH on enzyme concentration
12. Effect of temperature on enzyme concentration
13. Effect of substrate on enzyme concentration
14. Enzymes: Assay of amylase
15. Paper chromatography for separation of amino acids/carbohydrates
16. Thin layer chomatography demonstration for the separation of amino acids/carbohydrates
17. **University Practical Examination**

Text Books

1. Buchanan, B. B., Gruissem, W., & Jones, R. L. (2002). *Biochemistry and molecular biology of plants* (2nd Ed.). UK: Blackwell Publications. pp. 1 - 1280
2. Nelson, D. L., & Cox, M. M. (2017). *Principles of Biochemistry* (7th Ed.). New York: W.H. Freeman & Co. Publishers. pp. 1 - 1198

3. Rameshwar, A., (2006). *Practical Biochemistry: A Basic Course* (3rd Ed.). Ludhiana: Kalyani Publishers. pp.1 - 204
4. Sadashivam, S., & Manickam, A. (1992). *Biochemical methods for Agricultural sciences* (1st Ed.). New Delhi: Wiley Eatern Ltd. pp. 1- 246
5. Tymoczk, J. L., Berg, J. M., Gatto, G. J., & Stryer L. (2019). *Biochemistry-A Short Course*. 9th Ed. New York: W.H. Freeman & Co. Publishers. pp.1- 800
6. Voet, D & Voet, J.G. (2018). *Principles of Biochemistry*. 5th Ed. Hoboken, NJ: John Wiley & sons Incl. pp. 1- 1520.

Reference Books

1. Akawaza, T., & Ashasi, T. (2014). *The New Frontiers in Plant Biochemistry (Advances in Agricultural Biotechnology)*. 1st Ed. Netherlands: Springer. pp 1 - 257.
2. Hans-Walter, H., & Piechulla., B. (2020*). Plant Biochemistry*. 5th Ed. Massachusetts: Academic Press. pp 1- 656.
3. Nagaraj, G. (2015). *Agricultural Plant Biochemistry*. 1st Ed. New Delhi: New India Publishing Agency. pp 1 - 266.

Web-References

1. http://www.biologydiscussion.com
2. https://courses.lumenlearning.com/
3. https://www.nature.com/scitable/topicpage/
4. https://www.agriinfo.in/

Journals

1. Annual Review of Biochemistry
2. International Journal of Biochemistry and cell Biology
3. Biotechnology and Applied Biochemistry

Course Nature: Theory based Practical							
Total Marks (100)							
S.No.	Category	Assessment Tools					
		In- Semester Examination	Assignment	Record	Attendance	End-Semester Examination	Marks
1	Theory-External	-	-		-	*50*	*50*
2	Theory-Internal	*20*	-			-	*20*
3	Practical-External	-	-		-	*15*	*15*
4	Practical-Internal	-	*05*	*05*	*05*	-	*15*
						Grand Total	*100*

Course Code	CRH19203	Course Name	FUNDAMENTALS OF PLANT PATHOLOGY	Course Category	C	Compulsory Core	L	T	P	C
							2	0	1	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	CRH19501
Course Offering Department	Plant Pathology	Data Book / Codes/Standards		Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	*Understand the history, terms and concepts of plant pathology*			
CLR-2 :	*Discuss the features of fungi and its classification*			
CLR-3 :	*Knowledge on different symptoms caused by fungi*			
CLR-4 :	*Knowledge about different plant pathogenic organisms and symptoms caused by bacteria, virus, viroids, algae, nematodes and plant parasites*			
CLR-5 :	*Understand different epidemiological factors responsible for plant diseases*			
CLR-6 :	*Knowledge on various approaches of integrated disease management*			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:			
CLO-1 :	*Describe and interpret different crop related issues*	*4*	*90*	*75*
CLO-2 :	*Illustrate the survey and documention of disease incidence.*	*3*	*85*	*70*
CLO-3 :	*Identify the type of pathogenic organism based on symptoms and microscopic observation*	*2*	*95*	*70*
CLO-4 :	*Discuss environmental factors responsible for plant disease*	*4*	*80*	*65*
CLO-5 :	*Recognize plant stress phenomenon, and recommend the best cultural, chemical, and biological control methods towards management*	*4*	*75*	*60*
CLO6 :	*Demonstrate the qualities of a potential entrepreneur*	*5*	*75*	*65*

Program Learning Outcomes (PLO)														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Agriculture Knowledge	Problem Analysis	Design & Development	Analysis, Design,	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team	Communication	Project Mgt. & Finance	Life Long Learning	Ability to solve scientific problems	Ability to implement knowledge gained	Ability to understand social and ethical responsibilities
M								*L*	*H*		*H*	*H*	*H*	*H*
H		*M*						*H*	*H*		*H*	*H*	*H*	*H*
M	*M*							*M*	*H*		*H*	*H*	*H*	*H*
M								*L*	*H*		*H*	*H*	*H*	*H*
L	*L*							*L*	*H*		*H*	*H*	*H*	*H*
L						*H*		*L*	*H*		*H*	*H*	*H*	*H*

		Learning Unit / Module 1	Learning Unit / Module 2	Learning Unit / Module 3	Learning Unit / Module 4	Learning Unit / Module 5
Duration (hour)		8	11	18	13	15
S-1	SLO-1	*Plant Pathology - Introduction*	*Host pathogen interaction*	*Fungi – Introduction*	*Dothideomycetes - Classification*	*Classification of bacteria, phytoplasma, spiroplasma and FVB*
	SLO-2	*Plant Pathology - History*	*Mode of infection*	*Fungi – General characters*	*Dothideomycetes – Important genera*	*General characters*
S-2	SLO-1	*Terminologies*	*Survival of plant pathogens*	*Fungi – Different morphological structures*	*Eurotiomycetes - Classification*	*Viruses – General characters*
	SLO-2	*Concepts*	*Dispersal of plant pathogens*	*Resting structures and modifications*	*Eurotiomycetes – Important genera*	*Viruses – Symptoms*
S 3-4	SLO-1	*Lab 1: Laboratory tools and equipments*	*Lab3: Preservation of infected samples*	*Lab 6: Fungi – different morphological structures*	*Lab 10: Important characters - representative genera - Ascomycota.*	*Lab 13: Transmission of plant viruses*
	SLO-2					
S-5	SLO-1	*Classification of plant diseases*	*Plant physiology*	*Fungi – Mode of nutrition*	*Leotiomycetes - Classification*	*Viroids & Algae – General characters*
	SLO-2	*Factors affecting disease development*	*Plant physiology upon disease*	*Types of nutrition*	*Leotiomycetes – Important genera*	*Viroids & Algae – Symptoms*
S-6	SLO-1	*Plant pathogenic organisms - Introduction*	*Enzymes - Plant disease development*	*Fungi – Reproduction*	*Sordariomycetes & Mitosporicascomycetes – Classification*	*Abiotic factors*
	SLO-2	*Types of plant pathogenic organisms*	*Toxins - Plant disease development*	*Asexual and sexual reproduction*	*Sordariomycetes & Mitosporicascomycetes – Important genera*	*Symptoms*
S 7-8	SLO-1	*Lab2: Microscopes – Principles and types*	*Lab4: Types of culture media – Preparation*	*Lab 7: Symptoms of plant diseases*	*Lab 11: Important characters - representative genera - Basidiomycota.*	*Lab 14: Plant phanerogamic parasites*
	SLO-2					
S-9	SLO-1	-	*Plant defense mechanism*	*Symptoms – Plant pathogens*	*Agaricomycetes & Ustilaginomycetes – Classification*	*Nematodes – General characters*

	SLO-2	-	*Structural and chemical defense*	*Fungi, bacteria, phytoplasma, virus and viroids*	*Agaricomycetes & Ustilaginomycetes – Important genera*	*Nematodes – Symptoms*
S-10	SLO-1	-	-	*Plasmodiophoromycota – Classification*	*Pucciniomycetes - Classification*	*Nematodes – Classification*
	SLO-2	-	-	*Plasmodiophoromycota – Important genera*	*Pucciniomycetes – Important genera*	*Taxonomy*
S 11-12	SLO-1	-	*Lab 5: Isolation of plant pathogen, Koch postulates*	*Lab 8: Important characters - representative genera - Plasmodiophoromycota & Chromista*	*Lab 12: Staining & identification - plant pathogenic bacteria*	*Lab 15: Nematodes – Morphology & identification*
	SLO-2					
S-13	SLO-1	-	-	*Chromista - Classification*	*Exobasidiomycetes - Classification*	*Nematodes – Reproduction*
	SLO-2	-	-	*Chromista – Important genera*	*Exobasidiomycetes – Important genera*	*Types*
S-14	SLO-1	-	-	*Chytridiomycota - Classification*	-	-
	SLO-2	-	-	*Chytridiomycota – Important genera*	-	-
S 15-16	SLO-1	-	-	*Lab 9: Important characters - representative genera - Chytridiomycota & Zygomycota.*	-	*Lab 16: Nematodes – Extraction*
	SLO-2					
S-17	SLO-1	-	-	*Blastocladiomycota - Classification*	-	-
	SLO-2	-	-	*Blastocladiomycota – Important genera*	-	-
S-18	SLO-1	-	-	*Zygomycota - Classification*	-	-
	SLO-2	-	-	*Zygomycota – Important genera*	-	-

Learning Resources	*1. Agrios, G.N. (2005). Plant Pathology (5th Ed). New York: Academic Press. pp. 1-922.* *2. Alice, D., & Jeyalakshmi, C. (2014). Plant Pathology. Coimbatore: A.E Publications. pp. 1-375.*	**3.** *Richard N. Strange. (2003). Introduction of Plant Pathology. London: John Wiley & Sons Ltd. pp.1-480.*

	Level of Thinking	Continuous Learning Assessment (35% weightage)		University Practical Examination (15%)	End semester theory Examination (50%)
		In semester (20%)	Practical (15%)		
Level 1	Remember	40 %	45%	40%	45 %
	Understand				
Level 2	Apply	40 %	30%	30%	30 %
	Analyze				
Level 3	Evaluate	20 %	25%	20%	25 %
	Create				
	Total	100 %	100%	100%	100 %

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Dr. A. Bharani deppan, Ph.D. E.I. DuPont India Pvt Ltd. The V-Ascendas, Atria Block, 12th Floor, Plot.17 SoftwareUnits Layout, Madhapur, Hyderabad, Telangana Ph: 936666899 Mail: bharani-deepan.a@corteva.com	*Dr. A. Kamalakannan, Professor Department of Plant Pathology Tamil Nadu Agricultural University Coimbatore- 641003 Ph: 9790620313 E-Mail: kamals2k@yahoo.co.in*	*Dr. Rageshwari S* *Assistant Professor (Plant Pathology)* *Dr. VinodKumar S* *Assistant Professor (Plant Pathology)*

THEORY

Unit I - Plant Pathogenic Organisms
Plant Pathology: Definition, History, Economic importance of plant diseases. Terms and concepts of Plant Pathology. Classification of plant disease, Factors affecting disease development. Plant Pathogenic organisms: Protozoa, Phytomonas, Chromista, Fungi, Bacteria, *Candidatus phytoplasma,* Spiroplasma, Fastidious vascular bacteria, Viruses, Viroids, Algae, and Phanerogamic parasites.

Unit II – Pathogenesis
Pathogenesis, Host pathogen interaction. Mode of infection, pre-penetration, penetration and post penetration, Role of enzymes and toxins on disease development, Plant defense mechanisms. Effect of pathogen on physiological functions of the plants.

Unit III - General Characters and Taxonomy of Protozoa, Chromista and Fungi
General characters: definition of fungus, somatic structures, types of fungal thalli, fungal tissues, Resting spores, modifications of thallus, reproduction (asexual and sexual) and symptoms caused by plant pathogenic fungi. Nomenclature: Binomial system of nomenclature, rules of nomenclature, classification of fungi. Key to divisions, sub-divisions, orders and classes. Kingdom: Protozoa, Phylum: *Plasmodiophoromycota*, *Plasmodiophora brassicae*., Kingdom: Chromista, Phylum: Oomycota; *Pythium, Phytophthora, Sclerospora*, and *Peronosclerospora.* Kingdom: Fungi; Phylum: *Chytridiomycota- Olpidium;* Phylum: *Zygomycota; Mucor*, *Rhizopus*

Unit IV - General Characters and Taxonomy of Fungi - Ascomycota And Basidiomycota
Phylum: Ascomycota and Basidiomycota *Capnodium, Mycosphaerella, Helminthosporium, Macrophomina, Cochliobolus, Lewia, Sclerotium, Eurotium, Talaromyces, Erysiphe, Leveillula, Claviceps, Glomerella, Magnaporthe Gibberella, Verticillium, Puccinia, Uromyces, Ustilago, Tilletia, and Ustilaginoidea,*

Unit V - Bacteria, Phytoplasma, Virus, Viroid, Algae, Nematodes, Phanerogams, And Abiotic Disorders
General characters and symptoms- phytopathogenic bacteria, *Candidatus Phytoplasma*, Spiroplasma, Fastidious vascular bacteria, viruses, viroids, algae, Phanerogams – Abiotic disorders. Nematodes*:* General morphology and reproduction, classification, symptoms and nature of damage caused by plant nematodes (*Heterodera, Meloidogyne*, *Anguina, Radopholus,* etc.).

Theory – Lecture Schedule
1. Plant Pathology - Introduction, definition, and history
2. Terms and concepts of plant pathology.
3. Classification of plant diseases and factors affecting disease development.
4. Plant Pathogenic organisms: Protozoa, Chromista, Fungi, Bacteria, and Phytoplasma, Spiroplasma, Fastidious vascular bacteria, Viruses, Viroids, Algae, and Phanerogamic parasites.
5. Host pathogen interaction, Mode of infection, pre-penetration, penetration and post penetration
6. Survival and dispersal of plant pathogens
7. Effect of Pathogen on physiological functions of the plants
8. Role of enzymes and toxins in disease development
9. Plant Defense mechanisms
10. General characters of fungi
11. Different morphological structures of fungi
12. Mode of nutrition in fungi
13. Reproduction in fungi
14. Symptoms caused by fungal pathogens
15. Classification of *Plasmodiophoromycota*
16. Classification of *Chromista*
17. **In-semester examination**
18. Classification of *Chytridiomycota*
19. Classification of *Blastocladiomycota*
20. Classification of *Zygomycota*
21. Classification of *Ascomycota (Dothideomycetes*)
22. Classification of *Ascomycota (Eurotiomycetes*)

23. Classification of *Ascomycota (Leotiomycetes)*
24. Classification of *Ascomycota (Sordariomycetes* and *Mitosporicascomycetes)*
25. Classification and general characters of *Basidiomycota- Agaricomycetes* and *Ustilaginomycetes*
26. Classification and general characters of *Basidiomycota- Pucciniomycetes*
27. Classification and general characters of *Exobasidiomycetes*.
28. Classification of bacteria, General characters of bacteria, phytoplasma, spiroplasma, fastidious vascular bacteria and their symptoms.
29. General characters and symptoms of viruses.
30. General characters and symptoms of viroids and algae.
31. Abiotic factors and their symptoms.
32. General characters and symptoms caused by plant pathogenic nematodes.
33. Classification of plant pathogenic nematodes.
34. Reproduction of Plant Pathogenic nematodes.

Practical Schedule

1. Working principle and uses of various laboratory tools and equipment's.
2. Working principle of Microscope and their types.
3. Wet and dry preservation of infected samples.
4. Different types of media, uses and preparation of media for isolation of fungi, bacteria and actinomycetes.
5. Isolation of plant pathogen and proving Koch's postulates.
6. Fungi- definition. Study of different morphological structures and fruiting bodies of fungi.
7. Study of symptoms of various plant diseases caused by fungi, bacteria, virus, viroids, algae, phytoplasma, etc.
8. Important characters of representative fungal genera of *Plasmodiophoromycota* and *Chromista.*
9. Important characters of representative fungal genera of *Chytridiomycota* and *Zygomycota.*
10. Important characters of representative fungal genera of *Ascomycota.*
11. Important characters of representative fungal genera of *Basidiomycota.*
12. Staining and identification of plant pathogenic bacteria.
13. Transmission of plant viruses.
14. Plant phanerogamic parasites.
15. Study of morphological difference of plant parasitic nematodes and their identification.
16. Extraction of nematode from soil and mounting of nematodes.
17. **University practical examination**

Note: Students should submit fifty well preserved disease specimens

Text Books

1. Agrios, G.N. (2005). *Plant Pathology* (5th Ed). New York: Academic Press. pp. 1-922.
2. Alice, D., & Jeyalakshmi, C. (2014). *Plant Pathology*. Coimbatore: A.E Publications. pp. 1-375.
3. Dube, H.C. (2013). *An introduction to Fungi.* India: Scientific publisher. pp. 1-603.
4. Singh, R.P. (2012). *Plant pathology*. India: Kalyani publishers. pp. 1-724.

Reference Books

1. John Webster & Ronald Weber. (2007). *Introduction to fungi*. UK: Cambridge University Press. pp. 1-841.
2. Kirk, P.M. et al. (2008). *Ainsworth and Bisby's Dictionary of the Fungi* (10th ed.). Oxon, U.K: C.A.B International. pp.1-771.
3. Paul et al. (2009). *Bergey's Manual of Systematic Bacteriology*. New York: Springer-Verlag.
4. Richard N. Strange. (2003). *Introduction of Plant Pathology*. London: John Wiley & Sons Ltd. pp.1-480.

Web-References

1. http://www.biologydiscussion.com
2. https://www.microscopemaster.com/fungi
3. https://talk.ictvonline.org/taxonomy/
4. www.apsnet.org/edcenter
5. www.Tolweb.org
6. http://www.hillagric.ac.in/edu/coa/ppath/lectures.htm
7. http://ecoursesonline.iasri.res.in/course/view.php?id=143
8. www.ucmp.berkeley.edu/fungi
9. www.ictv.org
10. www.vivo.library.cornell.edu.
11. https://www.youtube.com/c/MTutorEdu/search?query=plant+pathology.
12. https://www.youtube.com/channel/UCsqovy3LIp-dB8pMxU2VZ7A

Journals

1. Phytopathology
2. Plant Pathology
3. Australasian Plant Pathology
4. Indian Phytopathology
5. Studies in Mycology
6. Journal of Plant Pathology

Course Nature: Theory based Practical							
Total Marks (100)							
S.No.	Category	Assessment Tools					
		In- Semester Examination	Assignment	Record	Attendance	End-Semester Examination	larks
1	Theory-External	-	-		-	*50*	*50*
2	Theory-Internal	*20*	-			-	*20*
3	Practical-External	-	-		-	*15*	*15*
4	Practical-Internal	-	*05*	*05*	*05*	-	*15*
						Grand Total	*100*

Course Code	GPB19201	Course Name	PRINCIPLES OF GENETICS AND CYTOGENETICS	Course Category	C	Compulsory Core	L	T	P	C
							2	0	1	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	Genetics and Plant Breeding	Data Book / Codes/Standards	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1 :	*Paraphrase the history and evolution of genetics and cytogenetics*
CLR-2 :	*Describe the genetic traits and its transmission to progenies*
CLR-3 :	*Explain the Chromosome behaviour and effects of their irregularities*
CLR-4 :	*Recongnise the importance of genetics in crop improvement*
CLR-5 :	*Outline the current trends in functional and molecular genetics*

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning		
		1	*2*	*3*
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	*Describe Cell Structure and indentify the functions of the Chromosome*	*1*	*90*	*85*
CLO-2 :	*Outline the importance of genetics in crop improvement*	*2*	*95*	*85*
CLO-3 :	*Recall Mendel's principles of heredity*	*2*	*80*	*70*
CLO-4 :	*Interpret the modern concepts of genetics.*	*3*	*85*	*75*
CLO-5 :	*Outline the concepts of cytoplasmic inheritance in plants*			

Program Learning Outcomes (PLO)														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Agriculture Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	Ability to solve scientific problems through Genetics	Ability to implement knowledge gained in the applied field of Genetics	Ability to understand social and ethical responsibilities of Genetics
H			*H*			*H*		*M*	*H*		*H*	*H*	*H*	*H*
H			*H*					*L*	*H*		*H*	*H*	*H*	*H*
M		*M*	*M*			*H*		*L*	*H*		*H*	*H*	*H*	*H*
M			*H*					*M*	*H*		*H*	*H*	*H*	*H*

		Learning Unit / Module 1	Learning Unit / Module 2	Learning Unit / Module 3	Learning Unit / Module 4	Learning Unit / Module 5
Duration (hour)		9	7	6	6	5
S-1	SLO-1	*Definition: Genetics cytogenetics*	*Pre-Mendelian ideas about heredity*	*Quantitative inheritance*	*Sex linked inheritance*	*DNA, the genetic material*
	SLO-2	*History of developments in genetics*	*Theories*	*Multiple factor hypothesis*	*Sex limited inheritance*	*RNA as genetic material*
S-2	SLO-1	*Physical basis of heredity*	*Mendel's experiments and laws of inheritance.*	*Polygenes*	*Chromosomal theory of sex determination*	*Structure of DNA*
	SLO-2	*Cell and cell organelles*	*Rediscovery of Mendel's work*	*Transgressive segregation*	*Sex determination in plants*	*Central dogma of life*
S-3,4	SLO-1	*Lab.1 Principles of killing and fixing, preparation of stains and preservatives*	*Lab. 5. Studying pollen fertility and viability*	*Lab. 8. Genetic ratio studies*	*Lab.11. recessive epistasis and duplicate recessive epistasis*	*Lab.14. Estimation of linkage*
	SLO-2					
S-5	SLO-1	*Cell division – Mitosis*	*Terminologies*	*Linkage*	*Genic balance theory of Bridges*	*Proof for semi conservative method of DNA replication*
	SLO-2	*Meiosis*	-	*Chromosomal theory of linkage of Morgan*	*Hormonal theory*	*Steps involved in DNA replication*
S-6	SLO-1	*Chromosome structure*	*Chromosomal theory of inheritance*	*Crossing over*	*Cytoplasmic inheritance*	*RNA types*
	SLO-2	*Chromosome banding*	*Allelic interactions*	*Stern's experiment*	*Plasmid inheritance*	*Protein synthesis*
S-7,8	SLO-1	*Lab.2 Studying the stages of mitosis and meiosis*	*Lab. 6. Permanent slides preparation*	*Lab. 9. Study of dihybrid ratio*	*Lab.12. Study of duplicate and additive epistasis*	*Lab 15: Problems on two point test cross, three point test cross*
	SLO-2					
S-9	SLO-1	*Types of chromosomes*	*Deviation from Mendelian inheritance*	*Strength of linkage*	*Mutation*	*Regulation of gene expression*
	SLO-2	*Special chromosomes*	*Bateson and Punnett's experiment*	*Recombination*	*Tilling and ecotilling*	*Transposable genetic elements - Ac - Ds system in maize*
S-10	SLO-1	*Chromosomal aberration*	*Recessive epistasis*	*Double cross over*		*Functional genomics*
	SLO-2	*Variation in chromosome structure*	*Duplicate dominant epistasis*	*Genetic map*		*Phenomics*

S-11,12	SLO-1	*Lab.3. Studying smear techniques and observing the mitotic phases in root tips of onion*	*Lab. 7. Principles of dominance, recessive, back cross, test cross, incomplete, co-dominance*	*Lab. 10 Study of simple interaction of genes*	*Lab 13: Multiple alleles*	*Lab 16: Studies on sex linked inheritance in Humans and Drosophila*
	SLO-2					
S - 13	SLO-1	*Euploid*	*Duplicate recessive epistasis*	-	-	-
	SLO-2	*Aneuploid*	*Dominant and recessive epistasis*	-	-	-
S - 14	SLO-1	*Polyploid*	*Lethal genes*	-	-	-
	SLO-2	*Evolution*	*Multiple alleles*	-	-	-
S–15,16	SLO-1	*Lab.4. Fixing and observing different meiotic phases in the inflorescence of corn*	-	-	-	-
	SLO-2		-	-	-	-

Learning Resources	1. *Gupta P.K. (2007). Cytogenetics. Meerut: Rastogi Publications. pp. 1- 432.* *2. Singh, B.D. (2004). Fundamentals of genetics. Chennai: Kalyani Publishers, pp. 1- 976.*	*3. Stansfield, W.D. (1990). Theory and problems of genetics. New York: Mc-Graw Hill Book Co. pp. 1- 458.*

	Level of Thinking	Continuous Learning Assessment (35% weightage)		University Practical Examination (15%)	End semester theory Examination (50%)
		In semester (20%)	Practical (15%)		
Level 1	Remember	40 %	30 %	35%	30 %
	Understand				
Level 2	Apply	40 %	40 %	35%	40 %
	Analyze				
Level 3	Evaluate	20 %	30 %	30%	30 %
	Create				
	Total	100 %	100 %	100%	100 %

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Dr. S M .Prabhu, Ph. D. *Senior Breeder (Paddy Breeding and Transgenic)* *R&D centre,* *Rasi Seeds (P) Ltd., Attur, Salem – 636141.*	*Dr. T. Sabesan* *Associate rofessor* *Department of Genetics and Plant Breeding* *Faculty of Agriculture, Annamalai University,* *Annamalai nagar , Chidambaram - 608 002* *sabavani@gmail.com*	*Dr. G. Selvakumar , Assistant Professor (GPB)* *Dr. R. Mahendran, Assistant Professor (GPB)* *Dr. J. Vanitha, Tutor (GPB)*

THEORY

Unit I –History, Chromosomes, Types and Chromosomal Aberration

Definition of genetics, heredity, inheritance, cytology, cytogenetics; Brief history of developments in genetics and cytogenetics. Physical basis of heredity: Structure and function of cell and cell organelles. Cell reproduction: mitosis, meiosis and its significance, cell cycle. Gametogenesis in plants: Microsporogenesis, microgametogenesis, megasporogenesis, microgametogenesis. Syngamy in plants: fusion of male and female gametes, embryo development, identical and fraternal twins. Chromosome structure, chemical composition, nucleosome, centromere, telomere, euchromatin, heterochromatin, NOR, satellite chromosome. Karyotype, ideogram and chromosome banding. Types of chromosomes based on position of centromere. Types of chromosomes based on structure and function: normal and special chromosomes - polytene, lampbrush, based on the role in sex determination: autosomes and allosomes. Other types of chromosomes - B, ring and isochromosomes. Chromosomal aberration: Variation in chromosome structure – deletion, duplication, inversion and translocation. Chromosomal aberration: Variation in chromosome number – euploid, aneuploid, types of aneuploids and their origin; Nondisjunction -Klinefelter syndrome and Turner syndrome; Definition of eugenics and euthenics. Polyploid - auto and allopolyploids, their characters; meaning of genome; evolution of wheat, triticale, cotton, tobacco, brassica.

Unit II - Mendelian Genetics and Deviation from Mendelian Inheritance

Pre-Mendelian ideas about heredity – Vapour and fluid theory, Magnetic power theory, Preformation theory, Lamarck's theory, Darwin's theory, Germplasm theory and Mutation theory. Mendelian genetics–Mendel's principles of heredity, deviation from Mendelian inheritance, Non allelic interaction without modification in Mendelian ratio – Bateson and Punnett's experiment on fowl comb shape. Non allelic interaction with modification in Mendelian ratio – i.) Dominant epistasis (12:3:1), ii.) Recessive epistasis (9:3:4), iii.) Duplicate and additive epistasis (9:6:1), iv.) Duplicate dominant epistasis (15:1), v) Duplicate recessive epistasis (9:7), vi.) Dominant and recessive epistasis (13:3). Pleiotropy, threshold characters, co-dominance, penetrance and expressivity. Chromosome theory of inheritance, gene interaction. Multiple alleles.

Unit III – Quantitative Inheritance, Linkages and Crossing Over

Quantitative inheritance – Multiple factor hypothesis – Nilsson Ehle experiment on wheat kernel colour. Polygenes – transgressive segregation, comparison of quantitatively and qualitatively inherited characters; modifiers; Types of gene action controlling quantitative traits. Linkage - coupling and repulsion; Experiment on Bateson and Punnet – Chromosomal theory of linkage of Morgan – Complete and incomplete linkage, Linkage group. Crossing over – significance of crossing over; cytological proof for crossing over - Stern's experiment; Factors controlling crossing over. Strength of linkage and recombination; Two point and three point test cross. Double cross over, interference and coincidence; genetic map, physical map.

Unit IV - Sex Determination, **Cytoplasmic Inheritance and Mutation**

Sex determination: Autosomes and sex chromosomes - chromosomal theory of sex determination- different types – sex determination in human, fowl, butterfly, grasshopper, honey bee, fumea; Sex determination in plants – *Melandrium*, papaya, maize. Genic balance theory of Bridges, quantitative theory, hormonal theory, barr bodies, metabolic differentiation theory; Gynandromorphs – sex reversal in chicken. Sex linked inheritance – criss cross inheritance – reciprocal difference; holandric genes; sex influenced and sex limited inheritance. Cytoplasmic inheritance and maternal effects: features of cytoplasmic inheritance, chloroplast, mitochondrial - plastid colour in Mirabilis jalapa - iojap gene of maize, cytoplasmic male sterility in rice, kappa particles of paramecium - plasmid and episomic inheritance. Mutation – characteristics of mutation – micro and macro mutation – CIB technique - molecular basis of mutation- Transition and transversion; major physical and chemical mutagens.

Unit V - Modern Concepts of Genetics

Structure of DNA – Watson and Crick model – Central dogma of life. Proof for semi conservative method of DNA replication; Models of DNA replication; steps involved in DNA replication. RNA types - mRNA, tRNA, rRNA; genetic codes. Protein synthesis – transcription, Translation. DNA, the genetic material – Griffith's experiment, experiment of Avery, McCleod and McCarthy – confirmation by Hershey and Chase; RNA as genetic material – Frankel, Conrat and Singer experiment. Regulation of gene expression – operon model of Jacob and Monad; Structural genes and regulator genes. Cistron, muton and recon. Complementation test; exons, introns – split genes – Transposable genetic elements - Ac - Ds system in maize. Prelude on Functional genomics, Metagenomics, Transcriptomics, Proteomics, Metabolomics Phenomics, forward genetics, reverse genetics - TILLING and EcoTILLING, GMO and Genome editing – CRISPR Cas9.

Theory Lecture Schedule

1. Definition of genetics, heredity, inheritance, cytology, cytogenetics; Brief history of developments in genetics and cytogenetics
2. Physical basis of heredity: Structure and function of cell and cell organelles – Differences between Prokaryotes and Eukaryotes
3. Cell division – mitosis, meiosis and their significance, cell cycle; zygote formation and embryo development - identical and fraternal twins
4. Chromosome structure, chemical composition, nucleosome, centromere, telomere, euchromatin, heterochromatin, NOR, satellite chromosome, karyotype, ideogram – chromosome banding
5. Types of chromosomes based on position of centromere, based on structure and function: normal and special chromosomes - polytene, lampbrush, based on the role in sex determination: autosomes and allosomes, Other types of chromosomes - B, ring and isochromosomes
6. Chromosomal aberration: Variation in chromosome structure – deletion, duplication, inversion and translocation – genetic and cytological implications
7. Chromosomal aberration: Variation in chromosome number – euploid, aneuploid, types of aneuploids and their origin; Nondisjunction - Klinefelter syndrome and Turner syndrome; Definition of eugenics and euthenics
8. Polyploid - auto and allopolyploids, their characters; meaning of genome; evolution of wheat, Triticale, cotton, tobacco, *Brassica*

9. Pre-Mendelian ideas about heredity – Vapour and fluid theory, Magnetic power theory, Preformation theory, Lamarck's theory, Darwin's theory, Germplasm theory and Mutation theory
10. Mendel's experiments and laws of inheritance. Rediscovery of Mendel's work
11. Terminologies: gene, allele, locus, homozygous, heterozygous, hemizygous, genotype, phenotype, monohybrid, dihybrid, trihybrid, polyhybrid
12. Chromosomal theory of inheritance. Allelic interactions – Dominance vs recessive, complete dominance, codominance, incomplete dominance, over dominance
13. Deviation from Mendelian inheritance – Non allelic interaction without modification in Mendelian ratio – Bateson and Punnett's experiment on fowl comb shape. Non allelic interaction with modification in Mendelian ratio – i.) Dominant epistasis (12:3:1)
14. ii.) Recessive epistasis (9:3:4) iii.) Duplicate and additive epistasis (9:6:1). iv.) Duplicate dominant epistasis (15:1)
15. v) Duplicate recessive epistasis (9:7) vi.) Dominant and recessive epistasis (13:3); Summary of epistatic ratios (i) to (vi)
16. Lethal genes, Pleiotrophy, penetrance and expressivity, phenocopy: Multiple alleles, blood group in humans, coat colour in rabbits, self incompatibility in plants; pseudo alleles, isoalleles
17. **In Semester Examination**
18. Quantitative inheritance – Multiple factor hypothesis – Nilsson Ehle experiment on wheat kernel colour
19. Polygenes – transgressive segregation, comparison of quantitatively and qualitatively inherited characters; modifiers; Types of gene action controlling quantitative traits
20. Linkage - coupling and repulsion; Experiment on Bateson and Punnet – Chromosomal theory of linkage of Morgan – Complete and incomplete linkage, Linkage group
21. Crossing over – significance of crossing over; cytological proof for crossing over - Stern's experiment; Factors controlling crossing over
22. Strength of linkage and recombination; Two point and three point test cross
23. Double cross over, interference and coincidence; genetic map, physical map
24. Sex determination: Autosomes and sex chromosomes - chromosomal theory of sex determination- different types – sex determination in human, fowl, butterfly, grasshopper, honey bee, fumea; Sex determination in plants – *Melandrium*, papaya, maize
25. Genic balance theory of Bridges, quantitative theory, hormonal theory, barr bodies, metabolic differentiation theory; Gynandromorphs – sex reversal in chicken
26. Sex linked inheritance – criss cross inheritance – reciprocal difference; holandric genes; sex influenced and sex limited inheritance
27. Cytoplasmic inheritance and maternal effects – features of cytoplasmic inheritance, chloroplast, mitochondrial - plastid colour in *Mirabilis jalapa* - iojap gene of maize, cytoplasmic male sterility in rice, kappa particles of paramecium - plasmid and episomic inheritance
28. Mutation – characteristics of mutation – micro and macro mutation – ClB technique - molecular basis of mutation- Transition and transversion; major physical and chemical mutagens
29. DNA, the genetic material – Griffith's experiment, experiment of Avery, McCleod and McCarthy – confirmation by Hershey and Chase; RNA as genetic material – Frankel, Conrat and Singer experiment
30. Structure of DNA – Watson and Crick model – Central dogma of life
31. Proof for semi conservative method of DNA replication; Models of DNA replication; steps involved in DNA replication
32. RNA types - mRNA, tRNA, rRNA; genetic code, protein synthesis - transcription. Translation
33. Regulation of gene expression – operon model of Jacob and Monad; Structural genes and regulator genes. Cistron, muton and recon;Complementation test; exons, introns – split genes – Transposable genetic elements - Ac - Ds system in maize
34. Prelude on Functional genomics, Metagenomics, Transcriptomics, Proteomics, Metabolomics Phenomics, forward genetics, reverse genetics - TILLING and EcoTILLING, GMO and Genome editing – CRISPR Cas9

Practical Schedule

1. Principles of killing and fixing, preparation of stains and preservatives.
2. Studying the stages of mitosis and meiosis.
3. Studying smear techniques and observing the mitotic phases in root tips of onion.
4. Fixing and observing different meiotic phases in the inflorescence of corn.
5. Studying pollen fertility and viability.
6. Permanent slides preparation.
7. Principles of dominance, recessive, back cross, test cross, incomplete, co-dominance and lethal factors explaining with one model – principles of chi-square test.
8. Genetic ratio studies – monohybrid – incomplete dominance and test cross ratio and in combination of one or two above.
9. Study of dihybrid ratio – dominance, incomplete dominance and test cross ratio and in combination
10. Study of simple interaction of genes – comb character in fowls, dominant epitasis,
11. Study of recessive epistasis and duplicate recessive epistasis.
12. Study of duplicate and additive epistasis, duplicate dominant epistasis, duplicate recessive epistasis and dominant and recessive epistasis.
13. Multiple alleles and polygenic inheritance
14. Estimation of linkage with F2 and test cross data, coupling and repulsion phases

15. Problems on two point test cross, three point test cross
16. Studies on sex linked inheritance in Humans and Drosophila
17. **University Practical Examination**

Text Book

1. Gupta P.K. (2007). *Cytogenetics.* Meerut: Rastogi Publications. pp. 1- 432.
2. Singh, B.D. (2004). *Fundamentals of genetics.* Chennai: Kalyani Publishers, pp. 1- 976.
3. Stansfield, W.D. (1990). *Theory and problems of genetics*. New York: Mc-Graw Hill Book Co. pp. 1- 458.
4. Strickberger. M.W. (1996). *Genetics.* New Delhi: Prentice-Hall of India Pvt. Ltd. pp. 1- 245.
5. Verma, P.S. & Agarwal, V.K. (2010). *Genetics.* New Delhi: S.Chand and Company Ltd. pp. 1- 1294.

Reference Books

1. Anthony J.F. Griffiths, William M. Gelbart, Richard C. Lewontin & Jeffrey H. Miller. (2002). *Modern Genetic Analysis* (Second Edition). United States: W. H. Freeman. pp. 1- 736.
2. Benjamin Lewin. (2007). *Genes IX*. Oxford: Oxford University Press. pp. 1- 909.
3. Daniel Sundararaj, Thulasidas, G. & Stephen Dorairaj, M. (1997). *Introduction to Cytogenetics and Plant Breeding.* Chennai: Popular Book Depot. pp. 1- 362.
4. Gardner E. J., Simmons M. J., & Peter Snustad, D. (2015). *Principles of Genetics.* USA: John wiley and sons. pp. 1- 746.
5. Gupta, P.K. (1993). *Genetics.* Meerut: Rastogi publications. pp. 1- 631.
6. Russel, P.J. (2000). *Fundamentals of genetics.* USA: Addition Wesley Longman Publishers. pp. 1- 527.
7. Singh, R.J. (2002). *Plant cytogenetics.* USA: CRC Press. pp. 1- 488.

WEB-REFERENCES

1. https://www.cliffsnotes.com/study-guides/biology/biology/classical-mendelian-genetics/principles-of-genetics
2. https://www.jax.org/education-and-learning/clinical-and-continuing-education/ccep-non-cancer-resources/core-principles-in-genetics-2004
3. https://www2.palomar.edu/anthro/mendel/mendel_1.htm
4. https://www.youtube.com/watch?v=2ycwGQUjmJY&list=PLKlDmF-ilyAkT0rhgMzSvGmqQz5licCMs

Journals

1. Genetic Principles and Genetic Variations
2. Principles of genetics
3. Journal of Genetics
4. Genetics Research

Course Nature: Theory based Practical							
Total Marks (100)							
S.No.	Category	**Assessment Tools**					
		In- Semester Examination	Assignment	Record	Attendance	End-Semester Examination	Marks
1	Theory-External	-	-		-	*50*	*50*
2	Theory-Internal	*20*	-			-	*20*
3	Practical-External	-	-		-	*15*	*15*
4	Practical-Internal	-	*05*	*05*	*05*	-	*15*
Grand Total							*100*

Course Code	AGS19201	Course Name	RURAL SOCIOLOGY AND EDUCATIONAL PSYCHOLOGY	Course Category	S	Supportive Course	L	T	P	C
							2	0	0	2

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Agricultural Extension	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1 :	Describe the nature of sociology and its emergence
CLR-2 :	Explain the importance of social stratification and nature of migration
CLR-3 :	Summarize the influence of social control and types of social control in rural and urban areas
CLR-4 :	Explain the basics of psychology, social psychology and education psychology
CLR-5 :	Demonstrate concepts of motivation and factors influencing attitude

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	Interpret the nature of rural society and role of social groups in extension	1	80	75
CLO-2 :	Contrast between class and caste system	2	75	70
CLO-3 :	Outline the basic social processes and different customs prevailing in society.	3	80	70
CLO-4 :	Identify the different aspects of educational psychology.	3	80	75
CLO-5 :	Discuss the needs of hierarchy and the development of attitude	2	80	70

	Program Learning Outcomes (PLO)														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	Agriculture Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	Ability to solve scientific problems through Agricultural Extension	Ability to implement knowledge gained in the applied field of Agricultural Extension	Ability to understand social and ethical responsibilities of Agricultural Extension
CLO-1 :	M					H			M	H		H	M	H	H
CLO-2 :	H					H			L	H		H	M	H	H
CLO-3 :	M					H			L	H		H	M	H	H
CLO-4 :	M					H			M	H		H	M	H	H
CLO-5 :	L					H			M	H		H	M	H	H

		Learning Unit / Module 1	Learning Unit / Module 2	Learning Unit / Module 3	Learning Unit / Module 4	Learning Unit / Module 5
Duration (hour)		6	5	5	14	3
S-1	SLO-1	Sociology and Rural Sociology – Definitions.	Structure of Rural Society	Social Control – definition	Education, Psychology and Educational Psychology- Definitions.	Motivation – concept, Maslow's hierarchy of needs (including selfless-service),
	SLO-2	Nature of rural sociology	patterns of rural settlement	Formal and Informal agents of social control	Importance of Educational Psychology in extension.	Intrinsic and extrinsic motivation.
S-2	SLO-1	Importance of rural sociology in Extension education.	Social institutions and Social organizations	Customs – conventions, folkways.	Social psychology – Definitions.	Techniques of motivation
	SLO-2	Relationship between rural sociology and Extension education	Ecological entities - Region, Community, Neighbourhood, and Family.	Mores, rituals and taboos	Importance of social psychology in extension.	Importance of motivation in extension.
S-3	SLO-1	Society – rural and urban, characteristics, differences and relationship.	Social Stratification – concept, functions, types.	Social Interaction Process – definition.	Basic principles of Human behaviour	Attitude- Concept
	SLO-2	Important characteristics of Indian rural society.	Differences between class and caste system	Basic social processes.	Importance of basic principles human behavior	Factors influencing the development of attitude.
S-4	SLO-1	Social Groups – definitions, classification.	Social Values – definition, values and norms.	Social Change – concept, theories.	Cognitive and affective domain	-
	SLO-2	Role of social groups in extension	Characteristics of values and functions.	Factors and indicators of social change.	Psychomotor domain	-
S-5	SLO-1	Culture – concept, cultural traits,	Migration – concept.	Social development	Perception – meaning.	-
	SLO-2	Characteristics and functions.	Factors influencing migration	Features of social development	Characteristics of perception	-

S-6	SLO-1	Ethnocentrism, Acculturation and Cultural lag.	-	-	Sensation	-
	SLO-2	Cultural diffusion, Marginal man and Ethos.	-	-	Attention	-
S-7	SLO-1	-	-	-	Intelligence – concept.	-
	SLO-2	-	-	-	Types of intelligence	-
S-8	SLO-1	-	-	-	Intelligence - measurement	-
	SLO-2	-	-	-	Factors of affecting intelligence.	-
S-9	SLO-1	-	-	-	Personality – concept	-
	SLO-2	-	-	-	Types of personality	-
S-10	SLO-1	-	-	-	Personality -measurement	-
	SLO-2	-	-	-	Factors influencing personality	-
S-11	SLO-1	-	-	-	Teaching–Learning Process –	-
	SLO-2	-	-	-	Teaching – definition, meaning.	-
S-12	SLO-1	-	-	-	Principles of teaching,.	-
	SLO-2	-	-	-	Steps in extension teaching.	-
S-13	SLO-1	-	-	-	Learning – definition,.	-
	SLO-2	-	-	-	Meaning and principles of learning.	-
S-14	SLO-1	-	-	-	Types of learning.	-
	SLO-2	-	-	-	Learning situation.	-

Learning Resources	1. Chauhan, S.S. (2001). Advanced Educational Psychology. New Delhi:Vikas Publishing House Pvt. Ltd.pp.1-215 2. Chitambar, J.B.(1997). Introductory Rural Sociology. New Delhi: New Age International (P) Ltd., Publishers.pp.1-356 3. Mangal, S.K. (2000). Educational Psychology. Ludhiana: Prakash Brothers .pp 1-438.	4. Ray, G.L. (1999). Extension Communication and Management.Calcutta:Naya Prokash.pp.1-50 5. Usha Rao. (2008). Advanced Educational Psychology. New Delhi: Himalaya Publishing House .pp.1-299.

	Level of Thinking	Continuous Learning Assessment (50% weightage)		End semester theory Examination (50%)
		In semester (40%)	Theory Internal (10%)	
Level 1	Remember Understand	40 %	40 %	40 %
Level 2	Apply Analyze	40 %	40 %	40 %
Level 3	Evaluate Create	20 %	20 %	20 %
	Total	100 %	100 %	100 %

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Arun Kumar K Assistant Manager Business Initiatives Department National Bank for Agriculture and Rural Development Bandra, Mumbai-400051	Dr. C. Karthikeyan, Professor & Head (Social Sciences), Department of Social Sciences, Agricultural College and Research Institute, Tamil Nadu Agricultural University, Killikulam, Vallandu Thoothukudi dt-628 252	Dr. Mohanraj K

THEORY

Unit I - Introduction to Sociology, Social Groups, Culture and Social Values
Sociology and rural sociology: definitions; Society: rural and urban, characteristics, differences and relationships, important characteristics of Indian rural society; Social groups: definition, classification, civil society organizations, role of social groups in extension; Culture: concept, cultural traits, characteristics, functions, ethnocentrism, acculturation, cultural lag, cultural diffusion, marginal man, ethos;

UNIT II - Social Structure, Social Stratification and Migration
Structure of rural society: patterns of rural settlement, social institutions, social organizations, ecological entities (region, community, neighbourhood, family); Social stratification: concept, functions, types, differences between class and caste system; social values: definition, values and norms, characteristics of values, functions; Migration: concept, factors influencing migration.

UNIT III - Social control and Social customs
Social control: definition; customs: conventions, folkways, mores, rituals, taboos; Social Interaction Process: definition, basic social processes; Social change: concept, factors influencing social change, indicators of social change; social development.

UNIT IV - Introduction to Educational Psychology, Intelligence, Teaching, Learning process
Educational psychology: education, psychology; Social psychology: definitions, importance in extension; basic principles of human behaviour - sensation, attention, cognitive, affective, psychomotor domain perception: meaning, characteristics; Intelligence: concept, types, measurement, factors affecting intelligence; Personality: concept, types, measurement, factors influencing personality; Teaching: learning process, definition, meaning, principles of teaching, steps in extension teaching; Learning: definition, meaning, principles, types of learning and learning situation.

UNIT V – Motivation and Attitude
Motivation: concept, Maslow's hierarchy of needs, intrinsic and extrinsic motivation, techniques of motivation, importance in extension; Attitude: concept, factors influencing the development of attitudes.

Theory – Lecture Schedule
1. Sociology and Rural Sociology – Definitions, nature of rural sociology
2. Importance of rural sociology in extension education.
3. Society – rural and urban, characteristics, differences and relationship, important characteristics of Indian rural society.
4. Social Groups – definitions, classification, role of social groups in extension.
5. Culture – concept, cultural traits, characteristics, functions.
6. Ethnocentrism, Acculturation, Cultural lag, Cultural diffusion, Marginal man, Ethos.
7. Structure of Rural Society – patterns of rural settlement
8. Social institutions, Social organizations and ecological entities - Region, Community, Neighbourhood, and Family.
9. Social Stratification – concept, functions, types, differences between class and caste system
10. Social Values – definition, values and norms, characteristics of values, functions.
11. Migration – concept, factors influencing migration.
12. Social Control – definition
13. Customs – conventions, folkways, mores, rituals, taboos
14. Social Interaction Process – definition, basic social processes.
15. Social Change – concept, theories, factors and indicators of social change.
16. Social development
17. **In-semester Examination**
18. Education – Psychology – Educational Psychology –definitions, importance in extension.
19. Social Psychology – Definitions, importance in extension.
20. Basic principles of Human behaviour
21. Cognitive, affective, psychomotor domain
22. Perception – meaning, characteristics.
23. Sensation, Attention

24. Intelligence – concept, types.
25. Intelligence - measurement, factors affecting intelligence.
26. Personality – concept, types.
27. Personality measurement- factors influencing personality
28. Teaching–Learning Process – Teaching – definition, meaning.
29. Principles of teaching, steps in extension teaching.
30. Learning – definition, meaning, principles.
31. Types of learning, learning situation.
32. Motivation – concept, Maslow's hierarchy of needs (including selfless-service), intrinsic and extrinsic motivation.
33. Techniques of motivation, importance of motivation in extension.
34. Attitude – concept, factors influencing the development of attitude.

Text Books

1. Chitambar, J.B.(1997). Introductory Rural Sociology. New Delhi: New Age International (P) Ltd., Publishers.pp.1-356
2. Mangal, S.K. (2000). Educational Psychology.Ludhiana: Prakash Brothers.pp 1-438.
3. UshaRao. (2008). Advanced Educational Psychology. New Delhi:Himalaya Publishing House.pp.1-299.

Reference Books

1. Chauhan, S.S. (2001). Advanced Educational Psychology.New Delhi:Vikas Publishing House Pvt. Ltd.pp.1-215
2. Ray, G.L. (1999). Extension Communication and Management.Calcutta:Naya Prokash.pp.1-50

Web References

1. www.manage.gov.in
2. www.naarm.org.in
3. www.sociologyguide.com

Journals

1. Indian Journal of Social Research
2. Journal of Rural Development
3. Journal of Social Sciences
4. Journal of Advances in Social Work
5. Journal of Social Sciences and Research
6. Journal of Rural Sociology

Course Nature: Only Theory							
Total Marks (100)							
S.No.	Category	**Assessment Tools**					
		In- Semester Examination	Assignment	Record	Attendance	End-Semester Examination	Marks
1	Theory-External	-	-		-	*50*	*50*
2	Theory-Internal	*40*	*05*	-	*05*	-	*50*
						Grand Total	*100*

Course Code	HOR19203	Course Name	PRODUCTION TECHNOLOGY OF FRUIT AND PLANTATION CROPS	Course Category	S	*Supportive Course*	L	T	P	C
							1	0	1	2

Pre-requisite Courses	Nil	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Horticulture*	Data Book / Codes/Standards	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1	*Discuss the cultivation of fruits and plantation crops*
CLR-2	*Explain different intercultural operation for tropical, subtropical and temperate fruits*
CLR-3 :	*Summarize the importance of postharvest technology in tropical, subtropical and temperate fruits and planation crops*
CLR-4 :	*Summarize the technical knowledge on identification of different variety in fruits and plantation crops*
CLR-5 :	*Summarize the scope and importance of major plantation crops*
CLR-6 :	*Describe planting methods and different processing methods in plantation crops*

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning			Program Learning Outcomes (PLO)														
		1	*2*	*3*	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Horticulture Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	Ability to solve scientific problems through Horticulture	Ability to implement knowledge gained in the fruits and planation crops	Ability to understand social and ethical responsibilities of Horticulture
CLO-1 :	*Identify tropical, subtropical and temperate fruits and their nutritive value*	*3*	*90*	*80*	*M*								*M*	*H*		*H*	*H*	*H*	*H*
CLO-2 :	*Demonstrate -the skill for solving field problems*	*1*	*95*	*85*	*H*								*L*	*H*		*H*	*H*	*H*	*H*
CLO-3 :	*Demonstrate hands on practice experience on the cultivation of fruits and planation crops in different climacteric zones*	*2*	*80*	*70*	*M*		*L*	*L*					*L*	*H*		*H*	*H*	*H*	*H*
CLO-4 :	*Illustrate the ability to handle postharvest losses in fruits crops*	*3*	*75*	*65*	*M*			*L*	*L*				*M*	*H*		*H*	*H*	*H*	*H*
CLO-5 :	*Illustrate the knowledge on the quality control and production economic importance of major and minor plantation crops*	*2*	*75*	*60*	*L*	*L*							*M*	*H*		*H*	*H*	*H*	*H*
CLO6 :	*Demonstrate skills on identifying major physiological disorder in fruits and planation crops*	*2*	*75*	*65*	*L*						*H*		*M*	*H*		*H*	*H*	*H*	*H*

		Learning Unit / Module 1	Learning Unit / Module 2	Learning Unit / Module 3	Learning Unit / Module 4	Learning Unit / Module 5
Duration (hour)		5	3	3	3	3
S-1	SLO-1	*Scope and importance of fruit and plantation crop in India*	Production technology of Guava	Production technology of Apple	Production technology of Tea	Production technology of Cocoa
	SLO-2	*area, production, productivity and export potential of fruit and plantation crops*	Production technology of Papaya and Sapota	Production technology of Pear and Peach		
S 2-3	SLO-1	*Lab1: Varieties, propagation techniques, important cultural practices for mango*	*Lab5: Varieties, propagation techniques, important cultural practices for Papaya*	*Lab8: Varieties, propagation techniques, important cultural practices for Pomegranate and Jack fruit*	*Lab11: Varieties, propagation techniques, training and pruning, processing of Coffee*	*Lab14: Varieties, propagation techniques, top working, processing of Cashew*
	SLO-2					
S-4	SLO-1	*Production Technology of Mango*	Production technology of Grapes	Production technology of Strawberry	Production technology of Coffee	Production technology of Cashew
	SLO-2			Production technology of Almond and Walnut		
S 5-6	SLO-1	*Lab2: Varieties, propagation techniques, important cultural practices for Banana*	*Lab6: Varieties, propagation techniques, important cultural practices for Sapota*	*Lab9:* Preparation and application of PGR's in fruit crops	*Lab12: Varieties, propagation techniques, training and pruning, processing of Rubber*	*Lab15: Varieties, propagation techniques, processing of* Coconut and Arecanut
	SLO-2					
S-7	SLO-1	*Production Technology of Banana*	Production technology of Pineapple	-	Production technology of Rubber	Production technology of Coconut
	SLO-2		Production technology of Litchi	-		Production technology of Arecanut
S 8-9	SLO-1	*Lb3: Varieties, propagation techniques, important cultural practices for Citrus*	*Lab7: Varieties, propagation techniques, important cultural practices for Grapes*	*Lab10: Varieties, propagation techniques, training and pruning, processing of Tea*	*Lab13: Varieties, propagation techniques, tapping, processing of Cocoa*	*Lab16: Visit to commercial orchard/plantation industries*
	SLO-2					

S-10	SLO-1	*Production Technology of Acid lime and Sweet orange*	Production technology of Pomegranate	-	-	-
	SLO-2	*Production Technology of Mandarin*	Production technology of Jackfruit	-	-	-
S 11-12	SLO-1	*Lab4: Varieties, propagation techniques, important cultural practices for Guava*	-	-	-	-
	SLO-2				-	-

Learning Resources	1. *Shanmugavelu, K.G., N. Kumar and K.V. Peter, 2005. Production Technology of Spices and Plantation Crops. Agrobios (India), Jodhpur.* 2. *Bhardwaj Prasad S& R L 2015. Production technology of fruits. Agrobios (Indai)*

	Level of Thinking	Continuous Learning Assessment (35% weightage)		University Practical Examination (15%)	End semester theory Examination (50%)
		In Semester (20%)	Practical (15%)		
Level 1	Remember	*40 %*	*30 %*	*35%*	*30 %*
	Understand				
Level 2	Apply	*40 %*	*40 %*	*35%*	*40 %*
	Analyze				
Level 3	Evaluate	*20 %*	*30 %*	*30%*	*30 %*
	Create				
	Total	*100 %*	*100 %*	*100%*	*100 %*

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Dr. Amol Chaudhari Manager R&D Farm Jain irrigation system Ltd. Udumalpet	Dr. A. Rameshkumar Associate Professor (Horticulture) Central University of Tamil Nadu, Thiruvarur	Dr. B. Gopu K. Nivetha

THEORY

Unit I: Introduction to fruit and plantation crops

Scope and importance of fruit and plantation crop in India - area, production, productivity and export potential of fruit and plantation crops.

Production technology for Mango, Banana, Citrus

Climate and soil requirements – varieties – propagation and use of rootstocks- planting density and systems of planting - High density and ultrahigh density planting - cropping systems - after care - training and pruning - water, nutrient and weed management – fertigation - special horticultural techniques - plant growth regulation - important disorders – maturity indices and harvest- value addition.

Unit II: Production technology for Guava, Papaya, Sapota, Grapes, Pineapple, Litchi, Pomegranate and Jack fruit

Climate and soil requirements – varieties – propagation and use of rootstocks- planting density and systems of planting - High density and ultrahigh density planting - cropping systems - after care - training and pruning - water, nutrient and weed management – fertigation - special horticultural techniques - plant growth regulation - important disorders – maturity indices and harvest and value addition.

Unit III: Production technology for Apple, Pear, Peach, Strawberry, Almond and Walnut

Climate and soil requirements – varieties – propagation and use of rootstocks - planting density and systems of planting -High density and ultrahigh density planting -cropping systems - after care - training and pruning - water, nutrient and weed management –fertigation - special horticultural techniques - plant growth regulation - important disorders – maturity indices and harvest and value addition.

Unit IV: Production Technology for Tea, Coffee and Rubber

Climate and soil requirements - varieties - propagation - nursery management - planting and - planting systems - cropping systems - after care - water, nutrient and weed management - intercropping - multi-tier cropping system - mulching - special horticultural practices - maturity indices, harvest and yield - pests and diseases - processing - value addition

Unit V: Production Technology for Cocoa, Cashew, Coconut and Arecanut

Climate and soil requirements - varieties- propagation - nursery management - planting and planting systems - cropping systems- after care- training and pruning - water, nutrient and weed management - shade management - intercropping - mulching - cover cropping - special horticultural practices - maturity indices, harvest and yield - pests and diseases - processing - value addition.

Theory Schedule

1. Scope and importance of fruit and plantation crop industry in India - area, production, productivity and export potential of fruit and plantation crops
2. Production technology of Mango
3. Production technology of Banana
4. Production technology of Citrus (Acid Lime, Sweet Orange and Mandarin)
5. Production technology of Guava, Papaya and Sapota
6. Production technology of Grapes
7. Production technology of Pineapple and Litchi
8. Production technology of Pomegranate and Jackfruit
9. **In - Semester examination**
10. Production technology of Apple, Pear and Peach
11. Production technology of Strawberry, Almond and Walnut
12. Production technology of Tea
13. Production technology of Coffee
14. Production technology of Rubber
15. Production technology of Cocoa
16. Production technology of Cashew
17. Production technology of Coconut and Arecanut

Practical schedule

1. Varieties, propagation techniques, important cultural practices for Mango
2. Varieties, propagation techniques, important cultural practices for Banana
3. Varieties, propagation techniques, important cultural practices for Citrus
4. Varieties, propagation techniques, important cultural practices for Guava
5. Varieties, propagation techniques, important cultural practices for Papaya
6. Varieties, propagation techniques, important cultural practices for Sapota
7. Varieties, propagation techniques, important cultural practices for Grapes
8. Varieties, propagation techniques, important cultural practices for Pomegranate and Jackfruit

9. Preparation and application of PGR's in fruit crops
10. Varieties, propagation techniques, training and pruning, processing of Tea
11. Varieties, propagation techniques, training and pruning, processing of Coffee
12. Varieties, propagation techniques, tapping, processing of Rubber
13. Varieties, propagation techniques, processing of Cocoa
14. Varieties, propagation techniques, top working, processing of Cashew
15. Varieties, mother palm and seed nut selection, nursery practices, fertilizers application of Coconut and Arecanut
16. Visit to commercial orchard/plantation industries.
17. **Universityl Practical examination**

Text Books

1. Chattopadhyay, T. K. 2001. A text book of Pomology (Vol 1-3). Kalyani Publishers, New Delhi. edition:1 pp 1-213
2. Jitendra Singh. 2008. *Spices and Plantation Crops*. Aavishkar Publishers and Distributors, Jaipur edition:2 pp: 1-270
3. Pal, J.S. 2008. Fruit Growing, Kalyani Publishers, New Delhi. pp:1-240
4. Parthasarathy, V.A., P.K. Chattopadhyay and T.K. Bose. 2006. *Plantation Crops. Vol I and II*. Parthasankarbasu, Naya Udyog, Kolkata. edition1 pp:1-297
5. Radha, T and Lila Mathew. 2007. Fruit Crops *Volume 3 of Horticulture science series*, New India Publishing pp1-315
6. Shanmugavelu, K.G., N. Kumar and K.V. Peter, 2005. *Production Technology of Spices and Plantation Crops.* Agrobios (India), Jodhpur. pp:1-217

Reference Book

1. Kavino.M V.Jegadeeswari, R.M.Vijayakumar and S.Balakrishnan (2018) Production technology of fruits and plantation crops Publisher: Jaya publishing House 1st edition pp:1-214
2. Mishra.K.K (2018) Production technology for fruits and plantation crops (2018) Publishing: Brillion Publishing
3. Prasad.S and R.L. Bhardwaj (2015) Production technology of fruits crops Publisher: Agrobios (India) 2nd edition pp:1-310
4. Thamburaj.S, Kannan.K and V.Kanthaswamy (1997) Horticultural crop varieties released from TamilNadu Agricultural University Publishers: K.R.S.Offset Printers pp:1-421
5. Veeraraggavathatham.D M.Jawaharlal, S.Jeeva, R.Ravindran and G.Umapathy(2004) Scientific fruits culture Publishers: Suri Associates 2nd edition pp:1-310

Web-References

1. www.fruits-mg.com
2. www.fruits.com
3. www.hort.purdue.edu/newcrop/morton
4. www.bouquetoffruits.com
5. http://www.ishs.org

Journals

1. Journal of Indian Horticulture
2. Journal of Acta Horticulture
3. Journal of Progressive Horticulture
4. Journal of Chronica Horticulture
5. Indian Journal of Horticulture

Course Nature: Theory based Practical							
Total Marks (100)							
S.No.	Category	**Assessment Tools**					
		In- Semester Examination	Assignment	Record	Attendance	End-Semester Examination	Marks
1	Theory-External	-	-		-	*50*	*50*
2	Theory-Internal	*20*	-			-	*20*
3	Practical-External	-	-		-	*15*	*15*
4	Practical-Internal	-	*05*	*05*	*05*	-	*15*
Grand Total							*100*

Course Code	SKE19201	Course Name	AGRICULTURAL INFORMATICS	Course Category	S	Supportive Course	L	T	P	C
							0	0	1	1

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Skill Education	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1 :	Explain the basic computer knowledge
CLR-2 :	Use the operating and application software
CLR-3 :	Summarize programming language
CLR-4 :	Run Crop simulation model
CLR-5 :	Demonstrate the use of information & communication technology and smart phone apps in Agriculture
CLR-6 :	Recongnize the application of various computer technology in Agriculture development

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Agriculture Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	Ability to solve scientific problems through Agricultural infromatics	Ability to implement knowledge gained in the applied field of Agricultural Informatics	Ability to understand social and ethical responsibilities of Agricultural Informatics
CLO-1 :	Explain the applications of information and technology	3	80	60	H														
CLO-2 :	Demonstrate /use all the digital framework used in agriculture	3	80	70			H							H		H	H	M	M
CLO-3 :	Describe the Geospatial technology and crop simulation model	2	80	70		M		M						L			H		
CLO-4 :	Understand different information and communication technology applying in rural areas	2	80	75	M			L	L							M			
CLO-5 :	Use smart phone mobile app in agriculture	3	90	85	M	H						H	M	H		H			
CLO-6 :	Illustrate the use of Information & Technology in research	2	90	70	H		H			M	H	H				M	H	M	M

		Learning Unit / Module 1	Learning Unit / Module 2	Learning Unit / Module 3	Learning Unit / Module 4	Learning Unit / Module 5
Duration (hour)		4	8	6	6	8
S-1-2	SLO-1	***LAB 1:*** *Study of computer components and accessories*	***LAB 3:*** *Practice of DOS commands*	***LAB 7:*** *Introduction to World Wide Web*	***LAB 10:*** *Develop a C program to calculate Leaf Area Index (LAI), Crop Growth Rate (CGR) and analyze rain fall data*	***LAB 13****: Applications of geospatial technology in agriculture*
S-3-4	SLO-1	***LAB 2:*** *Study of computer operation system and software packages*	***LAB 4:*** *Use of MS word and MS power point for creating, editing and presenting a scientific document*	***LAB 8:*** *Introduction of programming languages -*	***LAB 11:*** *Hands on crop simulation models (DSSAT/Crop-Info/CropSyst/Wofost)*	***LAB 14:*** *Information and communication technology in agriculture*
S-5-6	SLO-1	-	***LAB 5:*** *MS EXCEL – creating a spreadsheet, use of statistical tools, writing expressions, creating graphs, analysis of scientific data*	***LAB 9:*** *Familiarizing with the Integrated Development Environment of C Programs*	***LAB 12:*** *Computation of water and nutrient requirement of crops using CSM*	***LAB 15:*** *Smartphone mobile apps in agriculture*
S-7-8	SLO-1	-	***LAB 6:*** *MS ACCESS – creating database, preparing queries and reports*		-	***LAB 16:*** *Crop calendar – Crop planning tool for farmers*

Learning Resources	1. Mahapatra S. K., Subrata K. M. Bhuiya J., & Pradhan J. (2019). Introductory Agri Informatics, New Delhi. Jain Brothers 2. Blackie M. J. (2012). Information Systems for Agriculture, Netherlands: Springer.

	Level of Thinking	Continuous Learning Assessment (60% weightage)		University Practical Examination (40%)
		In semester (40%)	Practical Internal (20%)	
Level 1	*Remember*	35%	35%	35%
	Understand			
Level 2	*Apply*	35%	35%	35%
	Analyze			
Level 3	*Evaluate*	30%	30%	30%
	Create			
	Total	100%	100%	100%

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
S. Bharat *Vedmaya Software Technologies Pvt. Ltd., Chennai*	*Dr. Sandipan Das* *Symbiosis International University* *(Deemed to be University), Pune, India*	*Dr. Kamlesh Golhani* *Dr. M. Sanjeeva Gandhi*

Practical Schedule

1. Study of computer components and accessories
2. Study of computer operation system and software packages
3. Practice of DOS commands
4. Use of MS word and MS power point for creating, editing and presenting a scientific document
5. MS EXCEL – creating a spreadsheet, use of statistical tools, writing expressions, creating graphs, analysis of scientific data
6. MS ACCESS – creating database, preparing queries and reports
7. Introduction to World Wide Web
8. Introduction of programming languages
9. Familiarizing with the Integrated Development Environment of C Programs
10. Develop a C program to calculate Leaf Area Index (LAI), Crop Growth Rate (CGR) and analyze rain fall data
11. Hands on crop simulation models (DSSAT/Crop-Info/CropSyst/Wofost)
12. Computation of water and nutrient requirement of crops using CSM
13. Applications of geospatial technology in agriculture
14. Information and communication technology in agriculture
15. Smartphone mobile apps in agriculture
16. Crop calendar – Crop planning tool for farmers
17. **University Practical Examination**

Text Books

1. Gurvinder, S., Rachhpal S., & Saluja K. K. (2003). *Fundamentals of Computer*
2. *Programming and Information Technology*, Kalyani Publishers.
3. Mahapatra S. K., Subrata K. M. Bhuiya J., & Pradhan J. (2019). *Introductory Agri Informatics*, Jain Brothers, New Delhi.

Reference Books

1. Blackie M. J. (2012). Information Systems for Agriculture, Netherlands: Springer.
2. Saravanan, R., Kathiresan, C., & Indra Devi, T. (2011). *Information & Communication Technology for Agriculture and Rural Development*, New India Publ. Agency.
3. Chandan Kumar Panda, Anil Paswan & Singh S. R. (2018). *Advances in ICT in Agriculture,* New Delhi Publisher, India.

Web-References

1. https://edu.gcfglobal.org/en/word2016/
2. https://edu.gcfglobal.org/en
3. http://indiagovernance.gov.in/files/ict_in_agriculture.pdf
4. www.manage.gov.in/studymaterial/AKM-E.pdf
5. https://www.youtube.com/watch?v=Jy9QDrFlyXE

Journals

1. Information Processing in Agriculture
2. Journal of Indian Society of Remote Sensing
3. Journal of Geographic Information System

Course Nature: Only Practical							
Total Marks (100)							
S.No.	Category	**Assessment Tools**					
		In- Semester Examination	*Assignment*	*Record*	*Attendance*	*End-Semester Examination*	*Marks*
1	Practical-External	-	-	-	-	*40*	*40*
2	Practical-Internal	*40*	*05*	*10*	*05*	-	*60*
						Grand Total	*100*

Course Code	MAT19201	Course Name	ELEMENTARY STATISTICS	Course Category	A	Allied Course	L	T	P	C
							1	0	1	2

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Mathematics	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1 :	Explain the fundamental statistical concepts and skills
CLR-2 :	Interpret the statistical calculations in agricultural research
CLR-3 :	Calculate mathematical models applicable to field trials
CLR-4 :	Use CRD, RBD in solving real time applications
CLR-5 :	Illustrate the applications of Testing of Hypothesis in problems of Agricultural science
CLR-6 :	Apply Sampling Theory in all problems of Agricultural sciences

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Agriculture Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	Ability to solve scientific problems through Mathematics	Ability to implement knowledge gained in Mathematics	Ability to understand social and ethical responsibilities of Mathematics
CLO-1 :	Define the Basics of Probability and Statistics	2	90	80	M	H	-	L	-	-	-	-	H	-	-	H	H	H	-
CLO-2 :	Choose the model and analyze the system using random variables	2	95	85	-	M	-	-	-	-	-	-	M	-	-	H	M	-	-
CLO-3 :	Apply the testing of Hypothesis	3	85	75	-	M	-	-	-	-	-	-	H	-	-	H	L	-	-
CLO-4 :	Apply the statistical Models in the Field	3	70	60	H	-	-	M	-	-	-	-	H	-	-	H	H	L	-
CLO-5 :	Explain the techniques related in Sampling	2	80	70	-	-	-	-	-	-	-	-	M	-	-	H	M	-	-
CLO6 :	Identify the fundamental difference between Discrete and Continuous Distributions	2	80	70	M	-	-	-	-	-	-	-	L	-	-	H	M	L	-

		Learning Unit / Module 1	Learning Unit / Module 2	Learning Unit / Module 3	Learning Unit / Module 4	Learning Unit / Module 5
Duration (hour)		**3**	4	5	2	2
S-1	SLO-1	*Introduction – Measures of central tendency: arithmetic mean, geometric mean, harmonic mean.*	*Sampling theory – population – sample – parameter and statistic – sampling distribution - sampling vs complete enumeration.*	*Null and alternative hypothesis – types of errors - critical region and tests of significance.*	*Correlation – Scatter diagram - Karl Pearson's correlation coefficient.*	*Analysis of Variance (ANOVA) – assumptions – one way and two way classifications.*
	SLO-2	*Median and mode –Merits and demerits*	*Types of sampling - simple random sampling selection using random numbers Stratified - Systematic sampling*	*Large sample test – single mean and difference between two means.*	*Spearman's rank Correlation - computation and properties.*	*Basic principles of experimental designs*
S-2	SLO-1	*Measures of dispersion: Range, Quartile deviation, Mean deviation.*	*Probability distributions –*	*Test for Single proportion*	*Regression – simple linear regression – fitting of simple linear regression equation.*	*Completely Randomized Design (CRD)*
	SLO-2	*standard deviation, and coefficient of variation - Skewness and kurtosis*	*Discrete distributions: Bernoulli*	*Difference between two proportions*	*Properties of regression coefficient.*	*Randomized Block Design (RBD)*
S-3	SLO-1	*Diagrammatic representation of data; One, Two and Three dimensional diagrams with applications.*	*Binomial distribution*	*Small sample tests – F-test -*	-	-
	SLO-2	*Graphical representation of data; Histogram, frequency polygon, frequency curve, ogives*	*Poisson distribution*	*t-test for testing the significance of single mean*	-	-

S-4	SLO-1	-	*Continuous distribution:*	*Independent t test*	-	-
	SLO-2	-	*Normal distribution*	*Paired t test*	-	-
S-5	SLO-1	-	-	*Chi square test for testing the association of r x c contingency table*	-	-
	SLO-2	-	-	-	-	-

Learning Resources	1. *Gupta, S. C. & Kapoor, V. K. (2014). Fundamentals of Mathematical Statistics. New Delhi: Sultan chand and sons. pp. 1-682* 2. *Rangaswamy, R.(1995). A Text Book of Agricultural Statistics. Hyderabad:New Age International Publishing Limited. pp. 1- 526*

	Level of Thinking	Continuous Learning Assessment (35% weightage)		University Practical Examination (15%)	End semester theory Examination (50%)
		In semester (20%)	Practical (15%)		
Level 1	Remember	*40 %*	*30 %*	*30%*	*40 %*
	Understand				
Level 2	Apply	*40 %*	*40 %*	*40%*	*40 %*
	Analyze				
Level 3	Evaluate	*20 %*	*30 %*	*30%*	*20 %*
	Create				
	Total	*100 %*	*100 %*	*100%*	*100 %*

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
	Dr. A. Govindarajan, Professor and Head, Department of Mathematics(E&T), SRMIST, Kattankulathur	*Dr. M. Selva rani* *Ms. A. Muthulakshmi*

THEORY

Unit I: Descriptive Statistics

Introduction, Measures of central tendency, arithmetic mean, geometric mean, harmonic mean, median and mode –Merits and demerits. Measures of dispersion: Range, Quartile deviation, Mean deviation, standard deviation, and coefficient of variation, Skewness and kurtosis, Merits and demerits- Diagrammatic representation of data, Graphical representation of data; Histogram, frequency polygon, frequency curve, ogives.

Unit II: Sampling Theory and Probability Distributions

Sampling theory, population, sample, parameter and statistic, sampling distribution, sampling vs complete enumeration, Types of sampling, simple random sampling, selection using random numbers, Stratified, Systematic sampling. Probability distributions, Discrete distributions: Bernoulli, Binomial and Poisson. Continuous distribution: Normal distribution, definitions and properties.

Unit III: Testing of Hypothesis

Null and alternative hypothesis, types of errors, critical region and tests of significance. Large sample test, single mean and difference between two means, single proportion and difference between two proportions. Small sample tests, F-test, t-test for testing the significance of single mean – independent and paired t test, chi square test for testing the association of r x c contingency table.

Unit IV: Correlation and Regression

Correlation, Scatter diagram, Karl Pearson‘s correlation coefficient, Spearman‘s rank correlation, computation and properties. Regression, simple linear regression, fitting of simple linear regression equation, properties of regression coefficient.

Unit V: Analysis of Variance and Experimental Designs

Analysis of Variance (ANOVA), assumptions, one way and two way classifications. Basic principles of experimental designs, Completely Randomized Design (CRD), Randomized Block Design (RBD), Split plot design (SPD) and Latin Square Design (LSD).

Theory-Lecture Schedule

1. Introduction – Measures of central tendency: arithmetic mean, geometric mean, harmonic mean, median and mode –Merits and demerits
2. Measures of dispersion: Range, Quartile deviation, Mean deviation, standard deviation, and coefficient of variation - Skewness and kurtosis
3. Diagrammatic representation of data; One, Two and Three dimensional diagrams with applications. Graphical representation of data; Histogram, frequency polygon, frequency curve, ogives.
4. Sampling theory – population – sample – parameter and statistic – sampling distribution - sampling vs complete enumeration –Types of sampling - simple random sampling selection using random numbers Stratified - Systematic sampling
5. Probability distributions – Discrete distributions: Bernoulli
6. Binomial and Poisson distribution,
7. Continuous distribution: Normal distribution
8. Null and alternative hypothesis – types of errors - critical region and tests of significance - Large sample test – single mean and difference between two means.
9. **In- Semester Examination**
10. Single proportion and difference between two proportions
11. Small sample tests – F-test - t-test for testing the significance of single mean
12. Independent and paired t test
13. Chi square test for testing the association of r x c contingency table
14. Correlation – Scatter diagram - Karl Pearson‘s correlation coefficient – Spearman‘s rank Correlation - computation and properties
15. Regression – simple linear regression – fitting of simple linear regression equation – properties of regression coefficient.
16. Analysis of Variance (ANOVA) – assumptions – one way and two way classifications. Basic principles of experimental designs
17. Completely Randomized Design (CRD) – Randomized Block Design (RBD)

PRACTICAL SCHEDULE

1. Computation of arithmetic mean, geometric mean, harmonic mean, median and mode
2. Computation of range, standard deviation, variance, coefficient of variance
3. Histogram, frequency polygon, frequency curve, ogives.
4. Selection of sample using simple random sampling method, Simple problems in Bernoulli distribution
5. Simple problems in Binomial distribution and Poisson distribution
6. Simple problems in Normal distribution
7. Large sample test – test for single proportion and difference between two proportions

8. Large sample test – test for single mean and difference between two means
9. Small samples test – t-test for single mean – t test for difference between two sample means (equal variances only)
10. Paired t-test
11. Chi square test
12. Computation of Karl Pearson's correlation coefficient
13. Fitting of simple linear regression equation y on x – correlation and regression
14. Analysis of Completely Randomised Design (CRD) – for equal replications only
15. Analysis of Randomised Block Design (RBD) and FRBD
16. Analysis of Split plot design and Latin Square Design (LSD)
17. University Practical Examination

Text Books

1. Chandel S. R. S. (2014). *A Handbook of Agricultural Statistics*. Kanpur: Achal Prakashan Mandir. pp. 1-87
2. Gupta, S.P. (2004). *Statistical Method.* New Delhi: Sultan chand and sons. *pp. 1-1476.*
3. Nageswara Rao, G. (2007).*Statistics for Agricultural Sciences*. Hyderabad: B.S. Publications. pp. 1- 512
4. Panse, V.G. & Sukhatme, P. V. (1954). *Statistical Methods for Agricultural Workers*. India: Indian Council of Agricultural Research. pp. 1- 361
5. Vittal P. R. (2012). *Mathematical Statistics*. Chennai: Margham Publications. pp. 1 – 950

References Books

1. Agrawal B.L. (2005). *Basic Statistics*. New Delhi: New age International Ltd. pp. 1- 656
2. Dhamu, K.P. & Ramamoorthy, K. (2009). *Fundamentals of Agricultural Statistics*. India: Scientific Publishers. pp. 1- 130
3. Gupta, S.P. (1978). *Elementary Statistical Method.* New Delhi: Sultan chand and sons. *pp. 1-438*
4. Kailasam, G. & Gangaiselvi, R.(2010). *Applied Statistics*. New Delhi: Kalyani Publishers. pp. 1 -200
5. Vijay K. Rohatgi, Ehsanes Saleh A.K.M.D. (2008). *An Introduction to Probability and Statistics*, (2nd ed.). New Jersey: John Wiley and sons Inc. pp.1 - 631

Web References

1. www.statisticshowto.com
2. www.mathisfun.com
3. www.mathinsight.org
4. http://www.statistics.com/resources/glo.ssary/
5. www.statsoft.com
6. http://www.iasri.res.in/ebook/EB_SMAR/index.html
7. www.statsci.org/jourlist.html

Journals

1. The Indian journal of Statistics
2. International journal of Mathematics and Statistics
3. Annals of Statistics
4. Probability Theory and related fields
5. International Journal of Agricultural and Statistical sciences.
6. Journal of the Indian society of Agricultural Statistics
7. Journal of Statistics and Management Systems

Course Nature: Theory based Practical							
Total Marks (100)							
S.No.	Category	**Assessment Tools**					
		In- Semester Examination	Assig nment	Record	Attendance	End-Semester Examination	Marks
1	Theory-External	-	-		-	*50*	*50*
2	Theory-Internal	*20*	-			-	*20*
3	Practical-External	-	-		-	*15*	*15*
4	Practical-Internal	-	*05*	*05*	*05*	-	*15*
						Grand Total	*100*

Course Code	CRH19301	Course Name	FUNDAMENTALS OF ENTOMOLOGY	Course Category	C	Compulsory Core	L	T	P	C
							2	0	1	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Crop Protection	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Agriculture Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	Ability to solve scientific problems through Agricultural Entomology	Ability to implement knowledge gained in the applied field of Agricultural Entomology	Ability to understand social and ethical responsibilities of Agricultural Enotmology
CLR-1 :	Recongnise the contributions of different scientists in the development field of Entomology																		
CLR-2 :	Outline the position of insect in animal kingdom and their relationship with other arthropods and reason behind the insect dominance																		
CLR-3 :	Recongnise the morphology and mouth parts of insects and able to relate to the application of pesticides and control.																		
CLR-4 :	Recite the technical knowledge on the physiology of insects																		
CLR-5 :	Interpret taxonomical feature of insects																		
CLR-6 :	Summarize the taxonomy of 29 insect orders																		
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																		
CLO-1 :	Summarize the position of insects and their relationships with other arthropods	3	90	80	M								M	H		H	H	H	H
CLO-2 :	Describe the basic morphological feature of different group of insects	1	95	85	H								L	H		H	H	H	H
CLO-3 :	Recall the morphological features insect wings and relate it to the classification based on the wing morphological feature	2	80	70	M		L	L					L	H		H	H	H	H
CLO-4 :	Recall the physiology of insects and recommend appropriate pesticide to control insects	3	75	65	M			L	L				M	H		H	H	H	H
CLO-5 :	Summarize the taxonomical classification of insects	2	75	60	L	L							M	H		H	H	H	H
CLO6 :	Recall taxonomical classification of 29 orders	2	75	65	L						H		M	H		H	H	H	H

		Learning Unit / Module 1	Learning Unit / Module 2	Learning Unit / Module 3	Learning Unit / Module 4	Learning Unit / Module 5
Duration (hour)		4	9	25	12	14
S-1	SLO-1	History and Importance, Position of insects in the animal kingdom	Insect body wall - its structure and function, cuticular appendages.	Digestive system - structure of alimentary canal and its modifications in certain groups. Digestive enzymes, digestion and absorption of nutrients.	Taxonomy principles and procedures of classification and nomenclature of insects.	Psocoptera, Mallophaga and Siphunculata.
	SLO-2	Reason for insect dominance	Moulting process in insects.	Lab:4 Mouth parts of cockroach, modifications in the mouth parts in plant bug, female mosquito, honeybee, thrips, antlion grub, housefly, moths and butterflies	Lab:10 Observing the characters of Apterygota - Collembola and Thysanura and Exopterygota - Odonata and Ephemeroptera and Phasmida	Lab: 13 Observing the characters of orders Thysanoptera and Diptera (Cecidomyiidae, Agromyzidae, Tephritidae, Asilidae, Tabanidae, Tachinidae, Hippoboscidae, Culicidae, Syrphidae and Muscidae)
S-2	SLO-1	Lab:1 Observations on external features of grasshopper / cockroach	Lab:2 Methods of insect collection, preservation, pinning, labelling, display and storage	Excretory system in insects - malpighian tubules - accessory excretory organs and physiology of excretion.	Distinguishing characters of insect orders — Apterygota - Collembola and Thysanura	Endopterygota — Lepidoptera and families of agricultural importance..

	SLO-2	-	*Structure of insect head and its appendages.*	*Respiratory system in insects - structure of trachea - tracheoles - types of respiratory system - types of spiracles - respiration in aquatic and Endoparasitic insects.*	*Exopterygota — Ephemeroptera, Odonata and Phasmida*	*Coleoptera and families of agricultural importance*
S-3	SLO-1	-	*Structure of insect thorax and its appendages.*	*Lab:5 Structure of thorax and abdomen and their appendages —modifications in insect*	*Lab:11 Dictyoptera, Dermaptera, Embioptera, Orthoptera (Acrididae, Tettigonidae, Gryllidae and Gryllotalpidae), Mallophaga and Siphunculata*	*Lab:14 Observing the characters of Hymenoptera (Tenthredinidae, Apidae, Sphecidae, Vespidae, Formicidae , Xylocopidae, Chalcididae, Megachilidae, Ichneumonidae, Bethylidae, Braconidae, Agaonidae, Evaniidae, Encyrtidae, Eulophidae and Trichogrammitidae).*
	SLO-2	-	*Lab:3 Types of insect head and antenna*	*Circulatory system in insects - haemocoel and dorsal vessel - circulation of blood - composition of haemolymph - haemocytes and their functions.*	*Dictyoptera, Dermaptera, Embioptera*	*Diptera and families of agricultural importance.*
S-4	SLO-1	-	*Structure of insect abdomen and its appendages.*	*Nervous system in insects - structure of neuron – types of nervous systems*	*Orthoptera (Families of Agricultural Importance) and Isoptera — social life in termites*	*Hymenoptera and families of agricultural importance.*
	SLO-2	-	-	*Lab:6 legs and wings — wing venation, regions and angles — wing coupling.*	*Lab: 12 Exopterygota —Isoptera and Hemiptera — Homoptera (Cicadidae, Cicadellidae, Delphacidae, Aphididae, Cercopidae, Membracidae, Aleyrodidae, Coccidae, Diaspididae, Pseudococcidae, Kerridae and Psyllidae); Heteroptera (Reduviidae, Pentatomidae, Miridae, Coreidae, Pyrrhocoridae, Lygaeidae, Nepidae, Belastomatidae, Gerridae, Cimicidae, Tingidae),*	*Lab: 15 Observing the characters of Coleoptera (Curculionidae, Apionidae, Cicindellidae, Carabidae, Staphylinidae, Dytiscidae, Coccinellidae, Gyrinidae, Lampyriidae, Hydrophilidae, Scarabaeidae, Dynastidae, Cerambycidae, Melolonthidae, Anobiidae, Tenebrionidae, Bruchidae, Meloidae, Cetonidae, Buprestidae, Elateridae and Bostrychidae).*
S-5	SLO-1	-	-	*Conduction of nerve impulses - axonic and synaptic transmissions.*	*Hemiptera (Families of Agricultural Importance) and Thysanoptera.*	*Neuroptera (Families of Agricultural Importance), Strepsiptera and Siphonaptera.*
	SLO-2	-	-	*Male and female reproductive systems in insects – structure and modifications. Spermatogenesis and Oogenesis.*	-	*Lab: 16 Observing the characters of Lepidoptera (Nymphalidae, Lycaenidae, Pieridae, Papilionidae, Satyriidae, Crambidae, Pyraustidae, Noctuidae, Arctiidae, Bombycidae, Cochlidiidae, Geometridae, Gelechiidae, Pterophoridae, Saturniidae, Sphingidae, Lymantriidae and Hesperidae) ,Observing the characters of Neuroptera (Chrysopidae, Myrmeliontidae, Mantispidae, Ascalaphidae), Siphonoptera.*
S-6	SLO-1	-	-	*Lab:7 Types of immature stages of insects.*	-	-
	SLO-2	-	-	*Types of reproduction - oviparous, viviparous, paedogenesis, polyembryony, oviporous and parthenogenesis.*	-	-
S-7	SLO-1	-	-	*Types of metamorphosis – Growth and development. Immature stages of insects*	-	-
	SLO-2	-	-	*Lab: 8 Study of digestive system.*	-	-
S-8	SLO-1	-	-	*Structure of sense organs - types of sensilla - photoreceptors; chemoreceptors and mechanoreceptors*	-	-

	SLO-2	-	-	*Exocrine and endocrine glands and their function - effect on metamorphosis and reproduction*	-	-
S-9	SLO-1	-	-	*Lab: 9 Study of male and female reproductive systems.*	-	-
	SLO-2	-	-	*Tropism and Biocommunication in insects - Sound and light production*	-	-
Learning Resources		*1. Alpheus, S Packard. (1898). Text Book of Entomology, The MacMillan Company Ltd, London.pp1-752.* *2. Ragumoorthi,K.N., Balasubramani, V and Srinivasan. M.R. (2017). Insecta an introduction, A. E. Publications.pp 1-224.*				

	Level of Thinking	Continuous Learning Assessment (35% weightage)		University Practical Examination (15%)	End semester theory Examination (50%)
		In semester (20%)	Practical (15%)		
Level 1	Remember	*40 %*	*30 %*	*35%*	*30 %*
	Understand				
Level 2	Apply	*40 %*	*40 %*	*35%*	*40 %*
	Analyze				
Level 3	Evaluate	*20 %*	*30 %*	*30%*	*30 %*
	Create				
	Total	*100 %*	*100 %*	*100%*	*100 %*

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Dr. K. Ramesh Ph.D *Principal Biologist –Rice Insecticide and Nematicide, South Asia* *Co-chair for insecticide resistance action committee(IRAC), India* *Corteva agrisciences (Dow Dupont)* *Madhapur, Hyderabad, India* *e- mail :ramesh.kaliaperumal@corteva.com* *mobile : 9952885708*	*Dr. Kumar k, Professor and Head, Department of Agricultural Entomology, PAJANCOA&RI, Karaikal-609603*	*Dr. L.Ramazeame*

THEORY

Unit I– History and Importance

Entomology as a science - its importance in Agriculture. History of Entomology in India, Position of insects in the animal kingdom and their relationship with other classes of Arthropoda, Reasons for insect dominance.

Unit II–Morphology

General organization of insect body wall - structure and function, cuticular appendages, moulting. Body regions - insect head, thorax and abdomen, their structures and appendages

Unit III– Anatomy and Physiology

Elementary knowledge of digestive, excretory, respiratory, circulatory, nervous and reproductive systems in insects. Sense organs and their functions, Exocrine and endocrine glands. Life cycle of insects- immature stages - types of reproduction – metamorphosis growth and development.

Unit IV– Taxonomy of Apterygota and Exopterygota

Taxonomy, Classification and nomenclature of insects. Distinguishing characters of agriculturally important orders and families of Apterygotes- Collembola and Thysanura, Exopterygotes - Ephemeroptera, Odonata, Orthoptera, Phasmida, Dictyoptera, Embioptera, Dermaptera, Hemiptera, Isoptera, Psocoptera, Mallophaga, Siphunculata and Thysanoptera.

Unit V–Taxonomy of Endopterygota

Distinguishing characters of agriculturally important families of Lepidoptera, Coleoptera, Diptera, Hymenoptera, Siphonaptera, Strepsiptera and Neuroptera.

Theory –Lecture Schedule

1. Study of insects and their importance in Agriculture. History of Entomology in India Position of insects in the animal kingdom - relationship with other members of Arthropoda.
2. Insect dominance - structural, morphological and physiological factors responsible for dominance.
3. Insect body wall - its structure and function cuticular appendages.
4. Moulting process in insects.
5. Structure of insect head and its appendages.
6. Structure of insect thorax and its appendages.
7. Structure of insect abdomen and its appendages.
8. Digestive system - structure of alimentary canal and its modifications in certain groups. Digestive enzymes, digestion and absorption of nutrients.
9. Excretory system in insects - malpighian tubules - accessory excretory organs and physiology of excretion.
10. Respiratory system in insects - structure of trachea - tracheoles - types of respiratory system - types of spiracles - respiration in aquatic and Endoparasitic insects.
11. Circulatory system in insects - haemocoel and dorsal vessel - circulation of blood - composition of haemolymph - haemocytes and their functions.
12. Nervous system in insects - structure of neuron – types of nervous systems.
13. Conduction of nerve impulses - axonic and synaptic transmissions.
14. Male and female reproductive systems in insects – structure and modifications. Spermatogenesis and Oogenesis.
15. Types of reproduction - oviparous, viviparous, paedogenesis, polyembryony, oviporous and parthenogenesis.
16. Types of metamorphosis – Growth and development. Immature stages of insects.
17. **In- semester examination**
18. Structure of sense organs - types of sensilla - photoreceptors; chemoreceptors and mechanoreceptors
19. Exocrine and endocrine glands and their function - effect on metamorphosis and reproduction
20. Tropism and Biocommunication in insects — Sound and light production.
21. Taxonomy principles and procedures of classification and nomenclature of insects.
22. Distinguishing characters of insect orders — Apterygota - Collembola and Thysanura
23. Exopterygota — Ephemeroptera, Odonata and Phasmida,
24. Dictyoptera, Dermaptera, Embioptera
25. Orthoptera (Families of Agricultural Importance) and Isoptera — social life in termites
26. Hemiptera (Families of Agricultural Importance)
27. Thysanoptera.
28. Psocoptera, Mallophaga and Siphunculata.
29. Endopterygota — Lepidoptera and families of agricultural importance.

30. Coleoptera and families of agricultural importance.
31. Diptera and families of agricultural importance.
32. Hymenoptera and families of agricultural importance.
33. Neuroptera (Families of Agricultural Importance)
34. Strepsiptera and Siphonaptera.

Assignment

Each student has to submit a minimum of 100 preserved insects representing various orders and families.

Practical– Schedule

1. Observations on external features of grasshopper / cockroach
2. Methods of insect collection, preservation, pinning, labelling, display and storage
3. Types of insect head and antenna
4. Mouth parts of cockroach, modifications in the mouth parts in plant bug, female mosquito, honeybee, thrips, antlion grub, housefly, moths and butterflies
5. Structure of thorax and abdomen and their appendages —modifications in insect
6. Legs and wings — wing venation, regions and angles — wing coupling.
7. Types of immature stages of insects.
8. Study of digestive system.
9. Study of male and female reproductive systems.
10. Observing the characters of Apterygota - Collembola and Thysanura and Exopterygota -Odonata and Ephemeroptera and Phasmida
11. Dictyoptera, Dermaptera, Embioptera, Orthoptera (Acrididae, Tettigonidae, Gryllidae and Gryllotalpidae), Mallophaga and Siphunculata
12. Exopterygota —Isoptera and Hemiptera — Homoptera (Cicadidae, Cicadellidae, Delphacidae, Aphididae, Cercopidae, Membracidae, Aleyrodidae, Coccidae, Diaspididae, Pseudococcidae, Kerridae and Psyllidae); Heteroptera (Reduviidae, Pentatomidae, Miridae, Coreidae, Pyrrhocoridae, Lygaeidae, Nepidae, Belastomatidae, Gerridae, Cimicidae, Tingidae),
13. Observing the characters of orders Thysanoptera and Diptera (Cecidomyiidae, Agromyzidae, Tephritidae, Asilidae, Tabanidae, Tachinidae, Hippoboscidae, Culicidae, Syrphidae and Muscidae)
14. Observing the characters of Hymenoptera (Tenthredinidae, Apidae, Sphecidae, Vespidae, Formicidae , Xylocopidae, Chalcididae, Megachilidae, Ichneumonidae, Bethylidae, Braconidae, Agaonidae, Evaniidae, Encyrtidae, Eulophidae and Trichogrammitidae).
15. Observing the characters of Coleoptera (Curculionidae, Apionidae, Cicindellidae, Carabidae, Staphylinidae, Dytiscidae, Coccinellidae, Gyrinidae, Lampyriidae, Hydrophilidae, Scarabaeidae, Dynastidae, Cerambycidae, Melolonthidae, Anobiidae, Tenebrionidae, Bruchidae, Meloidae, Cetonidae, Buprestidae, Elateridae and Bostrychidae).
16. Observing the characters of Lepidoptera (Nymphalidae, Lycaenidae, Pieridae, Papilionidae, Satyriidae, Crambidae, Pyraustidae, Noctuidae, Arctiidae, Bombycidae, Cochlidiidae, Geometridae, Gelechiidae, Pterophoridae, Saturniidae, Sphingidae, Lymantriidae and Hesperidae) ,Observing the characters of Neuroptera (Chrysopidae, Myrmeliontidae, Mantispidae, Ascalaphidae), Siphonoptera.
17. **University practical examination**

Text Books

1. Alpheus ,S PACKARD. (1898). Text Book of Entomology , The MacMillan Company Ltd,London. pp1- 752.
2. Sehgal, P.K. 2017. Fundamentals of Agricultural Entomology. Kalyani publisher, Kolkata, pp1-399
3. Wigglesworth, V.B. (2013). Insect Physiology. Springer, Netherlands (Originally published by Chapman and Hall, London, 1974).pp1-192

References Books

1. Borror, D.J., D.M. Delong and Triple Horn. C.A. (1976). An introduction to the study of insects (IV Edition). Holt, Rinehart and Winston, New York, London and Sydney.pp1-852
2. Chapman, R.F. (1981). The Insects: Structure Function. Edward Arnold (publishers)Ltd, London.pp1-354
3. Cedric Gillott. (2005). Entomology (Third Edition). Springer, Netherlands.pp1-834
4. Nayar. K.K., T.N. Ananthakrishnan and David, B.V. (1976). General and Applied Entomology. Tata Mc-Graw Hill publishing Company Ltd, New Delhi.pp1-589
5. Richards O.W. and Davies, R.G. (1977). Imm's General Text Book of Entomology Vol. I and II. Chapman and Hall Publication, London. Pp1-942

Web References

1. http://www.itis.usda.gov/it is/

2. http://www.bluehen.ags.udel.edu.insects/description/entohoma.html
3. http://www.ex.ac.uk/gilramel/anatomy.html.
4. http://www.uark.ed u/academics/u nderg rad.html.
5. http://www.cabi-publishing.org
6. https://youtu.be/WPeIF61BkvQ

Journals

1. Insect Morphology and Phylogeny
2. International Journal of Insect Morphology and Embryology
3. Journal of Insect Science

Course Nature: Theory based Practical							
Total Marks (100)							
S.No.	Category	**Assessment Tools**					
		In- Semester Examination	Assignment	Record	Attendance	End-Semester Examination	Marks
1	Theory-External	-	-		-	*50*	*50*
2	Theory-Internal	*20*	-			-	*20*
3	Practical-External	-	-		-	*15*	*15*
4	Practical-Internal	-	*05*	*05*	*05*	-	*15*
						Grand Total	*100*

Course Code	GPB19301	Course Name	FUNDAMENTALS OF PLANT BREEDING	Course Category	C	*Compulsory Core*	L	T	P	C
							2	0	1	3

Pre-requisite Courses	Nil	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Genetics and Plant Breeding*	Data Book / Codes/Standards	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1 :	Describe *the reproductive system* of *crop plants and their importance* in *plant breeding*
CLR-2 :	Summarize the *knowledge on breeding methods for crop plants according to the mode of pollination*
CLR-3 :	Discuss *the utilization of special breeding methods in crop plants*
CLR-4 :	Describe the importance of *maintenance breeding in crop improvement*
LR-5 :	Outline *the trait-introgression protocols in crop breeding*

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning			Program Learning Outcomes (PLO)														
		1	*2*	*3*	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Agriculture Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	Ability to solve scientific problems through Plant Breeding	Ability to implement knowledge gained in the applied field of Plant Breeding	Ability to understand social and ethical responsibilities of Plant Breeding
CLO-1 :	*Demonstrate the Plant breeding methods*	1	90	85	H			H			H		M	H		H	H	H	H
CLO-2 :	*Illustrate the development of hybrids*	2	95	85	H			H					L	H		H	H	H	H
CLO-3 :	*Recall the breeding methodologies to develop new traits*	2	80	70	M		M	M			H		L	H		H	H	H	H
CLO-4 :	*Illustrate trait transfer to new genetic background*	3	85	75	M			H					M	H		H	H	H	H
CLO-5 :	*Outline the new trends in crop improvement*	3	85	90	M								M	H		H	H	H	H

		Learning Unit / Module 1	Learning Unit / Module 2	Learning Unit / Module 3	Learning Unit / Module 4	Learning Unit / Module 5
Duration (hour)		9	7	6	6	5
S-1	SLO-1	*Objectives and role of plant breeding*	*Basic biometrics for plant breeding*	*Genetic structure of a population in cross pollinated crop*	*Polyploidy breeding*	*Types of cultivars*
	SLO-2	*Historical perspective of Plant Breeding*	*Heritability and genetic advance*	*Hardy Weinberg law*	*Induction of polyploidy*	*Concept of seed certification and TC plants certification*
S-2	SLO-1	*Centres of origin for the crops*	*Plant introduction*	*Mass selection in cross pollinated crops*	*Wide hybridization*	*Transgenic crops and Concept of Plant Varietal protection,*
	SLO-2	*Contribution of Vavilov, Harlan, Zhukovosky for plant breeding and law of homologous series*	*Quarantine and acclimatization*	*Half sib and full sib*	*Overcoming barriers in wide hybridization*	*Geographical indications and DUS*
S-3,4	SLO-1	*Lab1: Pollination and reproduction in plants*	*Lab. 4. Emasculation and pollination techniques in horticultural crops*	*Lab. 7. Maintenance of A, B and R line and TGMS lines - Hybrid seed production techniques*	*Lab.10. Studies on different wild species in crop plants and wide hybridization*	*Lab.14. Layout of different yield trials - Observing the experimental plots - nucleus and breeder seed production plots*
	SLO-2					
S-5	SLO-1	*Plant genetic resources and their importances*	*Genetic basis of self pollinated crops*	*Breeding methods of cross pollinated crops involving artificial hybridization*	*Mutation breeding*	-
	SLO-2	*Gene Bank for crop breeding*	*Vilmorin principle of progeny selection and Johannsen's pure line theory.*	*Recurrent selection*	*Ideotype concept*	-
S-6	SLO-1	*Characterization and utilization of germplasm*	*Breeding methods for self pollinated crops without involving artificial hybridization*	*Heterosis breeding*	*Somaclonal variation*	-
	SLO-2	*Germplasm exchange and quarantine*	*Mass selection in self pollinated crops*	*Inbreeding depression*	*Concept of biotic and abiotic stress resistance Breeding*	-
S-7,8	SLO-1	*Lab 2: Mechanisms enforcing*	*Lab. 5. Studies on segregating generation*	*Lab. 8 Estimation of heterosis*	*Lab.11. procedure for irradiation of*	*Lab. 15. Screening methods – laboratory and*

	SLO-2	*self and cross pollination in crops*	*and maintenance of records.*		*seeds and planting materials*	*field – for biotic and abiotic stresses*
S-9	SLO-1	*Modes of reproduction crops*	*Breeding methods of self pollinated crops involving artificial hybridization*	*Heterosis breeding*	*Introduction to markers*	-
	SLO-2	*Significance of pollination*	*Creating variability in self pollinated crops*	*Emasculation in hybrid seed production*	*Marker assisted selection*	-
S-10	SLO-1	*Self incompatibility classifications and mechanisms*	*Hybridization and selection*	*Maintenance of parental lines*	-	*Lab. 16. Procedure for marker assisted selection*
	SLO-2	*Applications of SI in crop breeding*	*Transgressive breeding*	*Hybrid variety*	-	
S-11,12	SLO-1	*Lab3: Breeder kit and its components for selfing and crossing techniques*	*Lab. 6. Maintenance of A, B and R line and TGMS lines - Hybrid seed production techniques*	*Lab. 9. Induction of polyploidy using colchicine*	*Lab.12. Germplasm preservation – conservation - records maintained in research stations*	-
	SLO-2					-
S - 13	SLO-1	*Introduction to male sterility*	*Pedigree and mass pedigree breeding*	*Synthetics and composites*	-	-
	SLO-2	*Classification of male sterility*	*Bulk breeding*	*Achievements in synthetics and composites*	-	-
S - 14	SLO-1	*Environmentally influenced male sterility systems in crops*	*Comparison of pedigree and bulk breeding methods.*	*Genetic characters of asexual reproduction*	-	-
	SLO-2	*Transgenic Male sterility and applications*	*Single Seed Descent (SSD) method*	*Chimeras and its types*	-	-
S–15,16	SLO-1	*Emasculation and pollination techniques in field crops*	-	-	*Lab 13:Calculation of PCV, GCV, heritability, genetic advance*	-
	SLO-2					
S-17	SLO-1	*Apomixis in crop improvement*	*Backcross breeding*	-	-	-
	SLO-2	*Parthenocarpy*	*Population improvement approach in self-pollinated crops*	-	-	-

Learning Resources	1. *Allard, R. (2010). Principles of Plant breeding (2nd ed.). India: Wiley India Pvt Ltd. pp. 1- 247.* 2. *Bharadwaj, D. N. (2012). Breeding Field Crops. Jodhpur: Agrobios (India). pp. 1- 934.*	3. *Chahal, G.S. & Gosal, S. S. (2002). Principles and Procedures of Plant Breeding: Biotechnological and Conventional Approaches. India: Narosa Publishing House. pp. 1- 624.*

	Level of Thinking	Continuous Learning Assessment (35% weightage)		University Practical Examination (15%)	End semester theory Examination (50%)
		In semester (20%)	Practical (15%)		
Level 1	Remember	40 %	30 %	35%	30 %
	Understand				
Level 2	Apply	40 %	40 %	35%	40 %
	Analyze				
Level 3	Evaluate	20 %	30 %	30%	30 %
	Create				
	Total	100 %	100 %	100%	100 %

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Dr. S M .Prabhu, Ph. D. Senior Breeder (Paddy Breeding and Transgenic) R&D centre, Rasi Seeds (P) Ltd., Attur, Salem – 636141.	*Dr. T. Sabesan Associate rofessor Department of Genetics and Plant Breeding Faculty of Agriculture, Annamalai University, Annamalai nagar , Chidambaram - 608 002 sabavani@gmail.com*	*Dr. G. Selvakumar* *Assistant Professor (GPB)* *Dr. R. Mahendran* *Assistant Professor (GPB)* *Dr. J. Vanitha, Tutor (GPB)*

THEORY

Unit I - Reproductive Systems In Plant Breeding

Objectives and role of plant breeding - historical perspective – activities in Plant Breeding. Centres of origin – contribution of Vavilov, Harlan, Zhukovosky – law of homologous series. Plant genetic resources – importance – germplasm – types – activities – gene erosion - gene bank – collection - conservation – types of conservation – agencies – quarantine. Germplasm: evaluation – use of descriptors, documentation, utilization; Agencies – national and international; germplasm exchange – quarantine. Modes of reproduction – sexual – asexual - self and cross fertilization – significance of pollination. Self incompatibility – classifications–mechanisms–application–measures to overcome and limitations. Sterility – male sterility – classification – CMS, GMS, CGMS - inheritance and applications. TGMS, PGMS, Gametocides, Transgenic Male sterility and applications. Apomixis – introduction – classification - applications; Parthenocarpy and its types.

Unit II - Breeding Methods of Self Pollinated Crops

Basic biometrics - nature and significance of qualitative and quantitative variation - phenotypic, genotypic and environmental variation - heritability and genetic advance. Plant introduction – types of introduction – objectives – quarantine - acclimatization – achievements - merits and demerits. Genetic basis of self pollinated crops – Vilmorin principle of progeny selection - Johannsen's pure line theory. Breeding methods for self pollinated crops without involving artificial hybridization: Pure line selection – merits and demerits – achievements; Mass selection in self pollinated crops – types – comparison of mass and pureline selection – achievements. Breeding methods of self pollinated crops involving artificial hybridization: Creating variability in self pollinated crops - Hybridization and selection — choice of parents – combining ability - combination breeding and transgressive breeding – kinds of emasculation. Pedigree breeding – mass pedigree – merits – demerits – achievements; Bulk breeding – merits – demerits – achievements. Comparison of pedigree and bulk breeding methods. Single Seed Descent (SSD) method – application – merits and demerits. Backcross breeding – prerequisites – procedures for transferring dominant and recessive genes – merits – demerits – multi lines and multi blends - population improvement approach in self-pollinated crops.

Unit III - Breeding Methods of Cross Pollinated Crops and Clonally Propagated Crops

Genetic structure of a population in cross pollinated crop – Hardy Weinberg law – gene frequencies in random mating population – principles in population improvement. Breeding methods of cross pollinated crops without involving artificial hybridization: Mass selection in cross pollinated crops – modified mass selection – unit selection – mass selection with progeny testing – half sib family selection – full sib family selection. Breeding methods of cross pollinated crops involving artificial hybridization: Recurrent selection principles – types merits and demerits. Heterosis breeding – theories - genetic basis – hybrid vigour – estimation of heterosis – inbreeding depression – development of inbreds. Heterosis breeding procedure – use of male-sterility systems and manual emasculation in hybrid seed production – maintenance of parental lines - types of hybrids – achievements – merits and demerits – hybrid variety–merits and demerits. Synthetics and composites-steps in development of synthetics and composites – achievements – merits and demerits. Genetic characters of asexual reproduction – breeding methods – clonal selection – hybridization and clonal selection – merits and demerits – achievements; Chimeras and its types; Tree breeding – clonal orchards.

Unit IV - Special Breeding Methods

Polyploidy breeding – classification – induction of polyploidy – diploid x tetraploid and diploid x hexaploid crosses - achievements – limitations. Wide hybridization - history – importance - barriers and techniques for overcoming barriers-utilization. Mutation breeding: mutation – types – mutagens – breeding procedure – applications – achievements – limitations. Ideotype concept. Somaclonal variation - utilization in crop improvement; *In vitro* selection techniques — Use of doubled haploids in crop improvement. Concept of biotic and abiotic stress resistance breeding. Introduction to markers – morphological – biochemical- DNA markers – uses of Marker Assisted Selection (MAS) - major genes – merits – demerits –achievements.

Unit V - Maintenance Breeding

Types of cultivars – procedure for release of new varieties – stages in seed multiplication – concept of seed certification and TC plants certification. Maintenance Breeding: General seed production techniques – steps in nucleus and breeder seed production – varietal rundown and renovation. Transgenic crops. Concept of Plant Varietal Protection and geographical indications and DUS.

Theory – Lecture Schedule

1. Objectives and role of plant breeding - historical perspective – activities in Plant Breeding
2. Centres of origin – contribution of Vavilov, Harlan, Zhukovosky – law of homologous series
3. Plant genetic resources – importance – germplasm – types – activities – gene erosion - gene bank – collection - conservation – types of conservation – agencies –quarantine
4. Germplasm: evaluation – use of descriptors, documentation, utilization; Agencies – national and international; germplasm exchange –quarantine
5. Modes of reproduction – sexual – asexual - self and cross fertilization – significance of pollination.
6. Self incompatibility – classifications – mechanisms – application – measures to overcome and limitations
7. Sterility – male sterility – introduction – classification – CMS, GMS, CGMS -inheritance andapplications
8. TGMS, PGMS, Gametocides, Transgenic Male sterility andapplications
9. Apomixis – introduction - classification-applications; Parthenocarpy and itstypes

10. Basic biometrics-nature and significance of qualitative and quantitative variation- phenotypic, genotypic and environmental-heritability and geneticadvance
11. Plant introduction- as a breeding method–types of introduction–objectives–quarantine acclimatization – achievements - merits and demerits
12. Genetic basis of self pollinated crops – Vilmorin principle of progeny selection - Johannsen's pure line theory
13. Breeding methods for self pollinated crops without involving artificial hybridization: Pure line selection – procedure – merits and demerits – achievements; Mass selection in self pollinated crops – procedure - types – comparison of mass and pureline selection – achievements
14. Breeding methods of self pollinated crops involving artificial hybridization: Creating variability in self pollinated crops
15. Hybridization and selection – objectives types – choice of parents – combining ability - combination breeding and transgressive breeding- steps in hybridization - kinds of emasculation
16. Pedigree breeding – procedure – mass pedigree – merits – demerits – achievements; Bulk breeding – procedure – merits – demerits –achievements.
17. **In Semester examination**
18. Comparison of pedigree and bulk breeding methods. Single Seed Descent(SSD) method procedure – application – merits and demerits
19. Backcross breeding – genetic principles – prerequisites – procedures for transferring dominant and recessive genes. Back cross breeding – merits – demerits – multi lines and multi blends - population improvement approach in self-pollinated crops
20. Genetic structure of a population in cross pollinated crop – Hardy Weinberg law – gene frequencies in random mating population – principles in population improvement
21. Breeding methods of cross pollinated crops without involving artificial hybridization: Mass selection in cross pollinated crops – modified mass selection – unit selection – mass selection with progeny testing – half sib family selection – full sib family selection
22. Breeding methods of cross pollinated crops involving artificial hybridization: Recurrent selection principles – types – merits and demerits
23. Heterosis breeding – theories - genetic basis – hybrid vigour – estimation of heterosis – inbreeding depression – development of inbreds
24. Heterosis breeding – procedure – use of male-sterility systems and manual emasculation in hybrid seed production
25. Maintenance of parental lines - types of hybrids – achievements – merits and demerits – hybrid variety – merits and demerits
26. Synthetics and composites - steps in development of synthetics and composites – achievements – merits and demerits
27. Genetic characters of asexual reproduction – breeding methods – clonal selection – hybridization and clonal selection – merits and demerits – achievements; Chimeras and its types; Tree breeding – clonal orchards
28. Polyploidy breeding – classification – induction of polyploidy – diploid x tetraploid and diploid x hexaploid crosses - achievements – limitations
29. Wide hybridization-history-importance-barriers and techniques for overcoming barriers- utilization
30. Mutation breeding: mutation – types – mutagens – breeding procedure – applications – achievements – limitations. Ideotype concept
31. Somaclonal variation - utilization in crop improvement; *In vitro* selection techniques –– Use of doubled haploids in crop improvement. Concept of biotic and abiotic stress resistance Breeding
32. Introduction to markers – morphological – biochemical- DNA markers – uses of marker assisted selection - major genes – merits – demerits –achievements
33. Types of cultivars– procedure for release of new varieties–stages in seed multiplication concept of seed certification and TC plants certification
34. Transgenic crops. Concept of Plant Varietal protection, geographical indications and DUS

Practical Schedule

1. Pollination and reproduction in plants
2. Description and drawing different pollination systems - Mechanisms enforcing self and cross pollination in crops; Pollen morphology - Exine structure of different crops. Fertility and sterility in A, B, R and TGMS lines
3. Breeder kit and its components – uses; Basic steps of selfing and crossing techniques
4. Emasculation and pollination techniques in field crops
5. Emasculation and pollination techniques in horticultural crops
6. Studies on segregating generation and maintenance of records
7. Maintenance of A, B and R line and TGMS lines - Hybrid seed production techniques
8. Estimation of heterosis
9. Induction of polyploidy using colchicine
10. Studies on different wild species in crop plants and wide hybridization
11. Irradiation - dosimetry - half life period - procedure for irradiation of seeds and planting materials Chemical mutagenesis - molar solution preparation - procedure for chemical mutagenesis of seeds and planting materials
12. Germplasm preservation – conservation - records maintained in research stations
13. Calculation of PCV, GCV, heritability, genetic advance
14. Layout of different yield trials - Observing the experimental plots - nucleus and breeder seed production plots
15. Screening methods – laboratory and field – for biotic and abiotic stresses

16. Procedure for marker assisted selection.
17. **University Practical Examination**

Text Books

1. Allard, R. (2010). *Principles of Plant breeding* (2nd ed.). India: Wiley India Pvt Ltd. pp. 1- 247.
2. Bharadwaj, D. N. (2012). *Breeding Field Crops*. Jodhpur: Agrobios (India). pp. 1- 934.
3. Chahal, G. S. & Gosal, S. S. (2002). *Principles and Procedures of Plant Breeding: Biotechnological and Conventional Approaches.* India: Narosa Publishing House. pp. 1- 624.
4. Singh, B.D. (2018). *Plant breeding - Principles and Methods.* India: Kalyani Publishers. pp. 1- 889.

Reference Books

1. Annaliese S. Mason. (2017). *Polyploidy and hybridizaton for crop improvement*. USA: CRC Press. pp. 1- 490.
2. Chaudhary, H. K. (1980). *Elementary Principles of plant breeding.* New Delhi: Oxford and IBH publication Co. pp. 1- 303.
3. Chopra, V. L. (1994). *Plant breeding theory and practice.* New Delhi: Oxford and IBH Publishing Co. Pvt. Ltd. pp. 1- 490.
4. Daniel Sundararaj, Thulasidas, G. & Stephen Dorairaj, M. (1997). *Introduction to Cytogenetics and Plant Breeding.* Chennai : Popular Book Depot. pp. 1- 362.
5. George Acquaah. (2012). *Principles of Plant Genetics and Breeding* (2nd ed.). Blackwell, USA. pp 1- 739.
6. Sharma, J. R. (1994). *Principles and practice of plant breeding.* Tata McGraw-Hill publishing Co, New Delhi. pp. 1- 599.

Web-References

1. https://www.britannica.com/science/plant-breeding
2. https://www.farm-europe.eu/travaux/new-plant-breeding-techniques-what-are-we-talking-about/
3. https://www.ag.ndsu.edu/plantsciences/research/durum/breeding-methods
4. https://www.toppr.com/guides/biology/strategies-for-enhancement-in-food-production/plant-breeding/http://www.edugreen.teri.res.in/explore/bio/breed.htm
5. http://cuke.hort.ncsu.edu/gpb/
6. http://www.stumbleupon.com/tag/plant-breeding
7. http://www.iaea.org/
8. https://www.youtube.com/watch?v=eZ0O0-tbhCs&list=PLMwQyDnbQLRUsaJXwn0lgTREs3e3pmqYi

Journals

1. Plant Breeding and Crop Science
2. Plant Breeding (Wiley)
3. Frontiers in Plant Science
4. Electronic Journal of Plant Breeding (EJPB)

Course Nature: Theory based Practical							
Total Marks (100)							
S.No.	Category	**Assessment Tools**					
		In- Semester Examination	Assignment	Record	Attendance	End-Semester Examination	Marks
1	Theory-External	-	-		-	*50*	*50*
2	Theory-Internal	*20*	-			-	*20*
3	Practical-External	-	-		-	*15*	*15*
4	Practical-Internal	-	*05*	*05*	*05*	-	*15*
						Grand Total	*100*

Course Code	AGE19301	Course Name	CROP PRODUCTION TECHNOLOGY – I (*KHARIF* CROPS)	Course Category	C	Compulsory Core	L	T	P	C
							1	0	1	2

Pre-requisite Courses	Nil	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Agronomy*	Data Book / Codes/Standards		*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	*2*	*3*
CLR-1 :	*Explain the importance, origin and distribution of Kharif crop*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-2 :	*Identify the improved varieties and climate requirements for Kharif crops.*			
CLR-3 :	*Explain the improved agronomic practices for harvesting the good economical yield under different agro-climatic conditions of Tamil Nadu and India*			
CLR-4 :	*Apply the various agronomic inputs for raising different crops and intensive cultivation to increase the food production*			
CLR-5 :	*Discuss the scientific principles of crop production*			
CLR-6 :	-			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*			
CLO-1 :	*Demostrate competency in sustainable field crop management.*	2	80	75
CLO-2 :	*Recall thetechnical and scientific principles of the cultivation of kharif crops and the ability to modify the factors influencing the quantity and quality of crop yield.*	3	85	90
CLO-3 :	*Recongnise the cropped species, their requirements and the practices to obtain the main agricultural products.*	2	80	85
CLO-4 :	*Demonstrate a conceptual understanding of key aspects of husbandry operations required to grow the major kharif crops successfully*	3	85	80
CLO-5 :	*Identify the critical management factors involved in profitable crop production*	2	80	75
CLO6 :	-			

Program Learning Outcomes (PLO)														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Agriculture Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	Ability to solve scientific problems	Ability to implement knowledge gained	Ability to understand social and ethical responsibilities
H		L			M	M		M	H		H	H	H	H
H				L		H		M	H		H	H	M	H
M				L	L	M		H	H		H	H	H	M
H	L		M			L		M	H	L	H	H	H	H
H			L			M		M	H		H	H	H	H

		Learning Unit / Module 1	Learning Unit / Module 2	Learning Unit / Module 3	Learning Unit / Module 4	Learning Unit / Module 5
Duration (hour)		4	4	3	4	3
S-1	SLO-1	*Importance of cereals (kharif)*	*Maize – origin, variety, climate*	*Pigeon pea– origin, variety, climate*	*Groundnut – origin, variety, climate*	*Cotton – origin, variety, climate*
	SLO-2	*Importance of millets (kharif)*	*Maize – cultivation practices*	*Pigeon pea– cultivation practices*	*Groundnut– cultivation practices*	*Cotton – cultivation practices*
S-2,3	SLO-1	*Lab 1. Identification of cereals, millets, pulses and oilseed crops in the crop cafeteria*	*Lab 4. Acquiring skill in different seed treatment techniques in important kharif crops*	*Lab 8. Acquiring skill in using seed drill for sowing operations*	*Lab 11. Observations on growth parameters of pulses and oilseeds*	*Lab 14. Working out cost and returns of important cereals, millets, pulses and oilseeds crops*
	SLO-2					
S-4	SLO-1	*Importance of major pulses (kharif)*	*Sorghum– origin, variety, climate*	*Blackgram production technology*	*Sesame – origin, variety, climate*	*Cultivation practices of Jute*
	SLO-2	*Importance of major oil seeds (kharif)*	*Sorghum – cultivation practices*	*Package of practices of green gram*	*Sesame – cultivation practices*	*Production technology of Mesta*
S-5,6	SLO-1	*Lab 2. Practicing various nursery types and main field preparation for rice crop*	*Lab 5. Estimation of plant population per unit area for important kharif crops*	*Lab 9. Acquiring skill in foliar nutrition for important field crops*	*Lab 12. Study of yield parameters and estimation of yield in cereals and millets*	*Lab 15. Visit to farmers field / research stations to study the cultivation techniques of cereal, millets, pulses, cotton and oilseeds*
	SLO-2					
S-7	SLO-1	*Rice – economic important*	*Pearl millet – origin, variety, climate*	*Cowpea– origin, variety, climate*	*Soybean – origin, variety, climate*	*Package of practices of fodder sorghum*
	SLO-2	*Rice – origin, variety - climate*	*Pearl millet – cultivation practices*	*Cow pea– cultivation practices*	*Soybean – cultivation practices*	*Cumbu napier cultivation technology*
S-8,9	SLO-1	*Lab 3. Nursery and main field preparation*	*Lab 6. Acquiring skill in field preparation,*	*Lab 10. Observations on growth*	*Lab 13. Study of yield parameters and*	*Lab 16. Visit to nearby Agricultural*

	SLO-2	*for important millets, pulses and oilseeds*	*sowing and manuring of crops under pure and intercropping situations for cereals and millets*	*parameters of cereals and millets*	*estimation of yield in pulses and oilseeds*	*Research Station / Farmer's field*
S-10	*SLO-1*	*Rice cultivation methods*	*Finger millet – origin, variety, climate*	-	-	-
	SLO-2	*Special methods of rice cultivation*	*Finger millet – cultivation practices*	-	-	-
S-11,12	*SLO-1*	-	*Lab 7. Acquiring skill in field preparation, sowing and manuring of crops under pure and intercropping situations for pulses and oilseeds*	-	-	-
	SLO-2	-		-	-	-

Learning Resources	1. *Ahlawat,I.P.S., Om Prakash and Saini, G.S. (2010). Scientific Crop Production in India. Rama publishing House, Meerut. pp. 1- 680.* 2. *Chidda Singh, Prem Singh and Rajbir Singh. (2020). Modern Techniques of Raising Field Crops. Oxford and IBH Publishing Co Pvt.Ltd, New Delhi. pp. 1- 596.* 3. *Mukund Joshi., (2015). Text Book of Field Crops. PHI Learning Private limited. New Delhi. pp. 1- 537.* 4. *Rajendra Prasad. (2017). Textbook of Field Crops Production (Volume 1 & 2). Indian Council of Agricultural Research (ICAR), New Delhi. pp. 1-1008.*

	Level of Thinking	Continuous Learning Assessment (35% weightage)		University Practical Examination (15%)	End semester theory Examination (50%)
		In semester (20%)	Practical (15%)		
Level 1	Remember	40 %	30%	30%	40 %
	Understand				
Level 2	Apply	40 %	40 %	35%	40 %
	Analyze				
Level 3	Evaluate	20 %	30 %	35%	20 %
	Create				
	Total	*100 %*	*100 %*	*100 %*	*100 %*

.

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Mr.P.B. Mukundan Organic farming Progressive farmer H. No. 92, Rajaji, Street, Chengalpattu – 603001 Tamil Nadu.	Dr. M. Mohamed Amanullah, Professor (Agronomy), Maize Research Station, Tamil Nadu Agricultural University Vagarai – 624 613, Palani Taluk, Dindigul District.	Dr. N. Krishnaprabu Dr. D. Selvakumar Dr. S. Marimuthu

THEORY

Unit - I CEREALS
Rice, Maize, - Origin, geographic distribution, economic importance, soil and climatic requirements, varieties, cultural practices (from land preparation to harvest) and yield.

Unit - II Millets
Sorghum, Pearl millet, Small millets - Finger millet, Foxtail millet, little millet, Kodo millet, Barnyard millet and Proso millet - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield.

Unit – III Pulses
Redgram, Blackgram, Greengram, Cowpea - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices, and yield.

Unit - IV Oilseeds (*Kharif*)
Groundnut, sesame, Soybean- Origin, and geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices, yield.

Unit – V Fibre and Forage
Cotton, Jute, Mesta, Fodder sorghum, Cumbu napier- Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices, and yield.

Cereals	Rice, maize
Millets	Sorghum, pearl millet, finger millet and minor millets
Pulses	Pigeon pea, green gram, black gram, cowpea,
Oilseeds	Groundnut, sesame, soybean
Fibre & Forage	Cotton, jute, fodder sorghum, Cumbu napier

Theory - Lecture Schedules
1. Importance and area, production and productivity of major cereals and millets of India and Tamil Nadu.
2. Importance and area, production and productivity of pulses and oilseeds crops of India and Tamil Nadu.
3. Rice - Origin - geographic distribution - economic importance - varieties - soil and climatic requirement.
4. Rice - cultural practices - yield - economic benefits.
5. Special type of Rice cultivation – SRI - and Hybrid rice cultivation.
6. Maize - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield.
7. Sorghum and Pearl millet - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield.
8. Finger millet and Minor millets - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield.
9. **In-Semester Examination.**
10. Pigeon pea - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield.
11. Greengram, Blackgram and Cowpea - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield - Agronomy of rice fallow pulses.
12. Groundnut - Origin, geographical distribution, economic importance, soil and climatic requirements - varieties, cultural practices yield and economics.
13. Sesame and Soybean - Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield.
14. Cotton - Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield.
15. Jute and Mesta- Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield.
16. Fodder sorghum- Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield.
17. Cumbu napier- Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield.

Practical Schedules
1. Identification of cereals, millets, pulses and oilseed crops in the crop cafeteria.
2. Practicing various nursery types and main field preparation for rice crop.
3. Nursery and main field preparation for important millets, pulses and oilseeds.
4. Acquiring skill in different seed treatment techniques in important kharif crops.
5. Estimation of plant population per unit area for important kharif crops.
6. Acquiring skill in field preparation, sowing and manuring of crops under pure and intercropping situations for cereals and millets.

7. Acquiring skill in field preparation, sowing and manuring of crops under pure and intercropping situations for pulses and oilseeds.
8. Acquiring skill in using seed drill for sowing operations.
9. Acquiring skill in foliar nutrition for important field crops.
10. Observations on growth parameters of cereals and millets.
11. Observations on growth parameters of pulses and oilseeds.
12. Study of yield parameters and estimation of yield in cereals and millets.
13. Study of yield parameters and estimation of yield in pulses and oilseeds.
14. Working out cost and returns of important cereals, millets, pulses and oilseeds crops.
15. Visit to farmers field / research stations to study the cultivation techniques of cereal, millets, pulses, cotton and oilseeds.
16. Visit to nearby Agricultural Research Station / Farmer's field.
17. **University practical examination**

Text Books

1. Ahlawat,I.P.S., Om Prakash and Saini, G.S. (2010). *Scientific Crop Production in India.* Rama publishing House, Meerut. pp. 1- 680.
2. Chidda Singh, Prem Singh and Rajbir Singh. (2020). *Modern Techniques of Raising Field Crops.* Oxford and IBH Publishing Co Pvt.Ltd, New Delhi. pp. 1- 596.
3. Mukund Joshi., (2015). *Text Book of Field Crops.* PHI Learning Private limited. New Delhi. pp. 1- 537.
4. Rajendra Prasad. (2017). *Textbook of Field Crops Production (Volume 1 & 2).* Indian Council of Agricultural Research (ICAR), New Delhi. pp. 1-1008.
5. Reddy. S.R. (2014). *Principles of Crop Production.* Kalyani Publishers, Ludhiana. pp. 1- 794.

Reference Books

1. Alabaster Jenkins. (2016). *Agronomy and crop production.* Syrawood publishing house, UK. pp. 1- 205.
2. Crop Production Guide. (2020). Directorate of Agriculture, Chennai and Tamil Nadu Agricultural University, Coimbatore. pp. 1-460.
3. Reddy, S.R. (2012). *Agronomy of field crops.* Kalyani publishers, New Delhi. pp. 1- 443.
4. Singh. S.S. (2015). *Crop management under irrigated and rainfed conditions.* Kalyani Publishers, New Delhi. pp. 1- 574.
5. Srinivasan Jeyaraman. (2018). *Field crops production and management (Volume I & 2).* Oxford and IBH Publishers. India. pp. 1- 1068.
6. Yellamanda Reddy, T. and G.H. Sankara Reddy. (2017). *Principles of Agronomy*. Kalyani publishers, Ludhiana. pp. 1- 685.

Web References

1. www.crida.org
2. www.cgiar.org
3. www.tnau.ac.in/agriporal
4. www.rkmp.irri.org.
5. https://www.agrimoon.com/wp-content/uploads/Introduction-to-major-field-crops.pdf

Journals

1. Journal of crop and weed
2. Field crop Research
3. Indian journal of Agronomy
4. Legume Research
5. Advances in Agronomy

Course Nature: Theory based Practical							
Total Marks (100)							
Assessment Tools							
S. No.	Category	In- Semester Examination	Assignment	Record	Attendance	End-Semester Examination	Marks
1	Theory-External	-	-		-	*50*	*50*
2	Theory-Internal	*20*	-			-	*20*
3	Practical-External	-	-		-	*15*	*15*
4	Practical-Internal	-	*05*	*05*	*05*	-	*15*
						Grand Total	*100*

Course Code	AGE 19302	Course Name	PRINCIPLES OF IRRIGATION MANAGEMENT	Course Category	C	Compulsory core	L	T	P	C
							1	0	1	2

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Agronomy	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1 :	Summarize the fundamental understanding of different irrigation water resources and its role on agriculture
CLR-2:	Identify the factors that influence soil water plant relationship
CLR-3:	Explain the basic requirements of irrigation and various irrigation techniques, requirements of the crops
CLR-4:	Determine the total water volume needs per unit of time and irrigation delivery
CLR-5:	Explain drainage in crop production and the need to control waterlogging and salinization
CLR-6:	Identify water resource use within the environment

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Agriculture Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	Ability to solve scientific problems	Ability to implement knowledge gained	Ability to understand social and ethical responsibilities
CLO-1:	Summarize the conceptual irrigation water management in crop production	1	75	80	M								M	H		H	H	H	H
CLO-2:	Interpret the critical awareness and understanding of challenges for future water professionals.	2	80	85	H						H		M	H		H	H	H	H
CLO-3:	Demonstrate designing and construction of irrigation structures for effective water productivity	2	80	70	M		H		L	L	M		H	H		H	H	H	H
CLO-4:	Calculate water budgets used to develop irrigation schedules	3	85	80	M			M					M	H		H	H	H	H
CLO-5:	Determine water requirements of crops and the irrigation schedule for different crops	2	90	85	H	L		L					M	H		H	H	H	H
CLO6:	Outline the factors related to drainage, essential to design, and manage a drainage system	3	85	80	H		H	H	M		H		H	H	L	H	H	H	H

		Learning Unit / Module 1	Learning Unit / Module 2	Learning Unit / Module 3	Learning Unit / Module 4	Learning Unit / Module 5
Duration (hour)		2	4	3	4	3
S-1	SLO-1	History and water resources	Concept of Soil-Water-Plant Continuum	Water requirement of major crops	Concept of irrigation scheduling	Quality of irrigation water
	SLO-2	Water availability and demand	Kinds of soil water	Consumptive water use (CU)	Irrigation scheduling approaches	Management of poor-quality water
S-2,3	SLO-1	Lab 1. Observation of irrigation structures in wetlands and irrigated drylands	Lab 3. Assessment of irrigation water quality parameters	Lab 7. Scheduling of irrigation based on indicator plants, soil-sand mini plot technique	Lab 10. Layout and operation of different surface irrigation systems	Lab 14. Determining the irrigation efficiency parameters
	SLO-2					
S-4	SLO-1	Role of water in crop growth	Soil water movement	Definition of crop water requirement	Surface methods of irrigation	Irrigation management in major crops
	SLO-2	Role of Govt. for promotion of irrigation	Soil moisture extraction pattern	Crop water requirement methods	Surface methods of irrigation	
S-5,6	SLO-1	Lab 2. Estimation of soil moisture by gravimetric methods	Lab 4. Estimation of ET – Empirical formula	Lab 8. Scheduling of irrigation based on depletion of available soil moisture and IW/CPE ratio	Lab 11. Layout, operation and maintenance of drip irrigation systems	Lab 15. Working out cost economics of irrigation systems
	SLO-2					
S-7	SLO-1	-	Estimation of evapotranspiration	Water flow measuring device	Drip irrigation	Scope and importance of drainage
	SLO-2	-	Crop co –efficient	Critical stages of irrigation for major crops	Sprinkler irrigation	Methods of drainage
S-8,9	SLO-1	-	Lab5. Estimation of effective Rainfall –	Lab 9. Measurement of water flow: flumes,	Lab 12. Layout, operation and	Lab 16. Observation on irrigation and

	SLO-2	-	*Soil moisture balance*	*weirs and water meters*	*maintenance of sprinkler irrigation systems*	*drainage structures during on/off campus field visits*
S-10	SLO-1	-	*Plant water stress*	-	*Irrigation efficiency*	-
	SLO-2	-	*Overcome the plant water stress*	-	*Water budgeting*	-
S-11,12	SLO-1	-	*Lab 6. Estimation of water and irrigation requirement for major crops*	-	*Lab 13. Fertigation systems & scheduling of fertilizers to major crops*	-
	SLO-2	-		-		-

Learning Resources	1. Dilip Kumar Mujmdar. (2013). *Irrigation Water Management: Principles and Practices.* Prentice Hall of India Pvt. Ltd. pp. 1-557. 2. Michael, A.M. (2015). *Irrigation Theory and Practices.* Vikas publishing house Pvt., Ltd. New Delhi. pp. 1-768.	3. Suresh, R. (2010). *Micro Irrigation: Theory and practices*. Standard publishers, New Delhi. 1-704.

	Level of Thinking	Continuous Learning Assessment (35% weightage)		University Practical Examination (15%)	End semester theory Examination (50%)
		In semester (20%)	Practical (15%)		
Level 1	Remember Understand	40 %	30 %	30%	40 %
Level 2	Apply Analyze	40 %	40 %	35%	40 %
Level 3	Evaluate Create	20 %	30 %	35%	20 %
	Total	*100 %*	*100 %*	*100%*	*100 %*

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Mr. Krishnan *The Green Turf Irrigation PVT LTD* *#23/6, first main road, Jawahar Nagar, Chennai-600 082.*	*Dr. M.V. Rangaswami, Dean& Head, Department of Agriculture Engineering, Saveetha Engineering College, Saveetha Nagar, Thandalam, Chennai-602 105*	*Dr. S. Marimuthu* *Dr. N. Krishnaprabu* *Dr. D. Selvakumar*

THEORY

Unit I - Water Resources

Water resources in World, India and Tamil Nadu; History and development of irrigation in India; Importance of water; Water availability and demand; Role of water in plant growth; Role of Govt. for the promotion of micro-irrigation in India.

Unit II - Soil- Water -Plant- Relationship

Soil - Plant - Atmospheric - Continuum (SPAC); Kinds of soil water; Soil water potential; Hydrological cycle; Soil Water Movement; Soil moisture constants; Distribution of soil moisture; moisture extraction pattern - Absorption of water; Evapotranspiration - Crop Co-efficient; Plant water stress and its effect.

Unit III - Crop Water Requirement

Water requirement for major crops - Factors affecting water requirement - Potential Evapotranspiration (PET) and consumptive use (CU) - Determining Crop Water requirement; Transpiration Ratio method, depth interval yield method, Water balance method, lysimeter studies - Effective rainfall - Water flow measuring devices - Critical stages of irrigation for major crops.

Unit IV - Scheduling of Irrigation and Methods of Irrigation

Concepts of irrigation scheduling: different approaches; Soil moisture regime, climatological and plant indices - Methods of irrigation; surface, sub-surface and pressurized irrigation, their suitability, merits and limitations; Fertigation: Merits and Demerits; Water Use Efficiency (WUE); Conjunctive use of water; Irrigation efficiency; Water budgeting; Virtual water.

Unit V - Irrigation Management and Drainage

Deficit irrigation; Quality of irrigation water; Management practices for use of poor-quality irrigation water; Water management for major crops; Drainage: definition, scope, importance and various methods.

Theory - Lecture Schedule

1. Water resources in World, India and Tamil Nadu - History and development of irrigation in India; Water availability and demand
2. Role of water in plant growth- importance of irrigation - Role of Govt. for the promotion of micro-irrigation in India
3. Soil- plant- water relations, Soil-Water-Plant Continuum (SPAC); hydrologic cycle, Kinds of soil water - Soil water potential
4. Soil water movement- saturated and unsaturated flow and vapour movement, Soil moisture constants - Distribution of soil moisture; moisture extraction pattern.
5. Evapotranspiration - Crop Co-efficient; various methods
6. Plant water stress- plant response and adaptations and its effect and methods to overcome plant water stress
7. Water requirement for major crops - Factors affecting water requirement - Potential Evapotranspiration (PET) and consumptive use (CU).
8. Crop Water requirement; Transpiration Ratio method, depth interval yield method, Water balance method, lysimeter studies - Effective rainfall.
9. **In- Semester Examination**
10. Water flow measuring devices - Critical stages of irrigation for major crops
11. Irrigation scheduling: different approaches; Soil moisture regime, climatological and plant indices.
12. Methods of irrigation; surface and sub-surface and pressurized irrigation methods.
13. Drip and sprinkler irrigation; their suitability, merits and limitations - Fertigation: advantages.
14. Water Use Efficiency (WUE): Irrigation efficiency -Water budgeting - Virtual water; Deficit irrigation.
15. Quality of irrigation water - Management practices for use of poor-quality water (saline, effluent and sewage water) for irrigation;
16. Irrigation water management in major crops.
17. Drainage: definition, scope, importance and various methods.

Practical Schedule

1. Observation of irrigation structures in wetlands and irrigated drylands
2. Estimation of soil moisture by gravimetric methods
3. Assessment of irrigation water quality parameters
4. Estimation of ET – Empirical formula
5. Estimation of effective Rainfall – Soil moisture balance
6. Estimation of water and irrigation requirement for major crops
7. Scheduling of irrigation based on indicator plants, soil-sand mini plot technique.
8. Scheduling of irrigation based on depletion of available soil moisture and IW/CPE ratio
9. Measurement of water flow: flumes, weirs and water meters
10. Layout and operation of different surface irrigation systems
11. Layout, operation and maintenance of drip irrigation systems

12. Layout, operation and maintenance of sprinkler irrigation systems
13. Fertigation systems & scheduling of fertilizers to major crops
14. Determining the irrigation efficiency parameters
15. Working out cost economics of irrigation systems
16. Observation on irrigation and drainage structures during on/off campus field visits
17. **University practical examination**

Text Books

1. Burton, M. (2010). *Irrigation Management Principles and Practices.* CABI. pp. 1-375.
2. Dilip Kumar Mujmdar. (2013). *Irrigation Water Management: Principles and Practices.* Prentice Hall of India Pvt. Ltd. pp. 1-557..
3. Panda, S.C. (2009). *Principles and Practices of Water Management.* Agrobios (India), Rajasthan. pp. 1-345.
4. Patil, S.V. and Rajakumar, G.R. (2016). *Water Management in Agriculture and Horticultural Crops.* Satish serial publishing House, Delhi. pp. 1-110.
5. Rao, Y.P. and Bhaskar, S.R. (2008). *Irrigation Technology. Theory and practices.* Agrotech publishing Academy, Udaipur. pp. 1-472.
6. Suresh, R. (2010). *Micro Irrigation: Theory and practices.* Standard publishers, New Delhi.pp. 1-704.

Reference Books

1. Ali, M.H. (2011). *Practices of Irrigation & On-farm Water Management (volume 1 & 2).* Springer-Verlag New York. pp. 1-518.
2. Carr, M.K.V. and Elias Fereres. (2014). *Advances in Irrigation Agronomy (fruits, vegetables).* Cambridge University Press. pp.1-360.
3. Davis Twomey. (2016). *Sustainable irrigation Management.* Callisto Reference, USA. pp. 1-228.
4. Goyal, M.R. (2015). *Sustainable micro irrigation design systems for agricultural crops.* Taylor and Francis. pp. 1-356.
5. Michael, A.M. (2015). *Irrigation Theory and Practices.* Vikas publishing house Pvt., Ltd. New Delhi. pp. 1-768.

Web References

1. agritech.tnau.ac.in/agriculture/agri_irrigationmgt.html
2. http://agriinfo.in/default.aspx?page=topiclist&superid=1&catid=67
3. www.dripirrigation.org
4. www.jains.com
5. www.springerlink.com/content/u35k21u5548x7320
6. www.wcc.nrcs.sda.gov/irrig.info.html
7. www.croinfo.net/irrigschedule.htm

Journals

1. Agricultural water management
2. International Journal of Water Resources Development
3. Journal of Indian Water Resources Society
4. Journal of Soil and Water Conservation
5. Irrigation science
6. Irrigation and Drainage Systems Engineering

Course Nature: Theory based Practical							
Total Marks (100)							
Assessment Tools							
S. No.	Category	In- Semester Examination	Assignment	Record	Attendance	End-Semester Examination	Marks
1	Theory-External	-	-		-	*50*	*50*
2	Theory-Internal	*20*	-			-	*20*
3	Practical-External	-	-		-	*15*	*15*
4	Practical-Internal	-	*05*	*05*	*05*	-	*15*
Grand Total							*100*

Course Code	AGS19301	Course Name	AGRICULTURAL FINANCE AND COOPERATION	Course Category	S	Supportive course	L	T	P	C
							2	0	1	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Agricultural Economics	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1 :	Explain the importance of agricultural finance
CLR-2 :	Identify and understand the Agriculture Finance institutions
CLR-3 :	Discuss the Farm finance analysis
CLR-4 :	Describe the types of banking institutions in India and overseas financial institutions
CLR-5 :	Identify Agriculture co-operations and cooperation institutions in India
CLR-6 :	Explain RBI, monetary policies and non-banking financial institutions and Insurance for crops

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Agriculture Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	Ability to solve scientific problems	Ability to implement knowledge gained in the applied field of Business Management	Ability to understand social and ethical responsibilities
CLO-1 :	Outline the financial activities in a farm	3	90	80	M	M	H	L	H	M	M	H	M	H	H	H	H	H	H
CLO-2 :	Identify the institutional approach to avail projects and funding	1	90	85	H	M	M	H	M	H	M	M	L	H	H	H	H	H	H
CLO-3 :	Describe on financial products in banks	2	75	70	M	H	L	M	M	H	M	M	H	H	H	H	H	H	H
CLO-4 :	Recall the information on central bank and monetary policies	3	80	75	M	H	M	M	L	M	L	M	M	H	H	H	H	H	H
CLO-5 :	Summarize the Activities of Agriculture cooperative banks and regional rural banks	2	85	80	M	M	H	M	M	M	M	M	M	H	H	H	H	H	H
CLO6 :	Identify Credit gaps and Agriculture insurances	2	85	80	M	H	M	H	H	L	H	L	M	H	H	H	H	H	H

		Learning Unit / Module 1	Learning Unit / Module 2	Learning Unit / Module 3	Learning Unit / Module 4	Learning Unit / Module 5
Duration (hour)		15	15	15	15	15
S-1	SLO-1	*Agriculture Finance*	*RBI (Central bank of India)*	*Bankable projects*	*Agricultural Cooperation in India*	*Crop Insurance: Schemes*
	SLO-2	*Agriculture Credits*	*Monetary policies*	*Farm credit proposals*	*Co-operating credit structure*	*Estimation of Crop Yields*
S-2	SLO-1	*Agriculture Credits Classifications*	*World bank*	*Credit analysis*	*Short term and long term*	*Weather based crop insurance*
	SLO-2	*History of rural credits*	*IMF*	*Discount and non-discount analysis*	*Farming cooperatives*	*Components in WBCI*
S-3-4	SLO-1	***Lab-1** Determinants of capital use,*	***Lab-4** Visit to Commercial banks*	***Lab-7** Preparation of bankable projects*	***Lab-11** Analysis on Balance sheet*	***Lab-14** Assessment of crop losses*
	SLO-2	*Profitable level of capital utilization*	*Role and functions of Commercial banks*	*Feasibility of farm credit proposals*	*Analysis on Income statement*	*Determination of compensation*
S-5	SLO-1	*Sources of Agriculture credits*	*NABARD*	*Compounding*	*ICA, and NCUI*	*Agricultural Insurance company*
	SLO-2	*Rural indebtedness*	*Flow of Co-operative banks*	*Discounting*	*NCDC and NAFED*	*Role and importance of AIC Ltd.*
S-6	SLO-1	*Micro financing*	*Regional Rural Banks*	*Undiscounted measures*	*Strength of co-operatives*	*Importance of value addition in farm*
	SLO-2	*Recent Agriculture finance policies*	*Importance of RRB*	*Discounted measures*	*Weakness of co-operatives*	*Key components in value addition*
S-7-8	SLO-1	***Lab-2** Optimum allocation of capital,*	***Lab-5** Visit to DCCB, Role and functions*	***Lab-8** Balance sheet*	***Lab-12** Preparation of bankable projects*	***Lab-15** Livestock Insurance Schemes*
	SLO-2	*Enterprises in farming*	*of Cooperative banks*	*Income statement*	*Preparation of farm credit proposal*	*Estimation of LIS*
S-9	SLO-1	*Priority sector and financing*	*Lead bank policy*	*Farm records*	*Negotiable Instruments*	*Analysis on Various CIS*

	SLO-2	*Nationalization of banks*	*KCC and SHG*	*Entries in farm records*	*NPA – Causes, consequences*	*Merits and demerits of existing CIS*
S-10-11	SLO-1	*Progress of cooperatives*	***Lab-6** Importance of lead bank*	***Lab-9** Preparation of Balance sheet*	***Lab-13** Undiscounted measures and sis*	***Lab-16** Students Presentation*
	SLO-2	*Performance of cooperatives*	*Role of NABARD in rural credits*	*Preparation of Cash flow statement*	*Discounted measures of analysis*	
S-12	SLO-1	*Commercial banks*	*Recent change in Agrl. credit*	*Time value of money*	*Role of RBI*	*Case study on credit availed farm –CB*
	SLO-2	*Micro-financing*	*Priority lending*	*Financial statements in farm*	*Monetary policies and instruments*	*Credit availed cooperative member*
S-13-14	SLO-1	*Progress of commercial banks*	*4 R's of Credit*	*SWOT – Analysis*	*Credit rationing*	
	SLO-2	*Performance of commercial banks*	*7 P's and 3C's of credits*	*Financial ratio Analysis*	*Credit gap*	
S-15	SLO-1	***Lab-3** SHG Models, Lead banks*	*Subsidized farm credits*	***Lab-10** Financial ratios*	*District consultative group*	
	SLO-2		*Differential interest rate*	*Importance of financial ratios*	*District credit plan*	

Learning Resources	1. *Bhagat, D.(2014). Textbook of Agricultural Marketing and Co-operation. India: Neha Publishers & Distributors. pp. 2-66* 2. *Charles Moss, B. (2013). Agricultural Finance,.UK: Routledge Company. pp.1-295* 3. *Geman,H. (2015). Agricultural Finance: From Crops to Land, Water and Infrastructure (The Wiley Finance Series). USA: Wiley Publishers. pp. 1-288*	4. *Lee, W.F., Boehlje, M.D., Nelson, A.G., & Murray,W.G. (1998). Agricultural Finance.New Delhi: Kalyani Publishers. pp. 1- 468* 5. *Reddy, S, S. (2017). Agricultural Finance and Management. New Delhi: Oxford & IBH Publishing.pp.1-268*

	Level of Thinking	Continuous Learning Assessment (35% weightage)		University Practical Examination (15%)	End semester theory Examination (50%)
		In semester (20%)	Practical (15%)		
Level 1	*Remember*	40 %	30 %	35%	30 %
	Understand				
Level 2	*Apply*	40 %	40 %	35%	40 %
	Analyze				
Level 3	*Evaluate*	20 %	30 %	30%	30 %
	Create				
	Total	100 %	100 %	100%	100 %

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Mr. K. Arun, Business Manager, *EDII Periyakulam Horti Business Incubation Forum,* *Periyakulam*	*Dr. D. Sureshkumar, Professor and Head,* *Department of Agricultural Economics,* *Centre for Agricultural and Rural Development Studies,* *Tamil Nadu Agricultural University, Coimbatore – 3*	*Dr. Anbarassan A* *Dr. Periasami N*

THEORY

Unit I – Agricultural Finance – Nature and Scope

Agricultural Finance- meaning, scope and significance, credit needs and its role in Indian agriculture. Agricultural credit: meaning, definition, need, classification. Sources of credit - advantages and disadvantages - Rural indebtedness- History and Development of rural credit in India.

Unit II – Financial Institutions

Sources of agricultural finance: institutional and non-institutional sources and their roles, commercial banks - social control and nationalization of commercial banks. Micro financing including KCC, Micro finance – SHG Models, Lead Bank Scheme, RRBs, Scale of finance and unit cost. Cost of credit. An introduction to higher financing institutions – RBI, NABARD, ADB, IMF, world bank, Insurance and Credit Guarantee Corporation of India. Recent development in agricultural credit: Rural credit policies of Government – Subsidized farm credit - Differential Interest Rate (DIR) Scheme – Loan relief measures

Unit III – Farm Financial Analysis

Credit analysis: 4 R's, 7 P's and 3C's of credit. Preparation of bankable projects / Farm credit proposals – Feasibility; Appraisal - Time value of money: Compounding and Discounting - Undiscounted and Discounted measures. Preparation and analysis of financial statements – Balance Sheet, Income Statement and Cash Flow Statement. Basic guidelines for preparation of project reports - Bank norms – SWOT analysis.

Unit IV – Co-operation

Agricultural Cooperation in India – Meaning, brief history of cooperative development in India - Pre and Post - Independence periods and Co-operation in different plan periods, objectives, principles of cooperation, significance of cooperatives in Indian agriculture. Co-operating credit structure: short term and long term. Agricultural Cooperation - credit, marketing, consumer and multi-purpose cooperatives, farmers' service cooperative societies, processing cooperatives, farming cooperatives, cooperative warehousing; role of ICA, NCUI, NCDC, NAFED. Strength and weakness of co-operative credit system, Policies for revitalizing co-operative credit.

Unit V – Banking and Insurance

Negotiable Instruments: Meaning, Importance and Types - Central bank: RBI – functions - Credit control – Objectives and Methods: CRR, SLR and Repo rate - Credit rationing - Dear money and cheap money - Financial Inclusion and Exclusion: credit widening and credit deepening monetary policies. Credit gap: Factors influencing credit gap. Non - Banking Financial Institutions (NBFI). NPA – Causes, consequences and mitigation. Crop Insurance: Schemes, Coverage, Advantages and Limitations in Implementation - Estimation of Crop Yields - Assessment of crop losses, Determination of compensation - Weather based crop insurance, features, determinants of compensation. Livestock Insurance Schemes Agricultural Insurance Company of India Ltd (AIC): Objectives and functions.

Theory Lecture Schedule

1. Agricultural Finance - meaning, scope and significance, credit needs and its role in Indian agriculture.
2. Agricultural credit: meaning, definition, need and classification.
3. Sources of credit - advantages and disadvantages.
4. Rural idebtedness - History and Development of rural credit in India.
5. Sources of agricultural finance: institutional and non-institutional sources - their roles.
6. Commercial banks - social control and nationalization of commercial banks.
7. Micro financing including KCC, Micro finance – SHG Models, Lead bank scheme.
8. RRBs, Scale of finance and unit cost. Cost of credit.
9. An introduction to higher financing institutions–RBI, NABARD, ADB, IMF and World Bank.
10. Role of Insurance and Credit Guarantee Corporation of India.
11. Recent developments in agricultural credit.
12. Rural credit policies of Government: Subsidized farm credit- Differential Interest Rate (DIR) Scheme. – Loan relief measures
13. Credit analysis: 4 R's, 7 P's and 3C's of credit.
14. Preparation of bankable projects / Farm credit proposals – Feasibility.
15. Appraisal: Time value of money: Compounding and Discounting - Undiscounted and Discounted measures.
16. Preparation and analysis of financial statements – Balance Sheet, Income Statement and Cash Flow Statement.
17. **In-Semester Examination**
18. Basic guidelines for preparation of project reports- Bank norms – SWOT analysis.
19. Agricultural Cooperation in India – Meaning, brief history of cooperative development in India.
20. Pre and Post - Independence periods and Co-operation in different plan periods, objectives, principles of cooperation, significance of cooperatives in Indian agriculture.

21. Co-operating credit structure: short term and long term. Agricultural Cooperation - credit, marketing, consumer and multi-purpose cooperatives, farmers' service cooperative societies, processing cooperatives, farming cooperatives, cooperative warehousing;
22. Role of ICA, NCUI, NCDC and NAFED.
23. Strength and weakness of co-operative credit system, Policies for revitalizing co-operative credit.
24. Negotiable Instruments: Meaning, Importance and Types.
25. Central bank: RBI – functions, Credit control – Objectives and Methods: CRR, SLR and Repo rate.
26. Credit rationing - Dear money and cheap money. Financial Inclusion and Exclusion: credit widening and credit deepening monetary policies.
27. Credit gap: Factors influencing credit gap.
28. Non - Banking Financial Institutions (NBFI).
29. NPA – Causes, consequences and mitigation.
30. Crop Insurance: Schemes, Coverage, Advantages and Limitations in Implementation.
31. Estimation of Crop Yields - Assessment of crop losses, Determination of compensation.
32. Weather based crop insurance, features, determinants of compensation.
33. Livestock Insurance Schemes
34. Agricultural Insurance Company of India Ltd (AIC): Objectives and functions.

Practical Schedule

1. Determination of most profitable level of capital use.
2. Optimum allocation of limited amount of capital among different enterprise.
3. Analysis of progress and performance of cooperatives using published data.
4. Analysis of progress and performance of commercial banks and RRBs using published data.
5. Visit to a commercial bank, cooperative bank / cooperative society to acquire first - hand knowledge of their management, schemes and procedures.
6. Visit to District Central Co-operative Bank (DCCB) to study its role, functions and procedures for availing loan – Fixation of Scale of Finance.
7. Guest lecture on Role and functions of Commercial Bank and Lead Bank / NABARD and its Role and Functions.
8. Estimation of credit requirement of farm business – A case study.
9. Preparation and analysis of Balance Sheet and Cash Flow Statement – A case study.
10. Exercise on Financial Ratio Analysis. Appraisal of farm credit proposals – A case study.
11. Preparation and analysis of income statement – A case study.
12. Preparation of Bankable projects / Farm Credit Proposals and appraisal.
13. Undiscounted methods and Discounted methods.
14. Techno-economic parameters for preparation of projects for various agricultural products and its value added products.
15. Analysis of Different Crop Insurance Products / Visit to crop insurance implementing agency.
16. Seminar on selected topics.
17. **University Practical Examination.**

Text Books

1. Bhagat, D.(2014). Textbook of Agricultural Marketing and Co-operation. India: Neha Publishers & Distributors. pp. 2-66
2. Reddy, S, S., (2017). Agricultural Finance and Management. New Delhi: Oxford & IBH Publishing. pp 1-268

Reference Books

1. Charles Moss, B. (2013). Agricultural Finance.UK: Routledge Company. pp.1-295
2. Geman,H (2015). Agricultural Finance: From Crops to Land, Water and Infrastructure (The Wiley Finance Series), USA: Wiley Publishers. pp.1-288
3. Lee, W.F., Boehlje, M.D., Nelson, A.G., & Murray,W.G.(1998). Agricultural Finance, New Delhi: Kalyani Publishers. pp.1- 468

Web-References

1. www.rbi.org.in

2. www.nsic.co.in
3. www.nabard.org

Journals

1. Agricultural Finance Review
2. Canadian Journal of Agricultural Economics
3. Journal of Agricultural Economics Research
4. American Journal of Environmental and Resource Economics

Course Nature: Theory based Practical							
Total Marks (100)							
S.No.	Category	**Assessment Tools**					
		In- Semester Examination	Assignment	Record	Attendance	End-Semester Examination	Marks
1	Theory-External	-	-		-	*50*	*50*
2	Theory-Internal	*20*	-			-	*20*
3	Practical-External	-	-		-	*15*	*15*
4	Practical-Internal	-	*05*	*05*	*05*	-	*15*
						Grand Total	*100*

Course Code	AGS19302	Course Name	FUNDAMENTALS OF AGRICULTURAL EXTENSION EDUCATION	Course Category	S	Supportive Course	L	T	P	C
							2	0	1	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Agricutural Extension	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1 :	Explain the fundamentals of extension education, extension systems in India, programme planning and rural development efforts, extension administration
CLR-2 :	Outline the pre-independence as well as post-independence extension efforts
CLR-3 :	Interpret the basic knowledge on rural development and rural leadership
CLR-4 :	Outline the emerging trends in agricultural Extension
CLR-5 :	Summarize on knowledge on transfer of technology, different models and communication models

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Agriculture Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	Ability to solve scientific problems through Agricultural Extension	Ability to implement knowledge gained in the applied field of Agricultural Extension	Ability to understand social and ethical responsibilities of Agricultural Extension
CLO-1 :	Identify the difference between different Extension systems in India	1	80	75	M					H			M	H		H	M	H	H
CLO-2 :	Discuss the importance of Agricultural Extension in Agricultural development	2	75	70	H					H			L	H		H	M	H	H
CLO-3 :	Describe the basic concepts of rural development and community development	3	80	70	M					H			L	H		H	M	H	H
CLO-4 :	Identify the new vistas in Agricultural Extension	3	80	75	M					H			M	H		H	M	H	H
CLO-5 :	Summarise the the relevance of agricultural journalism	2	80	70	L					H			M	H		H	M	H	H

		Learning Unit / Module 1	Learning Unit / Module 2	Learning Unit / Module 3	Learning Unit / Module 4	Learning Unit / Module 5
Duration (hour)		4	20	8	9	24
S-1	SLO-1	Education-meaning, definition and types	Extension efforts in pre-independence era (IVP, Sriniketan, Marthandam, Firka Development scheme, Sevagram, Gurgaon Experiment, Baroda Village Reconstruction Project Grow more Food Campaign, IVS , Firka Vikas Yojana etc.)	Community development –meaning, definition.	New trends in agricultural extension	Transfer of technolog: concept
	SLO-2	Extension education-meaning, definition, scope and process	Post – independence era (Etawah pilot project, Nilokheri Experiment.	Concepts and principles, philosophy of community development.	Privatization of Agricultural extension- Meaning-definition-importance in Agricultural Extension.	Participatory technology development and Farming System research and extension
S-2	SLO-1	Extension Programme planning – definition, meaning, process	Extension/ agricultural development programmes launched by ICAR/Govt. of India	Rural leadership: concept and definition.	Cyber extension/ E-extension	Capacity building of extension personnel-Training- definition.
	SLO-2	Principles and steps in programme planning / development	National demonstration, ORP, Lap to Land Programme and Farmers Training Centre	Types of leaders in rural context and selection of leaders.	Internet, cyber cafes, video and teleconferencing, web streaming and multimedia.	Need for training, training process, models , strategies, steps in conducting training programmes
S-3-4	SLO-1	Lab 1: To study the University extension system	Lab 2: Visit to State department of Agriculture to understand the organizational setup, roles, functions and various schemes.	Lab 7: Exercise on handling and use of audio visual equipments and digital camera and LCD projector	Lab 9:Preparation of leaflet, booklet, folder, pamphlet	Lab 11: To visit the village and understand the socio cultural and agricultural related problems being encountered by the villagers/ farmers
	SLO-2					

S-5	SLO-1	-	*Extension programmes of Ministry of Agriculture – Training and Visit (T&V) System, Broad Based Extension System (BBES), Agricultural Technology Management Agency (ATMA)*	*Extension administration: meaning, concept, scope.*	*Agri portals, Information Kiosks, Kisan Call Centre (KCC), Mobile phone.*	*Training need assessment, building up of training programme- trainer roles:*
	SLO-2	-	*First line Extension System – KVK, IVLP, ATIC, Frontline demonstrations.*	*Principles and functions of Extension administration.*	*Village Knowledge Centre (VKC), DEMIC, Geographical Information System (GIS)*	*Training institution for extension personnel- KVK, EEI, MANAGE, NAARM.*
S-6	SLO-1	-	*Rural Development – meaning, definition, concept and importance.* Various rural development programmes launched by Govt. of India	*Monitoring and evaluation: concept and definition*	*Market led extension, farmer led extension: meaning, definition.*	*Extension teaching methods: meaning, classification.*
	SLO-2	-	*Democratic Decentralization –Meaning of Democratic Decentralization and Panchayat Raj – Three tiers of Panchayat Raj system – Powers, Functions and Organizational setup.*	*Monitoring and evaluation of extension programmes, types and evaluation*	*Challenges and importance in agricultural extension.*	*Individual methods- Farm and Home, Personal letter, Official call, observation and Result demonstration*
S-7-8	SLO-1	-	*Lab 3:* Study the organizational set up and functions of DRDA.	*Lab 8:Preparation and use of AV aids*	*Lab 10:* Preparation of news stories and success stories.	*Lab 12: Understanding PRA techniques and practicing selected PRA techniques in a village setting*
	SLO-2	-				
S-9	SLO-1	-	*Community Development Programme (CDP), National Extension Service (NES).*	-	*Expert systems –meaning, definition.*	*Group Contact- Method demonstration, meeting, lecture, debate, workshop, seminar, forum, conference.*
	SLO-2	-	*Intensive Agricultural District Programme (IADP), Intensive Agricultural Area Programme (IAAP) - their strengths and weaknesses*	-	*Application in agriculture.*	*Symposium, panel, brain storming, buzz session, role playing and simulation games.*
S-10	SLO-1	-	*High Yielding Variety Programme (HYVP), Institution Village Linkage Programme (IVLP), Watershed Development Programme (WDP)*	-	-	*Mass contact methods- Campaign, exhibition, farmers day.*
	SLO-2	-	*Integrated Rural Development Programme (IRDP) - their strengths and weaknesses.*	-	-	*field trip- purpose procedure, merit and demerits and media mix strategies*
S-11-`12	SLO-1	-	*Lab 4:* Visit to NGO and learning from their experience in rural development	-	-	*Lab 13:* Visit to Community radio station to understand the process of programme production.
	SLO-2	-			-	
S-13	SLO-1	-	*National Agricultural Technology Project (NATP), Integrated Tribal Development Agency (ITDA).*	-	-	*ICT Applications in TOT (New and Social Media)*
	SLO-2	-	*Small Farmers Development Agency (SFDA), Marginal Farmers and Agricultural Labourers Development Agency (MFAL) - their strengths and weaknesses*	-	-	*Media mix strategies*

S-14	SLO-1	-	*National Rural Employment Programme (NREP), Rural landless Employment Guarantee Programme (RLEGP), Drought Prone Area Programme (DPAP).*	-	-	*Communication – meaning, definition, types, elements,*
	SLO-2	-	*Command Area Development Programme (CADP), Food for Work Programme (FFW), Jawahar Rozgar Yojana (JRY), Employment Assurance Scheme (EAS).*	-	-	*principles and functions of communication*
S-15-16	SLO-1	-	*Lab 5: Visit to KVK to understand various extension activities*	-	-	Lab 14: Exercise on Script writing for Radio and TV programme
S-17	SLO-2	-	*Indira Awaas Yojana (IAY), Swarnajayanthi Gram Swarozgar Yojana (SGSY), Prime Minister Employment Yojana (PMEY).*		-	*Communication models (Aristotle, Shanon-Weaver, Berlo, Schramm, Leagans, Rogers & Shoemaker) –*
	SLO-1	-	*Swarna Jayanthi Shahari Rozgar Yojana (SJSRY), Pradhan Mantri Gram Sadak Yojana (PMGSY) , ARYA -their strengths and weaknesses.*	-	-	*Barriers in communication.*
S-18	SLO-2	-	*Sampoorna Grameen Rozgar Yojana (SGRY), Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA),*	-	-	Agricultural Journalism: definition, principles
	SLO-1	-	*Providing Urban Amenities to Rural Areas (PURA), National Agricultural Innovation Project (NAIP), NADP (RKVY) - their strengths and weaknesses*	-	-	Importance, ABC of news, types of news.
S-19-20		- -	*Lab 6: Exercise on practicing group discussion technique and presentation skills*	- -	- - -	*Lab 15:* Exercise on script writing for print and electronic media
S-21	SLO-1	-	-		-	Diffusion of Innovations – definition, elements;
	SLO-2	-	-	-	-	Innovation – definition, attributes
S-22	SLO-1	-	-	-	-	Adoption – meaning, stages of adoption and adopter categories.
	SLO-2	-	-	-	-	Factors influencing adoption of innovations, consequences of innovations.
S-23-24	SLO-1	-	-	-	-	*Lab 16:* Visit to Television studio to study the various activities & programmes.

Learning Resources	1. *Ahuja, B.N. (1997). Theory and Practice of Journalism.New Delhi:Surjeet Publications..pp.1-40.* 2. *Dahama, O.P and Bhatnagar, O.P. (1985). Education and Communication for Development. New Delhi:Oxford & IBH Publishing Co. Pvt. Ltd.pp;1-70* 3. *Neela Mukherjee. (1993). Participatory Rural Appraisal: Methodology and Applications.Delhi:Concept Publishing Co.pp.1-160.* 4. *Ray, G.L. (1999). Extension Communication and Management. Calcutta:Naya Prokash.pp.1-358.*	5. *Rogers, E.M. (1995). Diffusion of Innovations.New York:The Free Press.pp.1-268.* 6. *Singh, A.K. (2012). Agricultural Extension.Agrobios:New Delhi.pp.160-240.* 7. *Supe, S.V. (1997). An Introduction to Extension Education.New Delhi:Oxford & IBH Publishing Co. Pvt. Ltd.pp.1-186.* 8. *Van den Ban, A.W and Hawkins, H.S. (2002). Agricultural Extension.New Delhi:CBS Publishers & Distributors.pp.1-50.*

	Level of Thinking	Continuous Learning Assessment (35% weightage)		University Practical Examination (15%)	End semester theory Examination (50%)
		In semester (20%)	Practical (15%)		
Level 1	Remember	40 %	30 %	30%	40 %
	Understand				
Level 2	Apply	40 %	40 %	40%	40 %
	Analyze				
Level 3	Evaluate	20 %	30 %	30%	20 %
	Create				
	Total	100 %	100 %	100%	100 %

Course Designers		
Experts from Industry/social sector	Experts from Higher Technical Institutions	Internal Experts
P.Subha Nandhini *Special Deputy Collector (Social Security Schemes)* *Tamil Nadu government*	*Dr. C. Karthikeyan, Professor & Head (Social Sciences), Department of Social Sciences, Agricultural College and Research Institute, Tamil Nadu Agricultural University, Killikulam, Vallandu Thoothukudi dt-628 252*	*Dr. Mohanraj K*

THEORY

Unit I Extension Education and Programme Planning

Education- meaning, definition & types; extension education –meaning, definition, scope and process; objectives and principles of extension education. Extension Programme planning – definition, meaning, process, principles and steps in programme development

Unit II Extension System in India and Rural Development

Extension efforts in pre-independence era (Sriniketan, Marthandam, Firka Development scheme, Gurgaon Experiment, etc.) Post – independence era (Etawah pilot project, Nilokheri Experiment, etc.,). Rural Development –Concept, meaning, definition: various rural development programmes launched by Govt. of India. Various extension/ agricultural development programmes launched by ICAR/Govt. of India(IADP, IAAP, HYVP,KVK, ORP, ND, NATP, NAIP etc.,)

Unit III Community Development, Administration, Monitoring and Evaluation

Community development –meaning, definition, concepts and principles, physiology of community development. Rural leadership: concept and definition, types of leaders in rural context: extension administration: meaning, concept, principles and functions. Monitoring and evaluation: concept and definition, monitoring and evaluation of extension programmes

Unit IV New Trends in Agricultural Extension

New trends in agricultural extension –Privatization of extension, Cyber extension/ E-extension, (Internet, cyber cafes, video and teleconferencing, Interactive Multimedia Compact disk (IMCD), Agri portals, Information Kiosks, Kisan Call Centre (KCC), Mobile phone, Village Knowledge Centre (VKC), DEMIC, Geographical Information System (GIS), market led extension, farmer led extension, expert systems etc.,

Unit V Transfer of Technology, Diffusion of Innovations and Extension Methods

Transfer of technology concept, models. Capacity building of extension personnel, extension teaching methods: meaning, classification, individual, group and mass contact methods. ICT Applications in TOT (New and Social Media), media mix strategies, media mix strategies. Communication: meaning, definition, models elements, characteristics and barriers to communication. Agricultural Journalism: Agricultural journalism (Print media) - definition, principles, importance, ABC of news, types of news. Diffusion of Innovations – definition, elements; Innovation – definition, attributes; Adoption – meaning, steps in adoption process, adopter categories, factors influencing adoption of innovations, Consequences of adoption.

Theory - Lecture Schedule

1. Education- meaning, definition and types; Extension education – meaning, definition, scope and process; objectives and principles and function of extension education.
2. Extension Programme planning – definition, meaning, process, principles and steps in programme planning / development
3. Extension efforts in pre-independence era (IVP, Sriniketan, Marthandam, Firka Development scheme, Sevagram, Gurgaon Experiment, Baroda Village Reconstruction Project Grow more Food Campaign, IVS , Firka Vikas Yojana etc.) Post – independence era (Etawah pilot project, Nilokheri Experiment.
4. Extension/ agricultural development programmes launched by ICAR/Govt. – National demonstration, ORP, Lap to Land Programme and Farmers Training Centre.
5. Extension programmes of Ministry of Agriculture – Training and Visit (T&V) System, Broad Based Extension System (BBES), Agricultural Technology Management Agency (ATMA); Firstline Extension System – KVK, IVLP, ATIC, Frontline demonstrations.
6. Rural Development – meaning, definition, concept and importance. Various rural development programmes launched by Govt. of India. Democratic Decentralization –Meaning of Democratic Decentralization and Panchayat Raj – Three tiers of Panchayat Raj system – Powers, Functions and Organizational setup.
7. Community Development Programme (CDP), National Extension Service (NES), Intensive Agricultural District Programme (IADP), Intensive Agricultural Area Programme (IAAP) - their strengths and weaknesses
8. High Yielding Variety Programme (HYVP), Institution Village Linkage Programme (IVLP), Watershed Development Programme (WDP), Integrated Rural Development Programme (IRDP) - their strengths and weaknesses.
9. National Agricultural Technology Project (NATP), Integrated Tribal Development Agency (ITDA), Small Farmers Development Agency (SFDA), Marginal Farmers and Agricultural Labourers Development Agency (MFAL) - their strengths and weaknesses
10. National Rural Employment Programme (NREP), Rural landless Employment Guarantee Programme (RLEGP), Drought Prone Area Programme (DPAP), Command Area Development Programme (CADP), Food for Work Programme (FFW), Jawahar Rozgar Yojana (JRY), Employment Assurance Scheme (EAS).
11. Indira Awaas Yojana (IAY), Swarnajayanthi Gram Swarozgar Yojana (SGSY), Prime Minister Employment Yojana (PMEY), Swarna Jayanthi Shahari Rozgar Yojana (SJSRY), Pradhan Mantri Gram Sadak Yojana (PMGSY) , ARYA -their strengths and weaknesses.
12. Sampoorna Grameen Rozgar Yojana (SGRY), Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA), Providing Urban Amenities to Rural Areas (PURA), National Agricultural Innovation Project (NAIP), NADP (RKVY) - their strengths and weaknesses
13. Community development –meaning, definition, concepts and principles, philosophy of community development
14. Rural leadership: concept and definition, types of leaders in rural context and selection of leaders.
15. Extension administration: meaning, concept, scope, principles and functions.

16. Monitoring and evaluation: concept and definition, monitoring and evaluation of extension programmes, types and evaluation
17. **In- semester Examination**
18. New trends in agricultural extension -Privatization of Agricultural extension- Meaning- definition-importance in Agricultural Extension.
19. Cyber extension/ E-extension, (Internet, cyber cafes, video and teleconferencing, web streaming and multimedia.
20. Agri portals, Information Kiosks, Kisan Call Centre (KCC), Mobile phone, Village Knowledge Centre (VKC), DEMIC, Geographical Information System (GIS),
21. Market led extension, farmer led extension : Meaning, definition, challenges and importance in agricultural extension.
22. Expert systems –meaning, definition, application in agriculture.
23. Transfer of technology: concept, models, PTD, FSRE.
24. Capacity building of extension personnel- Training- definition, need for training, training process, models , strategies, steps in conducting training programmes
25. Training need assessment, building up of training programme- trainer roles: training insituteion for extension personnel- KVK, EEI, MANAGE, NAARM.
26. Extension teaching methods: meaning, classification; Individual methods- Farm and Home, Personal letter, Official call, observation and Result demonstration
27. Group Contact- Method demonstration, meeting, lecture, debate, workshop, seminar, forum, conference, symposium, panel, brain storming, buzz session , role playing and simulation games.
28. Mass contact methods- Campaign, exhibition, farmers day and field trip- purpose procedure, merit and demerits
29. ICT Applications in TOT (New and Social Media), media mix strategies
30. Communication – meaning, definition, types, elements, principles and functions of communication
31. Communication models (Aristotle, Shanon-Weaver, Berlo, Schramm, Leagans, Rogers & Shoemaker),barriers in communication
32. Agricultural Journalism: definition, principles, importance, ABC of news, types of news.
33. Diffusion of Innovations – definition, elements; Innovation – definition, attributes
34. Adoption – meaning, stages of adoption and adopter categories. Factors influencing adoption of innovations, consequences of innovations.

Practical Schedule

1. To study the University extension system
2. Visit to State department of Agriculture to understand the organizational setup, roles, functions and various schemes.
3. Study the organizational set up and functions of DRDA.
4. Visit to NGO and learning from their experience in rural development
5. Visit to KVK to understand various extension activities
6. Exercise on practicing group discussion technique and presentation skills
7. Exercise on handling and use of audio visual equipments and digital camera and LCD projector
8. Preparation and use of AV aids
9. Preparation of leaflet, booklet, folder, pamphlet
10. Preparation of news stories and success stories.
11. To visit the village and understand the socio -cultural and agricultural related problems being encountered by the villagers/ farmers
12. Understanding PRA techniques and practicing selected PRA techniques in a village setting
13. Visit to Community radio station to understand the process of programme production.
14. Exercise on Script writing for Radio and TV programme
15. Exercise on script writing for print and electronic media
16. Visit to Television studio to study the various activities & programmes.
17. **University Practical Examination**

Text Books

1. Ray, G.L. (1999). Extension Communication and Management. Calcutta: Naya Prokash.pp.1-358.
2. Rogers, E.M. (1995). Diffusion of Innovations. New York: The Free Press.pp.1-268.
3. Singh, A.K. (2012). Agricultural Extension. Agrobios: New Delhi.pp.160-240.
4. Supe, S.V. (1997). An Introduction to Extension Education. New Delhi: Oxford & IBH Publishing Co. Pvt. Ltd.pp.1-186.
5. Van den Ban, A.W and Hawkins, H.S. (2002). Agricultural Extension. New Delhi: CBS Publishers & Distributors.pp.1-50.

Reference Books

1. Ahuja, B.N. (1997). Theory and Practice of Journalism. New Delhi: Surjeet Publications.pp.1-40.

2. Dahama, O.P & Bhatnagar, O.P. (1985). Education and Communication for Development. New Delhi: Oxford & IBH Publishing Co. Pvt. Ltd.pp.1-70
3. Neela Mukherjee. (1993). Participatory Rural Appraisal: Methodology and Applications. Delhi: Concept Publishing Co.pp.1-160.

Web References

1. www.manage.gov.in
2. https://rural.nic.in/
3. www.panchayat.gov.in
4. https://wcd.nic.in/
5. http://agritech.tnau.ac.in/
6. http://www.tnidb.tn.gov.in/forms/TN%20VISION%202023(PHASE%202).pdf
7. https://caes.ucdavis.edu/outreach/ce
8. https://cals.cornell.edu/outreach-extension
9. https://ag4impact.org/sid/socio-economic-intensification/building-human-capital/agricultural-extension/
10. https://uscode.house.gov/view.xhtml?req=%28title%3A7%20section%3A3221%20edition%3Aprelim%29%20OR%20%28granuleid%3AUSC-prelim-title7-section3221%29&f=treesort&edition=prelim&num=0&jumpTo=true
11. https://nifa.usda.gov/program/agricultural-extension-programs-1890-institutions

Journals

1. International Journal of Extension Education
2. Indian Journal of Extension Education
3. Journal of Extension Education
4. Indian Journal of Gender Studies
5. Journal of Rural Development
6. Yojana

Course Nature: Theory based Practical							
Total Marks (100)							
S.No.	Category	**Assessment Tools**					
		In- Semester Examination	Assignment	Record	Attendance	End-Semester Examination	Marks
1	Theory-External	-	-		-	*50*	*50*
2	Theory-Internal	*20*	-			-	*20*
3	Practical-External	-	-		-	*15*	*15*
4	Practical-Internal	-	*05*	*05*	*05*	-	*15*
						Grand Total	*100*

Course Code	HOR19305	Course Name	PRODUCTION TECHNOLOGY FOR VEGETABLES AND SPICES	Course Category	S	*Supportive Course*	L	T	P	C
							1	0	1	2

Pre-requisite Courses	Nil	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Horticulture*	Data Book / Codes/Standards	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1	*Explain the contributions of vegetables and spices cultivation*
CLR-2	*Describe the different intercultural operation for tropical and temperate vegetables*
CLR-3	*Summarize the knowledge on postharvest technology in tropical and temperate vegetables*
CLR-4	*Demonstrate the technical knowledge on grafting methods in vegetable crops*
CLR-5	*Summarize the awareness on scope and importance of major and minor spices crops*
CLR-6	*Outline the knowledge on seed production and oil extraction methods in major spices crops*

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning			Program Learning Outcomes (PLO)														
		1	*2*	*3*	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Horticulture Knowledge	Production technology	Varietal identification	Classification of vegetables and fruits	Modern Tool Usage	Culture practices	Environment problem	Intercultural operation	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	Ability to solve scientific problems through Horticulture	Ability to implement knowledge gained in field of Horticulture	Ability to understand social and ethical responsibilities
CLO-1	*Demonstrate skills on identifying tropical and temperate vegetables and their varieties*	3	90	80	M								M	H		H	H	H	H
CLO-2	*Identify the skills for solving field problems*	1	95	85	H								L	H		H	H	H	H
CLO-3	*Demonstrate hands on experience on the cultivation of vegetable and spices in different climacteric zones*	2	80	70	M		L	L					L	H		H	H	H	H
CLO-4	*Predict and handle postharvest losses in vegetable crops*	3	75	65	M			L	L				M	H		H	H	H	H
CLO-5	*Summarize the quality control and production economic importance of major and minor spice crops*	2	75	60	L	L							M	H		H	H	H	H
CLO6	*Identifythe major physiological disorders in vegetables and spices crops*	2	75	65	L						H		M	H		H	H	H	H

		Learning Unit / Module 1	Learning Unit / Module 2	Learning Unit / Module 3	Learning Unit / Module 4	Learning Unit / Module 5
Duration (hour)		2	6	3	2	3
S-1	SLO-1	Importance of vegetables and spices in human nutrition and national economy	Production technology of Tomato	Production technology of Cabbage	Production technology of Black pepper	Production technology of Coriander and Fenugreek
	SLO-2	Vegetable gardens: kitchen garden, truck garden, market garden and floating garden	Production technology of Brinjal	Production technology of Cauliflower and Knol-Khol	Production technology of Black pepper	Production technology of Fennel and Cumin
S 2-3	SLO-1	*Practical1:* Identification of vegetables and spices and their seeds	*Practical2:* Nursery techniques for direct sowing / vegetative and transplanted vegetable crops	*Practical7:* Post harvest handling of vegetable crops	*Practical12:* Maturity indices and harvesting of spices	*Practical15:* Visit to commercial vegetable farms
	SLO-2					
S-4	SLO-1	-	Production technology of Chilli and Capsicum	Production technology of Potato – Cultivation Practices	Production technology of Cardamom	Production technology of Clove
	SLO-2	-	Production technology of Okra	Production technology of Potato - TPS and SPT	Production technology of Cardamom	Production technology of Nutmeg and Cinnamon
S 5-6	SLO-1	-	*Practical3:* Study of morphological characters of tropical vegetables	*Practical8:* Study of morphological characters of different spice crops	*Practical13:* Curing, processing and grading of spices	*Practical16:* Visit to Commercial Spice garden
	SLO-2					
S-7	SLO-1	-	Production technology of Cucurbits (Cucumber, Gourds)	Production technology of Onion	Production technology of Turmeric	
	SLO-2	-	Production technology of Cucurbits (Melons, Pumpkin)	Production technology of Garlic	Production technology of Ginger	-

S 8-9	SLO-1	-	*Practical4:* Study of morphological characters of temperate vegetables	*Practical9:* Method of propagation – Seed treatment and sowing / planting of different spices	*Practical14:* Economics of vegetable and spice cultivation	-
	SLO-2					
S-10-11	SLO-1	-	Production technology of French beans	Production technology of Carrot	-	-
	SLO-2		Production technology of Cassava	Production technology of Radish and Beetroot	-	-
S 12-13	SLO-1	-	*Practical5:* Method of fertilizer applications in different vegetable crops	*Practical10:* Cultural operations – hoeing , earthing up, manuring and use of weedicides in spices	-	-
	SLO-2				-	-
S-14	SLO-1	-	Production technology of Moringa	Production technology of Garden Pea	-	-
	SLO-2	-	Production technology of Amaranthus	Production technology of Palak	-	-
S-15-16	SLO-1	-	*Practical6:* Harvesting techniques in different vegetable crops	*Practical11:* Training and pruning in spice crops	-	-
	SLO-2	-			-	-
S 17	SLO-1	-	-	-	-	-
	SLO-2	-	-	-	-	-
S 18-19	SLO-1	-	-	-	-	-
	SLO-2	-		-	-	-

Learning Resources	1. N.*Kumar (2014) Introduction to spices, plantation crops, Medicinal and Aromatic plants 2nd edition published by Oxford and IBH publishing CO.PVT.LTD* 2. *Thapa.U and Tripathy.P (2017) Production technology of tropical and subtropical vegetable crops, 1th edition, Agrotech publishing academy*

	Level of Thinking	Continuous Learning Assessment (35% weightage)		University Practical Examination (15%)	End semester theory Examination (50%)
		In semester (20%)	Practical (15%)		
Level 1	Remember	40 %	30 %	35%	30 %
	Understand				
Level 2	Apply	40 %	40 %	35%	40 %
	Analyze				
Level 3	Evaluate	20 %	30 %	30%	30 %
	Create				
	Total	100 %	100 %	100%	100 %

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
-	*Dr. Pratapsingh Khapte* *Scientist (vegetable science) Central Arid Zone Research Institute Jodhpur*	*A.Harish* *K.Nivetha*

THEORY

UNIT I- Introduction to Vegetable and Spice Crops
Importance of vegetables and spices in human nutrition and national economy- Vegetable gardens - Kitchen garden, truck garden, market garden and floating garden

Unit II- Production Technology of Tropical and Subtropical Vegetables
Origin – area - climate and soil – improved varieties and hybrids – seeds and sowing – transplanting – spacing - nutrient management – irrigation – weed management – plant growth regulators - physiological disorders – harvesting and yield
Crops: Tomato, Brinjal, Chili, Capsicum, Okra and Cucurbits (Cucumber, Pumpkin, Gourds and Melons), French beans, Cassava, Moringa and Amaranthus

Unit III- Production Technology of Temperate Vegetable Crops
Origin – area - climate and soil – improved varieties and hybrids – seeds and sowing – transplanting – spacing - nutrient management – irrigation – weed management – plant growth regulators - physiological disorders – harvesting and yield
Crops: Cabbage, Cauliflower, Knol-Khol, Potato, Onion, Garlic, Carrot, Radish, Beetroot, Garden Pea and Palak

Unit IV- Production Technology of Major Spices Crops
Origin – area – climate and soil - improved varieties and hybrids - cultivation practices such as propagation - nursery management - planting - cropping systems - shade regulation - training and pruning - fertilizer requirements - irrigation - inter cultural operations - harvesting and yield - processing - value addition
Crops: Black Pepper, Cardamom, Turmeric and Ginger

Unit V- Production Technology of Seed and Tree Spices
Origin – area – climate and soil - improved varieties and hybrids - cultivation practices such as propagation - nursery management - planting - cropping systems - shade regulation - training and pruning - fertilizer requirements - irrigation - inter cultural operations - harvesting and yield - processing - value addition
Crops: Coriander, Fenugreek, Fennel, Cumin, Clove, Nutmeg and Cinnamon

Theory Schedule
1. Importance of vegetables and spices in human nutrition and national economy and Vegetable gardens: kitchen garden, truck garden, market garden and floating garden
2. Production technology of Tomato and Brinjal
3. Production technology of Chilli, Capsicum and Okra
4. Production technology of Cucurbits
5. Production technology of French beans and Cassava
6. Production technology of Moringa and Amaranthus
7. Production technology of Cabbage, Cauliflower and Knol-Khol
8. Production technology of Potato
9. **In-semester examination**
10. Production technology of Onion and Garlic
11. Production technology of Carrot, Radish and Beetroot
12. Production technology of Garden Pea and Palak
13. Production technology of Black pepper
14. Production technology of Cardamom
15. Production technology of Turmeric and Ginger

16. Production technology of Coriander, Fenugreek, Fennel and Cumin
17. Production technology of Clove, Nutmeg and Cinnamon

Practical Schedule

1. Identification of vegetables and spices and their seeds
2. Nursery techniques for direct sowing / vegetative and transplanted vegetable crops
3. Study of morphological characters of tropical vegetables
4. Study of morphological characters of temperate vegetables
5. Method of fertilizer applications in different vegetable crops
6. Harvesting techniques in different vegetable crops
7. Post harvest handling of vegetable crops
8. Study of morphological characters of different spice crops
9. Method of propagation – Seed treatment and sowing / planting of different spices
10. Cultural operations – hoeing , earthing up, manuring and use of weedicides in spices
11. Training and pruning in spice crops
12. Maturity indices and harvesting of spices
13. Curing, processing and grading of spices
14. Economics of vegetable and spice cultivation
15. Visit to commercial vegetable farms
16. Visit to Commercial Spice garden
17. **University Practical Examination**

Text Books

1. Amit Baran Sharangi (2018) Indian spices: The legacy, production and processing of India Treasured Export pp1-475
2. Giuseppe Colla, Franciso Perez, Dietmar Schwarz (2017) Vegetable grafting – Principles and Practices pp: 27-50
3. Kumar.N (2014) Introduction to spices, plantation crops, Medicinal and Aromatic plants published by Oxford and IBH publishing CO.PVT.LTD 2nd edition pp:1-320
4. Sudheer.K.P and V. Indira (2007) Post harvest technology of horticultural crops, Published by New India Publishing Agency 2nd edition pp:1-218
5. Thamburaj,S and Narendra Singh (2001) Text book of vegetables, tubercrops and Spices 1st Edition, Published by ICAR pp:1-214
6. Thapa.U and Tripathy.P (2017) Production technology of tropical and subtropical vegetable crops, Agrotech publishing academy 1th edition,pp:1-364

References Books

1. Alice Kurian and Peter, K.V. 2007. Horticulture science series Vol. 08, New India Publishing Agency, New Delhi.pp:1-110
2. Gopalakrishnan, T.R. 2007. Vegetable Crops. Horticultural Science Series (Series Editor K.V.Peter). New India Publishing Agency. 1st deition pp:1-360
3. Henry Louis, I. 2002. Coconut- The wonder palm. Hi - Tech Coconut Corporation, Nagercoil. pp:120
4. Mandal, R.C. 2006. Tropical root and tuber crops. Agrobios (India) Peter.K.V. 2000. Genetics and Breeding of Vegetables, ICAR, Publication. 2nd edition pp:1-197
5. Mini, C. and Krishnakumar, K. 2004. Leaf Vegetables. Agro tech Publishing Academy, Udaipur 1st edition pp:1-249
6. Singh, P.K., S.K. Dasgupta and S.K. Tripathi, 2006. Hybrid Vegetable Development. International Book Distributing Co. pp:1-201
7. Veeeraragavathatham, D and et al., 2004. Scientific fruit culture, Sun Associates, Coimbatore.2nd edition pp:1-120
8. Veeraragavaththam,D., M.Jawaharlal and Seemanthini Ramadas 2000 " Vegetable Culture" 2nd edition pp:1-280

Web-References

1. http://www.jhortscib.com
2. http://journal.ashspublications.org
3. http://www.actahort.org/
4. http://www.aphorticulture.com/crops.htm
5. http://cpcri.nic.in/ http://indiancoffee.org

6. http://Iccn.gov/20160579
7. http://youtu.be/n0bh-6TqeA

JOURNALS

1. Indian Journal of Horticulture
2. Indian Journal of Vegetable sciences
3. International Journal of Vegetable Science
4. Indian Journal Arecanut, Spices and Medicinal Plants
5. Journal of Spices and Aromatic Crops.

Course Nature: Theory based Practical							
Total Marks (100)							
S.No.	**Category**	**Assessment Tools**					
		In- Semester Examination	Assignment	Record	Attendance	End-Semester Examination	Marks
1	Theory-External	-	-		-	*50*	*50*
2	Theory-Internal	*20*	-			-	*20*
3	Practical-External	-	-		-	*15*	*15*
4	Practical-Internal	-	*05*	*05*	*05*	-	*15*
						Grand Total	*100*

Course Code	SUP19301	Course Name	SOIL AND WATER CONSERVATION ENGINEERING	Course Category	S	Supplementary Course	L	T	P	C
							1	0	1	2

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Agricultural Engineering	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1 :	Outline the contributions of different scientists in the development of field of soil water conservation
CLR-2 :	Outline the different soil water conservation techniques and their role in agricultural operations
CLR-3 :	Summarize the different soil conservation techniques and their uses
CLR-4 :	Explain the technical knowledge on the Pump, well and different water conservation techniques used
CLR-5 :	Recongnise the technologies present in soil water conservation
CLR-6 :	Describe the technologies used in soil engineering

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Agriculture Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	Ability to solve scientific problems through Agricultural engineering	Ability to implement knowledge gained in the applied field of Agricultural Engineering	Ability to understand social and ethical responsibilities of Agricultural Engineering
CLO-1 :	Identify different components of well pumps and turbine	3	90	80	M								M	H		H	H	H	H
CLO-2 :	Summarize the different irrigation techniques used for agricultural purposes	1	95	85	H								L	H		H	H	H	H
CLO-3 :	Outline various surveying and irrigation techniques	2	80	70	M		L	L					L	H		H	H	H	H
CLO-4 :	Calculate the cost benefit economics of various soil conservation techniques	3	75	65	M			L	L				M	H		H	H	H	H
CLO-5 :	Describe different equipment used in soil water conservation engineering side	2	75	60	L	L							M	H		H	H	H	H
CLO6 :		2	75	65	L						H		M	H		H	H	H	H

		Learning Unit / Module 1	Learning Unit / Module 2	Learning Unit / Module 3	Learning Unit / Module 4	Learning Unit / Module 5
Duration (hour)		3	3	3	4	3
S-1	SLO-1	Soil conservation	Practical 4: Computation of rainfall erosivity	Practical 8: Problems- water measurement	Practical 12: Rain fall erosivity index	Practical 15: Different types of well and pumps
	SLO-2	Water conservation				
S-2	SLO-1	Practical 1: Study of survey instruments	Definition soil erosion	Agronomical measures	Irrigation methods	Well types
	SLO-2		Soil loss	Engineering measures	Plough measurement	Pump types
S-3	SLO-1	Land capability classification	Practical 5: Soil loss- USLE and MUSLE	Practical 9: Drip and sprinkler design	Practical 13: Estimation of sediment rate	Practical 16: Visit of soil erosion site
	SLO-2	Surveying				
S-4	SLO-1	Practical 2: Compass Survey	Soil erodibility	Design arrangements	Velocity method	Centrifugal pumps
	SLO-2		Soil loss measurement	Terraces	V- notch	Reciprocating pums
S5	SLO-1	Leveling	Practical 6: Grassed water and graded bunds	Practical 10: Water, wind erosion problems	Practical 14: Determination of sediment concentration	Turbine pumps
	SLO-2	Elevation differences				Air lift pumps
S6	SLO-1	Practical 3: Leveling	Water erosion	Rate of sedimentation	Orifices	-
	SLO-2		Wind erosion	Silt monitoring	Irrigation efficiency	-
S7	SLO-1	-	Practical 7: Contour bunds	Practical 11: Water erosion types	Surface drainage	-
	SLO-2	--			Sub-surface drainage	-

Learning Resources	
	1. Norman Hudson. 1985. Soil Conservation. Cornell University Press, Ithaka, New York, USA.
	2. Frevert, R.K., G.O. Schwab, T.W. Edminster and K.K. Barnes. 2009. Soil and Water Conservation Engineering, 4th Edition, John Wiley and Sons, New York.

	Level of Thinking	Continuous Learning Assessment (35% weightage)		University Practical Examination (15%)	End semester theory Examination (50%)
		In semester (20%)	Practical (15%)		
Level 1	Remember	40 %	30 %	35%	30 %
	Understand				
Level 2	Apply	40 %	40 %	35%	40 %
	Analyze				
Level 3	Evaluate	20 %	30 %	30%	30 %
	Create				
	Total	100 %	100 %	100%	100 %

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
-	-	*Dr. Suresh Nivritti Khatawkar*

THEORY

Unit I – Conservation and Surveying Concepts
Soil and Water Conservation: Introduction, Importance and concepts; Land Capability classification; Surveying – chain and compass – levelling – land measurement – difference in elevation.

Unit II – Soil, Water and Wind Erosion
Definition and agents of soil erosion, geologic and accelerated erosion; Soil loss estimation by universal Loss Soil Equation and modified USLE; Soil erodibility; Soil loss measurement techniques Runoff plots, soil saplers; Water erosion: Mechanism and forms of water erosion – splash, sheet, rill and Gully classification; ravines - landslides; wind erosion - factors influencing wind erosion - mechanics of wind erosion – suspension, saltation, surface creep

Unit III - Conservation Techniques
Agronomical measures: contour farming, strip cropping, cropping systems, conservation tillage and mulching; Engineering measures: contour and graded bunds; design and surplussing arrangements; Terraces: level and graded broad base terraces; Bench terraces: planning, design and layout procedure, contour stonewall and trenching; Rate of sedimentation, silt monitoring and storage loss in tanks.

Unit IV - Irrigation and Drainage
Irrigation - irrigation methods - drip and sprinkler irrigation component– measurement of flow in open channels - velocity area method - rectangular weir - Cippoletti weir - V notch - orifices - Parshall flume - duty of water - irrigation efficiencies - agricultural drainage - surface and sub-surface drainage systems.

Unit V – Well, Pump and Turbine
Types of wells– pump types – reciprocating pumps – centrifugal pumps – turbine pumps – submersible pumps – jet pumps – airlift pump

Theory –Lecture Schedule
1. Soil and Water Conservation: Introduction, Importance and concepts; Land Capability classification;
2. Surveying – chain and compass
3. Land measurement – difference in elevation.
4. Definition and agents of soil erosion, geologic and accelerated erosion; Soil loss estimation by universal Loss Soil Equation and modified USLE; Soil erodibility; Soil loss measurement techniques Runoff plots, soil saplers;
5. Water erosion: Mechanism and forms of water erosion – splash, sheet, rill and Gully classification; ravines - landslides;
6. wind erosion - factors influencing wind erosion - mechanics of wind erosion – suspension, saltation, surface creep
7. Irrigation - irrigation methods - drip and sprinkler irrigation component– measurement of flow in open channels - velocity area method
8. Rectangular weir - Cippoletti weir - V notch - orifices - Parshall flume - duty of water
9. **In-Semester Examination**
10. Irrigation efficiencies - agricultural drainage - surface and sub-surface drainage systems.
11. Agronomical measures: contour farming, strip cropping, cropping systems, conservation tillage and mulching; Engineering measures: contour and graded bunds
12. Design and surplussing arrangements; Terraces: level and graded broad base terraces; Bench terraces
13. Planning, design and layout procedure, contour stonewall and trenching; Rate of sedimentation, silt monitoring and storage loss in tanks.
14. Types of wells– pump types – reciprocating pumps
15. Centrifugal pumps – turbine pumps
16. Submersible pumps – jet pumps – airlift pumps

Practical Schedule
1. Study of survey instruments - chains and cross staff surveying - linear measurement - plotting and finding areas.
2. Compass survey - observation of bearings - computation of angles- radiation, intersection.
3. Levelling – fly levels – determination of difference in elevation and prepare contour map.
4. Exercises on computation of rainfall erosivity index.
5. Estimation and measurement of soil loss by USLE and MUSLE
6. Design of grassed water ways and graded bunds
7. Design of contour bunds and bench terracing system
8. Problems on water measurement, duty of water, irrigation efficiencies.

9. Design of drip and sprinkler irrigation
10. Introduction to water, wind erosion - problems and conservation techniques
11. Study of different types and forms of water erosion.
12. Exercises on computation of rainfall erosivity index.
13. Estimation of sediment rate using Coshocton wheel sampler and multislot devisor.
14. Determination of sediment concentration through oven dry method.
15. Study and selection of different types of well and pumps
16. Visit to soil erosion sites and watershed project areas
17. **University practical examination**.

Text Books

1. Norman Hudson. 1985. Soil Conservation. Cornell University Press, Ithaka, New York, USA.
2. Frevert, R.K., G.O. Schwab, T.W. Edminster and K.K. Barnes. 2009. Soil and Water Conservation Engineering, 4th Edition, John Wiley and Sons, New York.
3. Soil water conservation Engineering, R. Suresh, Standard Publishers, New Delhi.

Reference Books

1. Michael, A.M. and T.P. Ojha. 2003. Principles of Agricultural Engineering. Volume II. 4th Edition, Jain Brothers, New Delhi.
2. Mal, B.C. 2014. Introduction to Soil and Water Conservation Engineering. 2014. Kalyani Publishers.

Web-References

1. https://www.agroengineering.org
2. https://ascelibrary.org › journal › jidedh
3. https://ores.su › journals › irrigation-science
4. https://www.journals.elsevier.com › agricultural-water-management
5. https://internationalscholarsjournals.org › journal › ijiwm
6. https://ecourses.icar.gov.in/
7. https://nptel.ac.in/courses
8. https://ciae.in.nic.in
9. https://iirs.gov.in

Journals

1. Journal of Agriucltural Engineering
2. Journal of Agricultural Engineering Research
3. Indian Journal of Soil Conservation

Course Nature: Theory based Practical							
Total Marks (100)							
S.No.	Category	**Assessment Tools**					
		In- Semester Examination	*Assignment*	*Record*	*Attendance*	*End-Semester Examination*	*Marks*
1	Theory-External	-	-		-	*50*	*50*
2	Theory-Internal	*20*	-			-	*20*
3	Practical-External	-	-		-	*15*	*15*
4	Practical-Internal	-	*05*	*05*	*05*	-	*15*
						Grand Total	*100*

Course Code	SUP19302	Course Name	LIVESTOCK AND POULTRY MANAGEMENT	Course Category	S	*Supplementary Course*	L	T	P	C
							2	0	1	3

Pre-requisite Courses	Nil	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Animal Husbandry*	Data Book / Codes/Standards	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1 :	*Explain the contributions of different types of livestock and Poultry*
CLR-2 :	*Summarize Animal Population and rearing system in livestock and Poultry*
CLR-3 :	*Outline the information on diversified Poultry*
CLR-4 :	*Explain different livestock management systems*
CLR-5 :	*Describe feed formulation and nutritional management in livestock and poultry*
CLR-6 :	*Describe the management and bio security measures*

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning			Program Learning Outcomes (PLO)														
		1	*2*	*3*	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Animal husbandry Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	Ability to solve scientific problems through Practical knowledge	Ability to implement knowledge gained in the applied field of Animal husbandry	Ability to understand social and ethical responsibilities
CLO-1 :	*Illustrate skills on different rearing system of livestock*	*3*	90	80	M								M	H		H	H	H	H
CLO-2 :	*Explain the management of different age group animals*	*1*	95	85	H								L	H		H	H	H	H
CLO-3 :	*Describe the poultry sector*	*2*	80	70	M		L	L					L	H		H	H	H	H
CLO-4 :	*Demonstrate animal handling*	*3*	75	65	M			L	L				M	H		H	H	H	H
CLO-5 :	*Discuss clean milk production and Milk processing methods*	*2*	75	60	L	L							M	H		H	H	H	H
CLO6 :	*Outline entrepreneurship skills*	*2*	75	65	L						H		M	H		H	H	H	H

		Learning Unit / Module 1	Learning Unit / Module 2	Learning Unit / Module 3	Learning Unit / Module 4	Learning Unit / Module 5
Duration (hour)		2	14	6	3	8
S-1	SLO-1	*Common terminology*	*Cattle and buffalo breeds*	*Sheep and goat breeds*	*Breeds of swine*	*Breeds and strains of chicken*
	SLO-2	*Livestock census*	*Breeding*	*Rearing system*	*Economic traits*	*Brooding and litter management*
S-2	SLO-1	*Government programs*	*Reproduction*	*Floor space and housing*	*Breeding system*	*Broiler and layers*
	SLO-2	*Livestock rearing system*	*Housing – floor space*	*Breeding methods*	*Creep feeding*	*Hatchery management*
S-3	SLO-1	*Significance of livestock in Indian economy*	*Nutritional management*	*Care and management*	*Reproduction management*	*Phytobiotics*
	SLO-2	*Culling methods*	*Proximate principle*	*Disease- prevention – treatment*	*Disease management*	*Digestion – Egg formation*
S-4	SLO-1	-	*Feed supplement and additives*			*Diversified poultry – disease*
	SLO-2	-	*Bacterial and viral disease – Treatment*			

Learning	*1. ICAR. (2002). Handbook of Animal Husbandry (4th ed). New Delhi: ICAR.1-1549*

Resources	2. *G.C. Banerjee (2013.) A Text Book of Animal Husbandry (8th ed). Oxford and IBH Publishing Company Private Limited .pp- 1-1079*

	Level of Thinking	Continuous Learning Assessment (35% weightage)		University Practical Examination (15%)	End semester theory Examination (50%)
		In semester (20%)	Practical (15%)		
Level 1	Remember	40 %	30 %	35%	30 %
	Understand				
Level 2	Apply	40 %	40 %	35%	40 %
	Analyze				
Level 3	Evaluate	20 %	30 %	30%	30 %
	Create				
	Total	100 %	100 %	100%	100 %

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Dr. B. George Stephenson Manager -Technical Novas international Pvt.Ltd Mobile: 9500107918	Dr.T.Vasanthakumar Assistant Professor Livestock farm complex Veterinary college and research institute, Orathanadu Thanjavur (Dt) Mobile:9025250970	Dr. G.Prabakar

THEORY

Unit I Introduction to Livestock Farming

Role of livestock in the national economy – common terminology - livestock census - Different livestock development programs of Government of India and Tamil Nadu – livestock rearing system

Unit II Management of Cattle, Buffalo and Bullock

Important cattle and buffalo breeds; classification: indigenous and exotic; Breed characteristics- Economic traits of cattle- improvement of farm animals – breeding- Reproduction of farm animals- Oestrus Cycle; Artificial insemination- introduction to embryo transfer technology – Housing principles- Floor space requirement - Feeding and Management of young animal, Heifer, Pregnant, Milch animal- Digestion -Classification of feed stuff- Proximate principle of feed- Nutrients and their function -Feed ingredients for livestock – Feed supplement and additives - Common diseases of cattle – classification– symptoms – prevention and control measures- Vaccination schedule

Unit III Management of Sheep and Goat

Indian and exotic breeds of sheep and goat - Economic traits- housing - Floor space requirement - Improvement of sheep and goat – Breeding management — Feeding and management of different age group of sheep and goat. – common bacterial and viral disease - prevention and treatment – Vaccination schedule.

Unit 1V Management of Swine

Breed classification- economic traits -Reproduction – oestrus signs – housing – floor space requirement – management of different age group of swine – common disease – prevention and vaccination schedule

Unit V Poultry Management

Classification of breeds - – Housing principles - deep litter – litter management – cage system - Floor space requirement – Management of growers and layers — nutrient requirements –Phytobiotics- digestion-Improvement of farm animal - breeding methods -Reproduction in poultry – artificial insemination – egg formation – Incubation - hatching – brooding - Disease- prevention and control- Vaccination schedule

Theory - Lecture Schedule

1. Common terms- Role of livestock in Indian economy -livestock and poultry census.
2. Different livestock development programmes of Government of India and Tamil Nadu Livestock rearing system – extensive – semi- intensive – mixed and specialized farming
3. Classification of indigenous Dual purpose and draught breeds of cattle -Dual purpose - Hariyana- Tharparkar- Kankrej- Drought-Kankeyam- Umbalachery and Bargur
4. Milch and Exotic cattle breeds - Gir- Sahiwal-Sindhi- -breed characteristics – exotic – Jersey- HF
5. Indian buffalo breeds- Murrah-Surthi- Nili ravi –Jaffarabadi-breed characteristics
6. Improvement of cattle and Buffalo - Breeding-cross breeding-upgrading-economic traits of cattle and buffalo
7. Reproduction of livestock - Estrous cycle – signs of estrous - artificial insemination-merits and demerits-Principles and outline of embryo transfer
8. Housing principles- site selection - floor space requirement for calves, heifer, milch animal and work bullocks. Systems of housing-single row system-double row system- head to head and tail to tail-merits and demerits.
9. Feeding and management of calf and heifer
10. Feeding and management of pregnant, Milch animal and working bullock
11. Digestion – different compartment of stomach – digestive physiology
12. Classification of feeds – roughage – concentrate
13. Proximate principle of feed – moisture- crude protein – Ether extract
14. Nutrients and their function – water – energy- protein - Feed ingredients - energy and protein sources
15. Feed supplements and additives – vitamins – minerals – antibiotic- hormone- growth promotors
16. Common disease – Bacterial – viral –metabolic - Foot and Mouth disease- anthrax -Brucellosis- Milk fever- ketosis – Vaccination schedule
17. **In – semester examination**
18. Goat farming-classification of breeds of Indian and exotic origin - Economic traits.
19. Sheep Farming - classification of breeds of Indian and exotic origin - Economic traits.
20. Rearing system – Housing Principle – Floor space requirement of different age group
21. Improvement and reproduction – breeding – estrus signs
22. Nutritional management of different age group of sheep and goat – flushing
23. Common disease – blue tongue – enterotoxaemia – sheep and goat pox- vaccination schedule
24. Swine farming – breeds - economic traits – housing principle – floor space requirement
25. Nutritional management of piglet, boar and sow -Breeding management – estrus sign- lumbar lordosis

26. Disease prevention and control of swine diseases –hog cholera, foot and mout- ecto and endo parasites – Vaccination
27. Classification of chicken breeds – Housing principles
28. Deep litters – cage system -floor space requirement
29. Management of growers and layers –
30. Brooding management – broilers- layers
31. Nutrient requirements- chick, grower and layer- digestion
32. Breeding methods - reproduction – Artificial insemination
33. Egg formation – Incubation and hatching
34. Common diseases- - Ranikhet- IBD-Salmonellosis- E-coli- vaccination

Practical Schedule

1. External parts of livestock
2. Identification of farm animal, poultry and Restraining methods
3. Disbudding, dehorning ,castration, dentition and Judging of livestock
4. Culling of livestock and poultry
5. Layout for different livestock for housing
6. Ration formulation for livestock
7. Formulation of concentration mixture
8. Clean milk production and milking methods
9. Demonstration of value-added milk products
10. External parts and judging of poultry
11. Hatchery operation
12. Incubation and hatching
13. Management of chicks, grower and layer
14. Debeaking, dusting and vaccination
15. Economics of livestock and poultry
16. Visit to IDF and IPF
17. **University Practical Examination**

Text Book

1. CAR (2002). *Handbook of Animal Husbandry* (4th ed). New Delhi: ICAR. pp.1-1549.
2. G.C. Banerjee (2013*). A Text Book of Animal Husbandry* (8th ed).New Delhi : Oxford and IBH Publishing Company Private Limited.pp.1-1079
3. Lesson,S and Summers, J.D.(2001). *A text book of Scott Nutrition of the chicken* (4th ed). Canada: University books.pp.1-586
4. Reddy,D.V. (2001). *Principles of animal nutrition and feed technology* (2nd ed). Oxford and New Delhi: IBH Publishing Company Private Limited.pp.1-425

Reference Books

1. Sastry, N.S.R and Thomas**,** C.K. (2005). *Livestock Production Management.* (3rd ed). Ludhiana: Kalyani Publishers.pp.1-850
2. Gopalakrishnan, C.A., and Lal, D.M.M. (1992). *Livestock and Poultry Enterprises for Rural Development*. Ghaziabad, Uttar Pradesh: Vikas Publications Private Limited.pp.1-1096
3. Sreenivasaiah, P.V. (2006). *Scientific Poultry Production (*3rd ed).Lucknow :International Book Distributing Co. pp- 1-1487.

Web-References

1. https://www.drvet.in/p/e-books.html
2. https://www.coursera.org/lecture/livestock-farming/1-3-farming-101-the-basics-of-livestock-production-wfhyL
3. http://www.tanuvas.ac.in/e-learning/objectivities.html
4. https://ecourses.icar.gov.in/

Journals

1. Indian Journal of Poultry Science

2. Indian Journal of Animal Science
3. Indian Journal of Animal Research
4. Poultry Science
5. World Poultry Science

Course Nature: Theory based Practical							
Total Marks (100)							
S.No.	Category	**Assessment Tools**					
		In- Semester Examination	Assignment	Record	Attendance	End-Semester Examination	Marks
1	Theory-External	-	-		-	*50*	*50*
2	Theory-Internal	*20*	-			-	*20*
3	Practical-External	-	-		-	*15*	*15*
4	Practical-Internal	-	*05*	*05*	*05*	-	*15*
						Grand Total	*100*

Course Code	PHE19301	Course Name	YOGA FOR HUMAN EXCELLENCE	Course Category	E	Extension Activity-Non-Gradial	L	T	P	C
							0	0	0	0

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Physical and Health Education	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1 :	Explain the basic concepts and philosophy of yoga
CLR-2 :	Summarize the historical knowledge and features of yoga
CLR-3 :	Demonstrate the Indigenous ways of physical fitness
CLR-4 :	Outline the Importance of yoga and surya-namaskar in human life
CLR-5 :	Demonstrate free hand exercises and fitness with mudras
CLR-6 :	Recongnise the need of leisure, recreation and camping

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Knowledge on Yoga	Problem Analysis	Yoga's and Asanas	Methods of learning	Material needs	Society & Culture	Ecological Interactions	Morals and Ethics	Individual & Team Work	Communication	Attitude of self discipline	Life Long Learning	Ability to decision making	Mental and physical fitness	Camping and recreation and disseminating to others to earn mudras
CLO-1 :	Demonstrate confidence of self awareness	2	80	80	M	M	L	L	M	M	H	H	M	H	H	H	H	H	H
CLO-2 :	Demonstrate physical and mental fitness	3	75	85	H	M	M	H	M	H	M	M	L	H	H	H	H	H	H
CLO-3 :	Present clarity in the thinking and decision making process	2	75	70	M	H	M	M	M	H	M	M	H	H	H	H	H	H	H
CLO-4 :	Demonstrate interaction with the society of co-existence	5	80	75	M	H	M	M	L	M	L	M	M	H	H	H	H	H	H
CLO-5 :	Associate the development of personality with good hygiene	4	85	80	M	M	M	M	M	M	M	M	M	H	H	H	H	H	H
CLO-6 :	Present self evaluation capacity and recreation with right attitudes	6	85	80	M	H	M	M	M	L	H	L	M	H	H	H	H	H	H

		Learning Unit / Module 1	Learning Unit / Module 2	Learning Unit / Module 3	Learning Unit / Module 4	Learning Unit / Module 5
Duration (hour)		6	6	6	6	6
S-1-2	SLO-1	Lecture on History of Yoga and Concepts	Lecture on Indigenous way of physical fitness	Importance of Asanas and Surya namaskar	Free hand exercises	Guest lecture for motivation and self evaluation
	SLO-2					
S-3-4	SLO-1	Practicing Pranayamas	Curative exercises	Practicing surya namaskar	Practicing Yoga mudras	Recreation camp
	SLO-2					
S-5-6	SLO-1	Practicing Meditations and Yoga Kriyas	Games for social interactions	Practicing yoga	Practicing Yoga postures	Importance of co- existence with nature
	SLO-2					

Learning Resources	**1.** Anil Sharma. (2007). Encyclopaedia of Health, Physical Education and Sports Sciences**.** (9 Volumes). Khel Sahitya Kendra. New Delhi. 2. Chaudhery, N.V. and R. Jain. (2012) Encyclopedia of Yoga Health and Physical Education (7 Volumes). Pragun Publication. New Delhi.	3. Aiyasamy, P.K. (2019). Science of Yoga (First Edition). Notion press. Chennai. Pp. 1-443.

Level	Level of Thinking	
Level 1	Remember	40 %
	Understand	
Level 2	Apply	40 %
	Analyze	
Level 3	Evaluate	20 %
	Create	
	Total	100 %

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Mrs. Latha, Yoga Guru, *Magadheera Fitness & Yoga AYUSH QCI - Fitness centre Coimbatore, TN.*	*Dr. P. K. Ayyasmy,* *K.K.Pudur, Coimbatore.*	*Dr. Periasami N*

Practical Schedule

1. Lecture on History of Yoga and Concepts
2. Lecture on Indigenous way of physical fitness
3. Importance of Asanas and Surya namaskar
4. Free hand exercises
5. Guest lecture for motivation and self evaluation
6. Practicing Pranayamas
7. Curative exercises Practicing surya namaskar
8. Practicing Yoga mudras
9. Recreation camp
10. Practicing Meditations and Yoga Kriyas
11. Games for social interactions
12. Practicing yoga
13. Practicing Yoga postures
14. Importance of co- existence with nature
15. Visit to Yoga practicing centre
16. Visit to amusement theme park
17. **University practical examination**

Text Books

1. Aiyasamy, P.K. (2019). Science of Yoga (First Edition). Notion press. Chennai. Pp. 1-443.

Reference Books

1. Anil Sharma. (2007). Encyclopaedia of Health, Physical Education and Sports Sciences**.** (9 Volumes). Khel Sahitya Kendra. New Delhi.
2. Chaudhery, N.V. and R. Jain. (2012) Encyclopedia of Yoga Health and Physical Education (7 Volumes). Pragun Publication. New Delhi.

Web-References

1. www.hridaya-yoga.fr/yoga-union-with-the-divine/?gclid=Cj0KCQiA_rfvBRCPARIsANlV66OP3KHTiJfPiBbc7X6OLw6k1LluG3DpIkUFPo-Ig5P5AA0WmreyltYaAt_YEALw_wcB
2. www.ananda.org/meditation/meditation-support/articles/what-is-yoga/
3. www.honairesort.com/blog/what-is-the-importance-of-yoga-in-our-daily-life/
4. www.artofliving.org/in-en/benefits-sun-salutation
5. www.hindujagruti.org/hinduism-for-kids/238_surya_namaskar.html?gclid=Cj0KCQiA_rfvBRCPARIsANlV66PK0MPn4Cr78XO-XC4I8-5uRpdV5Op9auneRi7vgb8zPnve0KBEt4YaAvmHEALw_wcB
6. www.yogajournal.com/yoga-101/yoga-class-dos-and-don-ts
7. www.consciouslifestylemag.com/body-energy-systems-health/
8. www.chaitanyayoga.com/12%20Basic%20Asanas.html
9. www.artsandculture.google.com/exhibit/FgJSV8NUVt54LA

Journals

1. International Journal of Yoga
2. Indian Journal of Ancient Medicine and Yoga
3. Journal of Yoga and Physiotherapy
4. Journal of Yoga Studies
5. International Journal of Yoga and Allied Sciences: Indian Yoga

Course Nature: Practical			
Total Marks (100)			
S.No.	**Category**	**Assessment Tools**	Marks
1	Practical-Internal	*Purely internal based on the participation, involvement and contribution of students in the activities pertaining to the course*	
		Attendance	*05*
		Discipline	*15*
		Assignment	*10*
		Yoga & Postures	*40*
		Written	*20*
		Viva voce	*10*
		Grand Total	***100***

Course Code	AGE19401	Course Name	ENVIRONMENTAL STUDIES AND DISASTER MANAGEMENT	Course Category	C	*Compulsory Core*	L	T	P	C
							2	0	1	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Environmental Sciences*	Data Book / Codes/Standards	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1 :	Associate the environment and its relationships with human activities
CLR-2 :	Describe the natural resources and its associated problems
CLR-3 :	Demonstrate skills in managing ecosystems and biodiversity conservation
CLR-4 :	Explain the various factors which cause environmental pollution and their control measures
CLR-5 :	Summarize the social issues, human health and the environment
CLR-6 :	Outline the the foundations of hazards and associated phenomena and disaster management

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning			Program Learning Outcomes (PLO)														
		1	*2*	*3*	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Agriculture Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	Ability to solve scientific problems through Environmental Sciences	Ability to implement knowledge gained in the applied field of Environmental Sciences	Ability to understand social and ethical responsibilities of Environmental Sciences
CLO-1 :	Discuss the facts, concepts, and methods from multiple disciplines and apply to environmental problems	*3*	85	80		H				M	H	M		H		H	M	H	H
CLO-2 :	Outline the functions of ecosystems and identify the reasons for biodiversity loss and explain different biodiversity conservation measures	*1*	95	85		M		L		M	H	H	L	H		H	M	H	H
CLO-3 :	Summarize the critical environmental issues with optimization techniques for the useful utilization of resources, pollution control and solid waste management	*2*	80	70		M				H	H	M	L	H		H	M	H	H
CLO-4 :	Identify and quantify various environmental pollutants present in the environment	*3*	75	65		H		L	L	M	H	H	M	H		H	M	H	H
CLO-5 :	Recongnize the concepts and methodologies to analyze and understand interactions between social and environmental processes, human health and sustainable development	*2*	75	60		L				M	H	H	M	H		H	M	H	H
CLO-6 :	Manage the different public health aspects of disaster events at a local, national and global levels.	*3*	75	65		H	L		L	M	H	H	H	H		H	M	H	H

	Learning Unit / Module 1	Learning Unit / Module 2	Learning Unit / Module 3	Learning Unit / Module 4	Learning Unit / Module 5	
Duration (hour)	12	11	17	11	14	
S-1	SLO-1	*Introduction to environment*	*Concept of an ecosystem*	*Air pollution*	*Social Issues and the environment*	*Natural Disasters- meaning and nature*
	SLO-2	*Concepts and segments in environment*	*Structure and function of an ecosystem*	*Noise pollution*	*Sustainable development*	*Effects of floods, drought, cyclone*
S-2	SLO-1	*Natural resources and associated problems*	*Types and characteristic features of terrestrial ecosystems*	*Soil pollution*	*Environment protection act in India*	*Effects of earthquakes, landslides, avalanches*
	SLO-2	*Urban problems related to energy*	*Types and characteristic features of aquatic ecosystems*	*Control measures of soil pollution*		*Effects of volcanic eruptions, heat and cold waves*
S3-4	SLO-1	*Lab 1: Waste water sample collection*	*Lab 4: Study of simple ecosystems*	*Lab 7: Determination of suspended*	*Lab 13: Case studies on successful*	*Lab 15: Quantitative risk assessment*

	SLO-2			*particulate matter and important air pollutants*	*implementation of sustainable development model*	*for natural hazards and preparation of environmental zonation map for cyclone*
S-5	SLO-1	*Forest resources*	*Biodiversity- biogeographical classification of India*	*Water pollution –causes and effects*	*Issues involved in enforcement of environmental legislation*	*Manmade disasters*
	SLO-2	*Deforestation and case studies*	*Value of biodiversity*	*Control measures of water pollution*	*Role of an individual in prevention of pollution*	*Effects of manmade disasters*
S-6	SLO-1	*Water resources*	*Biodiversity at global, National and local levels*	*Marine pollution*	*Global treaties for environmental protection*	*Effects of climate change and global warming*
	SLO-2	*Effects of over-utilization of surface and ground water*	*Threats to biodiversity*	*Thermal pollution and Nuclear hazards*	*Conventions for environmental protection*	*Effects of sea level rise, acid rain and ozone layer depletion*
S7-8	SLO-1	*Lab 2: Biogas production*	*Lab 5: Biodiversity assessment in polluted and un polluted system*	*Lab 8: Estimation of acidity and alkalinity in water samples*	*Lab 14: Case studies on environmental issues and human health: Climate change*	*Lab 16: Visit to disaster affected area*
	SLO-2					
S-9	SLO-1	*Land resources*	*Conservation of biodiversity- In-situ and Ex-situ*	*Urban and industrial wastes*	*Water conservation-watershed management*	*Concept of disaster management*
	SLO-2	*Food resources*	*Biosphere Reserve - National parks and Wildlife Sanctuaries*	*Solid Waste Management*	*Wasteland reclamation*	*National disaster management framework and financial arrangements*
S-10	SLO-1	*Mineral resources*	-	-	*Human population and the environment*	*Effect to migrate disaster at national and global levels*
	SLO-2	*Role of an individual in conservation of natural resources*	-	-	*Family welfare programme*	*International strategy for disaster reduction*
S-11-12	SLO-1	*Lab 3: Visit to wind mill / hydro power / solar power generation units*	*Lab 6: Visit to river / forest / grassland /hill/mountain to document environmental assets*	*Lab 9: Estimation of water hardness*	-	-
	SLO-2					
S-13	SLO-1	-	-	-	*Environment and human health*	*Role of NGOs and community in disaster management*
	SLO-2	-	-	-	*Role of information technology in environment and human health*	*Role of organization in disaster management*
S-14	SLO-1	-	-	-	-	*Role of armed forces in disaster response and disaster management*
	SLO-2	--	-	-	-	*Police and other organizations in disaster response and management*
S-15-16	SLO-1	-	-	*Lab 10: Estimation of DO and BOD in water samples*	-	-
	SLO-2					
S-17	SLO-1	-	-	-	-	*Contingency planning for disaster risk reduction*
	SLO-2	-	-	-	-	Weather forecasting and early warning systems
S-18	SLO-1	-	-	-	-	Existing schemes and government policies to tackle agricultural disasters
	SLO-2	-	-	-	-	Criteria and constrains of crop/animal insurance and credit guarantee schemes
S-19-20	SLO-1	-	-	Lab 11: Estimation of COD in water	-	-

	SLO-2			samples		
S-21-22	SLO-1	-	-	Lab 12: Solid waste management: composting and vermicomposting	-	-
	SLO-2	-				

Learning Resources	1. *Erach Bharucha. (2013). Text book for Environmental studies. New Delhi, India: University Grants Commission. pp.1-324.* 2. *Sharma, P.D. (2010). Ecology and Environment. Meerut, India: Rastogi Publications. pp. 1-600.*

	Level of Thinking	Continuous Learning Assessment (35% weightage)		University Practical Examination (15%)	End semester theory Examination (50%)
		In semester (20%)	Practical (15%)		
Level 1	Remember Understand	40 %	30 %	35%	30 %
Level 2	Apply Analyze	40 %	40 %	35%	40 %
Level 3	Evaluate Create	20 %	30 %	30	30 %
	Total	100 %	100 %	100%	100 %

Course Designers	
Experts from Industry	Experts from Higher Technical Institutions
Mr.M.Parmeer Selvam, Environmental Engineer, VIRDT, Dharmapuri.	Dr. A. Balusamy, Scientist, Division of Natural Resource Management, ICAR-Research Complex for North Eastern Hill Region
	Internal Experts
	Dr. M. Sanjeevagandhi, Assistant Professor (ENS), SRMIST

THEORY

Unit I – Introduction to Environmental Science and Natural Resources

Environmental Science: Definition, scope and importance - Multidisciplinary nature of environmental science, Concepts and Segments; Global environmental initiatives and perspectives; Ecological footprint - Natural Resources: Renewable and non-renewable resources, Natural resources and associated problems - Energy resources: Growing energy needs, renewable and non-renewable energy sources, and use of alternate energy sources - Urban problems related to energy, Case studies - Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people - Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems - Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification. Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies - Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies; Role of an individual in conservation of natural resources - Equitable use of resources for sustainable lifestyles.

Unit II – Ecology and Biodiversity

Ecosystems: Concept of an ecosystem, Structure and function of an ecosystem, Producers, consumers and decomposers, Energy flow in the ecosystem. Ecological succession, Food chains, food webs and ecological pyramids - Species interactions and Biogeochemical cycles - Introduction, types, characteristic features, structure and function of Forest ecosystem - Grassland ecosystem - Desert ecosystem - Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) - Biodiversity - Introduction, definition, genetic, species & ecosystem diversity and biogeographical classification of India - Value of biodiversity - Biodiversity at global, National and local levels, India as a mega-diversity nation - Hot-sports of biodiversity - Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts - Endangered and endemic species of India - Conservation of biodiversity - In-situ and Ex-situ conservation of biodiversity; Biosphere Reserve - National parks and Wildlife Sanctuaries; Botanical Garden; Biodiversity legislation.

Unit III – Environmental Pollution and Management

Environmental Pollution - Definition, cause, effects and control measures of Air pollution and Noise pollution - Definition, cause, effects and control measures of Soil pollution – Bioremediation - Definition, cause, effects and control measures of Water pollution - Definition, cause, effects and control measures of marine pollution, Thermal pollution and Nuclear hazards - Causes, effects and control measures of urban and industrial wastes and Solid Waste Management.

Unit IV – Social Issues, Human Health and the Environment

Social Issues and the Environment: From Unsustainable to Sustainable development, consumerism and waste products - Role of an individual in prevention of pollution - Environment Protection Act in India - Issues involved in enforcement of environmental legislation - Public awareness - Global treaties and Conventions for Environmental Protection - Water conservation, rain water harvesting, watershed management - Wasteland reclamation - Human Population and the Environment: population growth, variation among nations, population explosion, Family Welfare Programme - Environment and human health: Human Rights, Value Education, HIV/AIDS - Women and Child Welfare - Role of information technology in environment and human health.

UNIT V – Disaster Management

Natural Disasters - Meaning and nature of natural disasters, their types and effects - floods, drought, cyclone, earthquakes, landslides, avalanches, volcanic eruptions, heat and cold waves - Man Made Disasters- Nuclear disasters and holocaust, chemical disasters, biological disasters, building fire, coal fire, forest fire, oil fire, pollution, road accidents, rail accidents, air accidents, sea accidents - Issues and possible solutions for climate change, global warming, sea level rise, acid rain, ozone layer depletion, deforestation - Concept of disaster management, national disaster management framework; financial arrangements - Disaster Management- Effect to migrate disaster at national and global levels - International strategy for disaster reduction - Role of NGOs, community –based organizations and media - Central, state, district and local administration on disaster management - Armed forces, police and other organizations in disaster response and disaster management - Contingency Planning for Disaster Risk Reduction - Existing schemes and government policies to tackle agricultural disasters.

Lecture Schedule

1. Environmental Science: Definition, scope and importance - Multidisciplinary nature of environmental science, Concepts and Segments; Global environmental initiatives and perspectives; Ecological footprint.
2. Natural Resources: Renewable and non-renewable resources, Natural resources and associated problems - Energy resources: Growing energy needs, renewable and non-renewable energy sources, and use of alternate energy sources - Urban problems related to energy, Case studies
3. Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people
4. Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems
5. Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification. Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies
6. Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies; Role of an individual in conservation of natural resources - Equitable use of resources for sustainable lifestyles
7. Ecosystems: Concept of an ecosystem, Structure and function of an ecosystem, Producers, consumers and decomposers, Energy flow in the ecosystem. Ecological succession, Food chains, food webs and ecological pyramids - Species interactions and Biogeochemical cycles
8. Introduction, types, characteristic features, structure and function of Forest ecosystem - Grassland ecosystem - Desert ecosystem - Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)
9. Biodiversity - Introduction, definition, genetic, species & ecosystem diversity and biogeographical classification of India - Value of biodiversity
10. Biodiversity at global, National and local levels, India as a mega-diversity nation - Hot-sports of biodiversity - Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts - Endangered and endemic species of India
11. Conservation of biodiversity - In-situ and Ex-situ conservation of biodiversity; Biosphere Reserve - National parks and Wildlife Sanctuaries; Botanical Garden; Biodiversity legislation
12. Environmental Pollution - Definition, cause, effects and control measures of Air pollution and Noise pollution
13. Definition, cause, effects and control measures of Soil pollution – Bioremediation
14. Definition, cause, effects and control measures of Water pollution
15. Definition, cause, effects and control measures of marine pollution,
    Thermal pollution and Nuclear hazards
16. Causes, effects and control measures of urban and industrial wastes and Solid Waste Management
17. **In-semester examination**
18. Social Issues and the Environment: From Unsustainable to Sustainable development, consumerism and waste products

19. Environment Protection Act in India
20. Issues involved in enforcement of environmental legislation - Role of an individual in prevention of pollution
21. Global treaties and Conventions for Environmental Protection
22. Water conservation, rain water harvesting, watershed management - Wasteland reclamation
23. Human Population and the Environment: population growth, variation among nations, population explosion, Family Welfare Programme
24. Environment and human health: Human Rights, Value Education, HIV/AIDS - Women and Child Welfare - Role of information technology in environment and human health
25. Natural Disasters - Meaning and nature of natural disasters, their types and effects - floods, drought, cyclone
26. Earthquakes, landslides, avalanches, volcanic eruptions, heat and cold waves
27. Man Made Disasters- Nuclear disasters and holocaust, chemical disasters, biological disasters, building fire, coal fire, forest fire, oil fire, pollution, road accidents, rail accidents, air accidents, sea accidents
28. Issues and possible solutions for climate change, global warming, sea level rise, acid rain, ozone layer depletion
29. Concept of disaster management, national disaster management framework; financial arrangements
30. Disaster Management- Effect to migrate disaster at national and global levels - International strategy for disaster reduction
31. Role of NGOs, community –based organizations and media - Central, state, district and local administration on disaster management
32. Armed forces, police and other organizations in disaster response and disaster management
33. Contingency Planning for Disaster Risk Reduction: agronomic, engineering other non-engineering interventions - Weather forecasting and early warning systems, flood forecasting, agricultural drought monitoring and forecasting
34. Existing schemes and government policies to tackle agricultural disasters - Insurance and loan schemes: criteria and constrains of crop/animal insurance and credit guarantee schemes

Practical Schedule

1. Waste water sample collection, processing and preservation
2. Biogas production from organic wastes
3. Visit to wind mill / hydro power / solar power generation units
4. Study of simple ecosystems-pond, river, hill slopes - Crop adaptation to different ecosystems
5. Biodiversity assessment in polluted and un polluted system
6. Visit to river/forest/grassland/hill/mountain to document environmental assets
7. Air sampling and determination of suspended particulate matter and important air pollutants
8. Estimation of acidity and alkalinity in water samples
9. Estimation of water hardness
10. Estimation of DO and BOD in water samples
11. Estimation of COD in water samples
12. Solid waste management: composting and vermicomposting of farm wastes
13. Case studies on successful implementation of sustainable development model
14. Case studies on environmental issues and human health: Climate change
15. Quantitative risk assessment for natural hazards and preparation of environmental zonation map for cyclone
16. Visit to areas affected by natural disaster
17. **University Practical examination**

Text Books:

1. Erach Bharucha. (2013). *Text book for Environmental studies.* New Delhi, India: University Grants Commission, pp.1-324.
2. Prasanthrajan, M & Mahendran, P.P. (2013). *A text book on Ecology and Environmental Science.* Udaipur, India: Agrotch Publishing Academy. pp.1- 285.

Reference Books:

1. Bhattacharya, T. (2012). *Disaster Science and management.* New Delhi, India: Tata McGraw Hill Education private limited, pp.1-198.
2. De, A.K. (2010). *Environmental Chemistry*. New Delhi, India: New Age International Publishers. pp.1-384.
3. Khannna, B.K & Nina Khanna. (2011). *Disaster–Strengthening community Mitigation and Preparedness.* New Delhi, India: New India Publication Agency. pp.1-308.
4. Mani, N. (2017). *Environment, Climate change and Disaster management.* New Delhi, India: New Century publication. pp.1-276.
5. Sharma P.D. (2010). *Ecology and Environment*. Meerut, India: Rastogi Publications. pp. 1-600.
6. Tyler Miller & Scot Spoolman. (2009). *Living in the Environment (Concepts, Connections, andSolutions).* Belmont, USA: Brooks/cole, Cengage learning publication. pp.1-816.

Web References:

1. http://ecoursesonline.iasri.res.in/course/view.php?id=486
2. https://www.youtube.com/watch?v=2swlzu3rzII&list=PLoGgviqq4847IAo58jX32INd_UxDVW0YJ
3. https://www.youtube.com/watch?v=DExlZTfKZAM&list=PLC4PaTsQiLcbejXqJR7S59Ohk2OK1rgEG
4. https://www.youtube.com/watch?v=mIPBPG-5dUw

Journals:

1. Environment Pollution and Climate Change
2. Environmental Science: An Indian Journal
3. Journal of Earth Science & Climatic Change
4. Journal of Industrial Pollution Control
5. Research & Reviews: Journal of Ecology and Environmental Sciences

Course Nature: Theory based Practical							
Total Marks (100)							
S.No.	Category	**Assessment Tools**					
		In- Semester Examination	Assignment	Record	Attendance	End-Semester Examination	Marks
1	Theory-External	-	-		-	*50*	*50*
2	Theory-Internal	*20*	-			-	*20*
3	Practical-External	-	-		-	*15*	*15*
4	Practical-Internal	-	*05*	*05*	*05*	-	*15*
						Grand Total	*100*

Course Code	AGE19402	Course Name	CROP PRODUCTION TECHNOLOGY – II (*RABI* CROPS)	Course Category	*C*	*Compulsory core*	L	T	P	C
							1	0	1	2

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Agronomy*	Data Book / Codes/Standards	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1:	*Explain the importance, origin and distribution of rabi crop*
CLR-2:	*Identify the improved varieties and climate requirements for Rabi crops*
CLR-3:	*Explain the improved agronomic practices for harvesting the good economical yield under different ago-climatic conditions of Tamil Nadu and India*
CLR-4:	*Apply the various agronomic inputs for raising different crops and intensive cultivation to increase the food production*
CLR-5:	*Discuss the application of the principles of the scientific basis of crop and plant production sciences*
CLR-6:	-

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning			Program Learning Outcomes (PLO)														
		1	*2*	*3*	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Agriculture Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	Ability to solve scientific problems	Ability to implement knowledge gained	Ability to understand social and ethical responsibilities.
CLO-1:	*Discuss sustainable field crop management.*	2	80	75	H		L			M	M		M	H		H	H	H	H
CLO-2:	*Summarize the technical and scientific principles of the cultivation of rabi crops*	3	85	90	H				L		H		M	H		H	H	M	H
CLO-3:	*Recognize requirements and the practices to obtain the main agricultural products from the cultivated crops.*	2	80	75	M				L	L	M		H	H		H	H	H	M
CLO-4:	*Outline the key aspects of husbandry operations required to grow the major Rabi crops successfully*	3	85	80	H	L		M			L		M	H	L	H	H	H	H
CLO-5:	*Discuss the critical management factors involved in profitable crop production*	2	90	85	H			L			M		M	H		H	H	H	H
CLO6:	-																		

		Learning Unit / Module 1	Learning Unit / Module 2	Learning Unit / Module 3	Learning Unit / Module 4	Learning Unit / Module 5
Duration (hour)		3	2	4	4	3
S-1	SLO-1	*Wheat – origin, economic importance*	*Chick pea– origin, variety, climate*	*Production technology of Rapeseed*	*Sugarcane – origin, economic importance*	*Sugarcane – value addition*
	SLO-2	*Wheat – soil and climate*	*Chick pea – cultivation practices*	*Package of practices of Mustard*	*Sugarcane – soil and climate*	*Sugarcane – by-products utilization*
S-2,3	SLO-1	*Lab 1. Identification of rabi crops and recording their importance in the crop cafeteria.*	*Lab 4. Estimation of plant population per unit area for rabi crops*	*Lab 6. Acquiring skill in detrashing and propping in sugarcane*	*Lab 10. Estimating Cost and returns of important rabi crops*	*Lab 14. Practicing field preparation and sowing Lucerne*
	SLO-2					
S-4	SLO-1	*Wheat – Variety, cultivation practices*	*Lentil production technology*	*Safflower production technology*	*Sugarcane – Nursery& transplanting methods*	*Production technology of Berseem*
	SLO-2	*Wheat – Yield*	*Package of practices of peas*	*Package of practices of Niger*	*Sugarcane – Cultural practices, Yield*	*Package of practices of Lucerne*
S-5,6	SLO-1	Lab 2. Acquiring skill in field preparation, sowing and manuring of rabi crops under pure and intercropping situations	Lab 5. Nursery preparation for Sugarcane	Lab 7. Study on growth parameters of sugarcane	Lab 11. Visit to Sugarcane Breeding Institute/ Research Station to study cultivation of sugarcane and its by-products	Lab 15. Practicing field preparation and sowing for fodder maize
	SLO-2					
S-7	SLO-1	Barley cultivation technology	-	Sunflower – origin, economic importance	Sugarcane - SSI	Fodder maize – origin, variety, climate
	SLO-2	Oats production technology	-	Sunflower – soil and climate	Sugarcane – Drip irrigation	Fodder maize – cultivation practices
S-8,9	SLO-1	Lab 3. Acquiring skill in seed treatment		Lab 8. Study on yield parameters and	Lab 12. Visit to - nearby sugar mill, for	Lab 16. Visit to Wheat research station,

	SLO-2	techniques and foliar nutrition of rabi crops		estimation of yield in sugarcane	observing juice extraction, quality assessment, sugar manufacture and by products	Wellington to study rabi crops
S-10	SLO-1	-	-	Sunflower – Variety, cultivation practices	Sugarcane – Crop logging	-
	SLO-2	-	-	Sunflower – Yield	Sugarcane – maturity and ripening	-
S-11,12	SLO-1	-	-	Lab 9. Study on yield parameters and estimation of yield in rabi crops	Lab 13. Silage making	-
	SLO-2	-	-			-

Learning Resources	1. *Ahlawat,I.P.S., Om Prakash and Saini, G.S. (2010). Scientific Crop Production in India. Rama publishing House, Meerut. pp. 1-680.* 2. *Chidda Singh, Prem Singh and Rajbir Singh. (2020). Modern Techniques of Raising Field Crops. Oxford and IBH Publishing Co Pvt. Ltd, New Delhi. pp. 1-596.*	3. *Mukund Joshi. (2015). Text Book of Field Crops. PHI Learning Private limited. New Delhi. pp. 1- 537.* 4. *Rajendra Prasad. (2017). Textbook of Field Crops Production (Volume 1 & 2). Indian Council of Agricultural Research (ICAR), New Delhi. pp. 1-1008.*

	Level of Thinking	Continuous Learning Assessment (35% weightage)		University Practical Examination (15%)	End semester theory Examination (50%)
		In semester (20%)	Practical (15%)		
Level 1	Remember Understand	40 %	30 %	40%	35 %
Level 2	Apply Analyze	40 %	40 %	35%	35 %
Level 3	Evaluate Create	20 %	30 %	35%	20 %
	Total	*100 %*	*100 %*	*100%*	*100 %*

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Mr.P.B. Mukundan, Organic farming Progressive farmer *H. No. 92, Rajaji, Street, Chengalpattu – 603001 Tamil Nadu.*	*Dr. M. Mohamed Amanullah, Professor (Agronomy),* *Maize Research Station,Tamil Nadu Agricultural University* *Vagarai – 624 613, Palani Taluk, Dindigul District.*	*Dr. N. Krishnaprabu* *Dr. D. Selvakumar* *Dr. S. Marimuthu*

THEORY

Unit - I Cereals
Wheat, barley, Oats - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices, yield.

Unit - II Pulses
Chickpea, lentil, peas - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices, yield.

Unit - III Oilseeds
Rapeseed, mustard, Niger, Safflower and sunflower- Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices, yield.

Unit - IV Sugar Crops
Sugarcane - Origin, geographic distribution, economic importance, nursery, soil and climatic requirement, varieties, cultural practices, yield.

Unit - V Forage Crops
Berseem, Lucerne, Fodder maize: Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices.

Theory - Lecture Schedules
1. Wheat- Origin, geographic distribution, economic importance, soil and climatic requirement.
2. Wheat - varieties, cultural practices and yield.
3. Barley and oats - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices, yield.
4. Chickpea- Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices, yield.
5. Lentil and Peas - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices, yield.
6. Rapeseed and Mustard - Origin, geographic distribution, economic importance, Classification, soil and climatic requirement, varieties.
7. Safflower and Niger- Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices, yield.
8. Sunflower - Origin, geographic distribution, economic importance, soil and climatic requirement.
9. **In-Semester Examination**
10. Sunflower- varieties, cultural practice and yield.
11. Sugarcane - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties,
12. Sugarcane – Nursery, types, cultural practices and yield.
13. Sugarcane- package of practices for SSI and drip irrigation
14. Sugarcane - Crop logging, maturity and ripening
15. Sugarcane - Gur manufacture, Value addition and by-product utilization.
16. Berseem and Lucerne - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices, yield.
17. Fodder maize - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices, yield.

Practical Schedule
1. Identification of rabi crops and recording their importance in the crop cafeteria.
2. Acquiring skill in field preparation, sowing and manuring of rabi crops under pure and intercropping situations.
3. Acquiring skill in seed treatment techniques and foliar nutrition of rabi crops.
4. Estimation of plant population per unit area for rabi crops.
5. Nursery preparation for Sugarcane.
6. Acquiring skill in detrashing and propping in sugarcane
7. Study on growth parameters of sugarcane.
8. Study on yield parameters and estimation of yield in sugarcane.
9. Study on yield parameters and estimation of yield in rabi crops.
10. Estimating Cost and returns of important rabi crops.
11. Visit to Sugarcane Breeding Institute/ Research Station to study cultivation of sugarcane and its byproducts.
12. Visit to - nearby sugar mill, for observing juice extraction, quality assessment, sugar manufacture and by products.

13. Silage making.
14. Practicing field preparation and sowing Lucerne.
15. Practicing field preparation and sowing for fodder maize.
16. Visit to Wheat research station, Wellington to study rabi crops
17. **University practical examination**

Text Books

1. Ahlawat,I.P.S., Om Prakash and Saini, G.S. (2010). *Scientific Crop Production in India.* Rama publishing House, Meerut. pp. 1-680.
2. Chidda Singh, Prem Singh and Rajbir Singh. (2020). *Modern Techniques of Raising Field Crops.* Oxford and IBH Publishing Co Pvt.Ltd, New Delhi. pp. 1-596.
3. Mukund Joshi., (2015). *Text Book of Field Crops.* PHI Learning Private limited. New Delhi. pp. 1- 537.
4. Rajendra Prasad. (2017). *Textbook of Field Crops Production (Volume 1 & 2).* Indian Council of Agricultural Research (ICAR), New Delhi. pp. 1-1008.
5. Reddy. S.R. (2014). *Principles of Crop Production.* Kalyani Publishers, Ludhiana. pp. 1 - 794.

Reference Books

1. Alabaster Jenkins. (2016). *Agronomy and crop production.* Syrawood publishing house, UK. pp. 1-205.
2. Crop Production Guide. (2020). Directorate of Agriculture, Chennai and Tamil Nadu Agricultural University, Coimbatore. pp. 1-460.
3. Reddy, S.R. (2012). *Agronomy of field crops.* Kalyani publishers, New Delhi. pp. 1-443.
4. Singh. S.S. (2015). *Crop management under irrigated and rainfed conditions.* Kalyani Publishers, New Delhi. pp. 1- 574.
5. Srinivasan Jeyaraman. (2018). *Field crops production and management (Volume I & 2).* Oxford and IBH Publishers. India. pp. 1- 1068.
6. Yellamanda Reddy, T. and Sankara Reddy, G.H. (2017). *Principles of Agronomy*. Kalyani publishers, Ludhiana. pp. 1-685.

Web References

1. www.crida.org
2. www.cgiar.org
3. www.tnau.ac.in/agriporal
4. www.rkmp.irri.org.
5. https://www.agrimoon.com/wp-content/uploads/Introduction-to-major-field-crops.pdf

Journals

1. Journal of crop and weed
2. Field crop Research
3. Indian journal of Agronomy
4. Legume Research
5. Advances in Agronomy

Course Nature: Theory based Practical							
Total Marks (100)							
S.No.	Category	**Assessment Tools**					
		In- Semester Examination	Assignment	Record	Attendance	End-Semester Examination	Marks
1	Theory-External	-	-		-	*50*	*50*
2	Theory-Internal	*20*	-			-	*20*
3	Practical-External	-	-		-	*15*	*15*
4	Practical-Internal	-	*05*	*05*	*05*	-	*15*
						Grand Total	*100*

Course Code	AGE19403	Course Name	FARMING SYSTEM AND SUSTAINABLE AGRICULTURE	Course Category	C	Compulsory Core	L	T	P	C
							1	0	0	1

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	AGRONOMY	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1:	Define and explain the concept, importance and advantages of sustainable agriculture.
CLR-2:	Describe cropping systems, crop rotation and its principles, factors affecting the selection of crop rotation
CLR-3:	Outline the type and method of farming system which help to solve the problem of soil health degradation
CLR-4:	Explain the natural resources including soil and water as a part of sustainable resource management
CLR-5:	Discuss the sustainable income through integrating more enterprises along with cropping
CLR-6:	-

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Agriculture Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	Ability to solve scientific problems	Ability to implement knowledge gained	Ability to understand social and ethical responsibilities
CLO-1:	Discuss modern agriculture in relation to sustainable agriculture and discuss the sustainable indicators on ecological basis	2	85	80	H						H		M	H		H	H	M	M
CLO-2:	Discuss sustainable agriculture in relation to tillage, fertilizers, irrigation, weed management and plant protection measures	2	80	75	H					L	H					H	H	H	H
CLO-3:	Outline the important cropping system for sustainable agriculture in India	3	90	95	H		H	M		L			H	H		H	M	H	M
CLO-4:	Summarize different cropping scheme for various ago-ecosystem	3	85	90	H					L						H	M	M	M
CLO-5:	Identify different Integrated farming system models for various ago-ecosystems	2	85	80	H	M				L	H		H			H	H	H	
CLO6:	-																		

Duration (hour)		Learning Unit / Module 1	Learning Unit / Module 2	Learning Unit / Module 3	Learning Unit / Module 4	Learning Unit / Module 5
		4	4	3	2	2
S-1	SLO-1	Cropping system (CS) - definition	Crop Varieties and tillage in cropping systems	Farming system: definition, principles	Resource recycling in IFS	Labour management in IFS
	SLO-2	CS - principles and concepts	Land shaping and crop geometry in cropping systems	Concepts and factors influencing choice and size of enterprises in farming system	IFS system evaluation	Cost reduction technologies and non-monetary inputs in IFS
S-2	SLO-1	Classification of cropping system	Water management and soil fertility management in cropping systems	Scope of IFS	IFS model - Wetland	Interactions between the allied enterprises
	SLO-2	Multiple cropping	Plant protection in cropping systems	Advantages of IFS	IFS model – Garden and dry land	-
S-3	SLO-1	Major cropping systems in India	Cropping scheme, principles	Allied enterprises – wetland	LEISA and HEIA-Principles and concepts	-
	SLO-2	Major cropping systems in TN	Factors influencing cropping scheme	Allied enterprises – garden and dry land		
S-4	SLO-1	Complementary and competitive interactions- light and nutrient	Indices for evaluation-land use	-	Conservation Agriculture	-
	SLO-2	Complementary and competitive interactions- Water and Weed	Indices for evaluation-Yield advantage and economic	-	-	-

Learning Resources	
	1. Jana, B.L. (2014). *Farming Systems.* Agrotech. Publishing Academy, Udaipur. pp. 1-304. 2. Jayanthi, C. Devasenapathy, P and Vennila, C. (2007). *Farming Systems. Principles and practices.* Satish Serial Publishing House, Delhi. pp. 1-299. 3. Palaniappan, S. P and Sivaraman, K. (1996). *Cropping systems in the tropics Principles and management.* New Age International (P) Ltd., New Delhi. pp. 1-209. 4. Panda, S.C. (2014). *Cropping and Farming Systems.* Agrobios Publishers. Jodhpur. pp. 1-417.

Level of Thinking		Continuous Learning Assessment (50% weightage)		End semester theory Examination **(50%)**
		In semester (40%)	Theory Internal (10%)	
Level 1	Remember	40 %	40 %	30 %
	Understand			
Level 2	Apply	35 %	35 %	40 %
	Analyze			
Level 3	Evaluate	25 %	25 %	30 %
	Create			
	Total	*100 %*	*100 %*	*100 %*

Course Designers		
Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
Mr. Sivakumar Madras iyer thottam organic farm, Kondappa naicken palayam, Sathyamangalam, Tamil Nadu 638503.	Dr. M. Mohamed Amanullah, Professor (Agronomy), Maize Research Station, Tamil Nadu Agricultural University Vagarai – 624 613, Palani Taluk, Dindigul District.	Dr. S. Marimuthu Dr. N. Krishnaprabu

THEORY:

Unit - I Cropping System
Cropping systems - Definition - Principles - Concepts - Classification - mono cropping- intensive cropping - cropping systems of India and Tamil Nadu - Interaction between different cropping systems-Cropping system management - Resource management - land, nutrient, water and weed.

Unit - II Cropping Scheme and Evaluation of Cropping System
Cropping scheme-factors influencing cropping scheme- principles, advantage-steps in preparing cropping scheme - Index for evaluation of cropping systems - Land use - yield advantages - Economic evaluation - sustainability.

Unit - III Farming System
Farming systems - Definition - Principles - Concepts - Enterprises selection and management - interaction between different enterprises with cropping - scope and advantages of Integrated Farming system - Integrated farming system models for different agro eco-systems - interaction between enterprises.

Unit - IV Evaluation of Farming System
Resource recycling in IFS - Evaluation indicators of integrated farming system - LEISA & HEIA - concepts and principles - Conservation agriculture - principles, concept and scope.

Unit - V Resource and Labour Management in Farming System
Resource management under constraint situations - Cost reduction strategies in crop production - Non-monetary inputs and low-cost technologies - Labour management - farming system and environment.

Theory- Lecture Schedules
1. Cropping system: Definition, Principles and basic concepts.
2. Classification of cropping system - Mono cropping, intensive cropping, multiple cropping, mixed cropping.
3. Major cropping systems prevailing in India and Tamil Nadu for different agro ecosystems.
4. Complementary and competitive interaction in different cropping systems - light, nutrient, water and weed.
5. Cropping system management: agronomic requirement for crops and cropping system selection of crops and varieties, tillage and land shaping, plant population and crop geometry.
6. Cropping system management: agronomic requirement for crops and cropping system - water management, soil fertility management and plant protection.
7. Cropping scheme-factors influencing cropping scheme- principles, advantage-steps in preparing cropping scheme.
8. Indices for evaluation of cropping system - land use, yield advantage and economics.
9. **In-Semester Examination**.
10. Farming system: definition, principles and concepts and factors influencing choice and size of enterprises
11. Scope and advantages of integrated farming system.
12. Allied enterprises for wetland, irrigated upland and dryland - selection and management and their interaction.
13. Resource recycling in integrated farming system and Integrated Farming System evaluation indicators.
14. Integrated farming system - models for wetland, irrigated upland and dryland ecosystem.
15. LEISA and HEIA - principles and concepts and Labour management in integrated farming systems.
16. Conservation agriculture and environmental impact of integrated farming systems.
17. Cost reduction technologies and non-monetary inputs in integrated farming systems.

Text Books

1. Jana, B.L. (2014). *Farming Systems.* Agrotech Publishing Academy, Udaipur. pp. 1-304.
2. Jayanthi, C. Devasenapathy, P and Vennila, C. (2007). *Farming Systems. Principles and practices.* Satish Serial Publishing House, Delhi. pp. 1-299.
3. Palaniappan, S. P and Sivaraman, K. (1996). *Cropping systems in the tropics Principles and management.* New Age International (P) Ltd., New Delhi. pp. 1-209.
4. Panda, S.C. (2014). *Cropping and Farming Systems.* Agrobios Publishers. Jodhpur. pp. 1-417.
5. Shagufta. (2015). *Cropping and Farming Systems.* APH Publishing Corporation. pp. 1-356.

Reference Books

1. Farming System and Poverty - Improving Farmers livelihoods in a changing World. (2001). (Ed.) Malcolm Hall et al., FAO and World Bank Publication. pp. 1-409.
2. Rattan Lal., Bal Ram Singh., Dismas L. Mwaseba., David Kraybill., David O. Hansen., Lars Olav Eik. (2015). *Sustainable intensification to advance food security and enhance climate resilience in Africa*. Springer International Publishing. pp. 1-271.
3. Sankarsana Nanda. (2016). *Integrated farming system practices: challenges and opportunities.* New India Publishing Agency, New Delhi. pp. 1-563.
4. Sunil Kumar Birendra Prasad. (2013). *Modern Technology for Sustainable Agriculture*. NIPA, New Delhi. pp. 1-400.
5. Zaman, A. (2019). *Integrated Farming System and Agricultural Sustainability.* New India Publishing Agency, New Delhi. pp. 1-336.

Web References

1. www.agriinfo.in
2. www.fao.org
3. www.agritech.tnau.ac.in
4. http://agritech.tnau.ac.in/agriculture/agri_majorareas_ifs.html
5. https://leisaindia.org/integrated-farming-an-approach-to-boost-up-family-farming/
6. www.fao.org/ag/ca
7. www.pdfsr.ernet.in

Journals

1. Green Farming
2. Journal of Farming Systems Research & Development
3. Agroecology and Sustainable Food Systems
4. Agronomy for Sustainable Development
5. International Journal of Sustainable Development and World Ecology
6. Ecology, Environment and Conservation

Course Nature: Only Theory							
Total Marks (100)							
S. No.	**Category**	**Assessment Tools**					
		In- Semester Examination	Assignment	Record	Attendance	End-Semester Examination	Marks
1	Theory-External	-	-		-	*50*	*50*
2	Theory-Internal	*40*	*05*	-	*05*	-	*50*
						Grand Total	*100*

Course Code	AGE19404	Course Name	INTRODUCTORY AGRO- METEOROLOGY AND CLIMATE CHANGE	Course Category	C	Compulsory Core	L	T	P	C
							1	0	1	2

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	AGRONOMY	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	Explain the science and use of agro meteorology in agricultural production decisions			
CLR-2:	Discuss the relationships between different stages of crop growth and weather elements			
CLR-3:	Describe the weather hazards, weather forecasting and impact of climate change on agriculture			
CLR-4:	Interpret the agro meteorological practices and services to farmers			
CLR-5:	Identify the threats and opportunities of predicted climate changes will influence specific sectors at global and regional scale			
CLR-6:	-			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Agriculture Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	Ability to solve scientific problems	Ability to implement knowledge gained	Ability to understand social and ethical responsibilities
CLO-1:	Recall the knowledge relevant to Meteorology	1	85	80	H						H		M	H		H	L	M	M
CLO-2:	Summarize the information on weather and climate basic input in agricultural planning	2	80	85	H					L	H					H	H	H	H
CLO-3:	Categories the meteorological instruments and recording the observation from the agro meteorological observatory.	3	80	75	H		H	M		L			H	M	L	H	M	H	M
CLO-4:	Outline the applications of agro meteorological information to farming community	3	85	70	H					L						H	M	M	M
CLO-5:	Analyse the Weather hazards, Weather forecasting and the impact of climate change in agriculture.	2	75	80	H	M				L	H		H			H	H	H	
CLO6:	-																		

Duration (hour)		Learning Unit / Module 1	Learning Unit / Module 2	Learning Unit / Module 3	Learning Unit / Module 4	Learning Unit / Module 5
		3	4	4	2	3
S-1	SLO-1	Importance of Agricultural meteorology	Solar radiation	Atmospheric pressure systems	Weather hazards	Climate change and global warming
	SLO-2	Atmospheric weather variables	Light intensity, quality, direction, duration	Cyclones and storms	Modification of microclimate	Climate change impacts on agriculture
S-2,3	SLO-1	**Lab 1.** Site selection and layout for Agromet Observatory	**Lab 4.** Humidity, wind direction and wind speed measurements	**Lab 8.** Heat Unit concept- GDD, HTU, PTU for fixing time of sowing	**Lab 12.** Estimation of length of growing periods using weekly rainfall data	**Lab 14.** Determine the soil moisture from water balance studies
	SLO-2					
S-4	SLO-1	Composition of earth atmosphere	Air temperature on crop production	Wind systems of the world	Weather forecasting	Climate change impacts on forestry and livestock
	SLO-2	Structure of atmosphere	Soil temperature on crop production	Clouds - types and their classification	Remote sensing in agriculture	Climate change impacts on marine and coastal ecosystem
S-5,6	SLO-1	**Lab 2.** Measurements of solar radiation	**Lab 5.** Measurement of atmospheric	**Lab 9.** Probability analysis of rainfall for crop planning	**Lab 13.** Working principle of automatic weather station (AWS)	**Lab 15.** Identification of efficient cropping zone- RYI, RSI
	SLO-2					
S-7	SLO-1	Differentiate climate and weather	Relative Humidity and its importance	Forms of precipitation	-	Carbon trading and sequestration
	SLO-2	Agricultural seasons in India	Wind and its effect on crops	Monsoons in India	-	UNFCCC and IPCC
S-8,9	SLO-1	**Lab 3.** Measurement of air and soil temperature	**Lab 6.** Measurement of rainfall and dew gauge	**Lab 10.** Preparation of synoptic charts, crop weather calendars & forecast based agro advisories	-	**Lab 16.** Mapping of Agro climatic Zones of India and Tamil Nadu
	SLO-2				-	
S-10	SLO-1	-	Energy balance of earth	Cloud seeding	-	-
	SLO-2	-	Heat unit and its importance	Potential evapotranspiration	-	-
S-11	SLO-1	-	**Lab 7.** Measurement of Evaporation	**Lab 11.** Preparation of pest weather calendar	-	-

	SLO-2	-		*and pest forewarning*	-	-

Learning Resources	1. Mahi, G.S. and Kingra, P.K. (2015). *Fundamentals of Agrometeorology*. Kalyani Publishers, New Delhi. pp. 1-383. 2. Mavi, H.S. and Tupper, G.J. (2004). *Agrometeorology: Principles and Application of Climate Studies in Agriculture*. Haworth Press. pp. 1-351.	3. Reddy, S.R. and Reddy, D.S. (2014). *Agrometeorology*. Kalyani Publishers New Delhi. pp. 1-381. 4. Sahu, D.D. (2007). *Agrometeorology and Remote Sensing: Principles and Practices*. Agrobios, Jodhpur. pp. 1-245.

Level of Thinking		Continuous Learning Assessment (35% weightage)		University Practical Examination (15%)	End semester theory Examination (50%)
		In semester (20%)	Practical (15%)		
Level 1	**Remember**	40 %	35 %	35%	30 %
	Understand				
Level 2	**Apply**	35 %	35 %	40%	40 %
	Analyze				
Level 3	**Evaluate**	25 %	30 %	25%	30 %
	Create				
	Total	*100 %*	*100 %*	*100%*	*100 %*

Course Designers		
Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
Mr. Umesh Nandgaokar. M/s. Ramkala Manufacturers, Sr no 50/12, Near Deshpande Carden, Narhe Road, Dhayari Phata, and Pune - 4l.	Dr. V. Geethalakshmi, Director, Directorate of Crop Management, Tamil Nadu Agricultural University, Coimbatore - 3	Dr. S. Marimuthu Dr. N. Krishnaprabu

THEORY

Unit I - Introduction
Agricultural meteorology: Importance and scope in crop production; Atmosphere: composition and structure; Atmospheric weather variables; Climate: weather, factors affecting climate and weather, climatic types, different agricultural seasons of India.

Unit II - Weather Parameters
Atmospheric phenomena: solar radiation, solar constant; Light: intensity, quality, direction and duration; Air and soil temperature: Diurnal variation - importance in crop production - Relative Humidity and its importance - vapor pressure deficit and its importance - Wind and its effect on crops - Energy balance of earth; Heat unit and its importance in agriculture.

Unit III - Atmospheric Circulations
Atmospheric pressure - Pressure systems - cyclones, anticyclones, tornado, hurricane and storms - Wind systems of the world - land breeze and sea breeze; InterTropical Convergence Zone. Clouds - types and their classification. Precipitation - forms - monsoon - Seasons of India- Cloud seeding, artificial rain making- Evaporation - transpiration - Evapotranspiration - PET.

Unit IV - Weather Hazards and Analysis
Weather hazards: drought, floods, frost, tropical cyclones and extreme weather conditions, heat-wave and cold-wave; Modifications of crop microclimate; Weather forecasting: Types and their uses; Synoptic chart; Crop weather calendar; Remote sensing and its application.

Unit V - Impacts of Climate Change
Climate change: variability, global warming, causes and impact: Crop production, Pest and diseases, Forestry, Marine and Coastal ecosystem; Clean Development Mechanism; Carbon Trading; Carbon sequestration; Montreal Protocol: UNFCCC and IPCC.

Theory- Lecture Schedule
1. Agricultural meteorology: Importance and scope in crop production; Atmospheric weather variables.
2. Earth atmosphere - composition, extent and structure.
3. Climate - weather, factors affecting climate and weather, climatic types, different agricultural seasons of India.
4. Atmospheric phenomena: Solar radiation, solar constant; Light - intensity, quality, direction and duration; short wave, long wave and thermal radiation; net radiation; albedo.
5. Air and soil temperature; Diurnal variation - importance in crop production
6. Relative Humidity and its importance - vapor pressure deficit and its importance - Wind and its effect on crops
7. Energy balance of earth; Heat unit and its importance in agriculture.
8. Atmospheric pressure - Pressure systems - cyclones, anticyclones, tornado, hurricane and storms
9. **In semester examination**
10. Wind systems of the world - land breeze and sea breeze; Intertropical Convergence Zone. Clouds - types and their classification
11. Precipitation- forms; Monsoons: North East and South West Monsoon; Mechanism and importance in Indian agriculture.
12. Cloud seeding, artificial rainmaking; Evaporation; Transpiration, Evapotranspiration, PET.
13. Weather hazards: drought, floods, frost, tropical cyclones and extreme weather conditions, heat-wave and cold-wave; Modifications of crop microclimate
14. Weather forecasting: Types and their uses; Synoptic chart; Crop weather calendar; remote sensing and its application.
15. Climate change: variability, global warming, causes and impact - Crop production, Pest and diseases
16. Climate change impacts on Livestock, Forestry, Marine and Coastal ecosystems.
17. Clean Development Mechanism; Carbon Trading; Carbon sequestration; Montreal Protocol: UNFCCC and IPCC.

Practical Schedule
1. Site selection and layout for Agromet Observatory - Calculation of local time - Time of observation of different weather elements - Reviewing agromet registers
2. Measurements of solar radiation (pyranometers), sunshine hours (sunshine recorder) - working out weekly and monthly mean for graphical representation
3. Measurement of air and soil temperature and grass minimum thermometers and thermograms - drawing isolines
4. Humidity measurements - use of wet and dry bulb thermometers- Hygrograph - Measurement of wind direction and wind speed and conversion - Beaufort ‘s scale
5. Measurement of atmospheric pressure - barograph - Fortein-s barometer - Isobars based on past data for different seasons

6. Measurement of rainfall - Ordinary and self-recording rain gauges - Measurement of Dew - dew gauge
7. Measurement of Evaporation - Open pan evaporimeter- application of evaporation data
8. Heat Unit concept- GDD, HTU, PTU for fixing time of sowing
9. Probability analysis of rainfall for crop planning
10. Preparation of synoptic charts, crop weather calendars & forecast based agro advisories
11. Preparation of pest weather calendar and pest forewarning
12. Estimation of length of growing periods using weekly rainfall data
13. Working principle of automatic weather station (AWS)
14. Determine the soil moisture from water balance studies
15. Identification of efficient cropping zone- RYI, RSI
16. Mapping of Agro climatic Zones of India and Tamil Nadu and its characterization
17. **University practical examination**

Text Books

1. Mahi, G.S. and Kingra, P.K. (2015). *Fundamentals of Agrometeorology*. Kalyani Publishers, New Delhi. pp. 1-383.
2. Mavi, H.S. and Tupper, G.J. (2004). *Agrometeorology: Principles and Application of Climate Studies in Agriculture*. Haworth Press. pp. 1-351.
3. Reddy, S.R. and Reddy, D.S. (2014). *Agrometeorology.* Kalyani Publishers New Delhi. pp. 1-381.
4. Sahu, D.D. (2007). *Agrometeorology and Remote Sensing: Principles and Practices.* Agrobios, Jodhpur. pp. 1-245.
5. Varshneya, M.C. and Balakrishana Pillai, P. (2003). *Textbook of Agricultural Meteorology*. ICAR. pp. 1-217.

Reference Books

1. Adaptation and mitigation of climate - Scientific Technical Analysis. (2006). Cambridge University Press, Cambridge. pp. 1-851.
2. Latief, A., Kanth, R.H., Parvaze, S and Mahdi, S. S. (2017). *Experimental Agrometeorology:* A Practical Manual. Springer International Publishing AG. pp. 1-159.
3. Mote, B.M. and Sahu, D.D. (2014). *Principles of Agricultural Meteorology.* Scientific Publishers, Jodhpur. pp. 1-197.
4. Prasad, Rao, G.S.L.H.V. (2005). *Agricultural Meteorology.* Kerala Agricultural University, Press, Thrissur. pp. 1-326.
5. Srivastava, A.K. and Tyagi, P. K. (2011). *Practical Agricultural Meteorology.* New India Publishing Agency, New Delhi. pp. 1-266.
6. Variraju, R and Krishnamurty. (1995). *Practical Manual on Agricultural Meteorology.* Kalyani publications, New Delhi. pp. 1-198.

Web References

1. www.tawn.tnau.ac.in
2. http://www.fao.org/docrep/x5672e/x5672e09.htm
3. www.imd.gov.in
4. https://library.wmo.int
5. www.usbr.gov/pn/agri.met

Journals

1. Journal of Agrometeorology
2. Advances in Meteorology
3. Agricultural Meteorology
4. Meteorological Applications
5. Journal of Applied Meteorology and Climatology
6. Advances in Agronomy

Course Nature: Theory based Practical							
Total Marks (100)							
S.No.	Category	**Assessment Tools**					
		In- Semester Examination	Assignment	Record	Attendance	End-Semester Examination	Marks
1	Theory-External	-	-		-	*50*	*50*
2	Theory-Internal	*20*	-			-	*20*
3	Practical-External	-	-		-	*15*	*15*
4	Practical-Internal	-	*05*	*05*	*05*	-	*15*
						Grand Total	*100*

Course Code	**Course Title**	T	P	Credit
AGE19405	**Study Tour-II**	0	1	1
Course Orientation: Institutional visits, Spot Study, Skill Education				

The students will undertake the short tour during third semester for ten days covering KVK's, Research stations, State Agricultural University and their constituent colleges and ICAR institutes in the southern part of Tamil Nadu. During the tour, the students will visit important Research Station /Institutions at least one in each zone to know about the soil, climatic conditions and cropping patterns in the respective agro-climatic zones. . Students should maintain a tour diary to record their observations regarding the places of visit. A tour record has to be submitted after the tour

Course Nature: Practical			
Total Marks (100)			
S. No.	**Category**	**Assessment Tools**	**Marks**
1	Practical-Internal	Purely internal based on the participation, involvement and contribution of students in the activities pertaining to the course and the assessment criteria be as follows,	
		Written Test	*40*
		Behaviour (Punctuality and Discipline)	*20*
		Observation Note Book	*25*
		Viva-Voce	*10*
		Attendance	*05*
		Grand Total	*100*

Course Code	NRM19401	Course Name	PROBLEMATIC SOILS AND THEIR MANAGEMENT	Course Category	C	Compulsory Core	L	T	P	C
							2	0	0	2

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Soil Science	Data Book / Codes/Standards		Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1 :	Identify the nature of soils and its distribution
CLR-2 :	Outline the problems encountered in soils and water
CLR-3 :	Describe the quality of soil and water for agricultural usage.
CLR-4 :	Discuss the chemistry of problematic soils and water.
CLR-5 :	Recall the technology for soil health management.

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Agriculture Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	Ability to solve scientific problems through Soil science	implement knowledge gained in the applied field	understand social and ethical responsibilities of
CLO-1 :	Summarize the nature and property of problematic soils.	1	90	80	H								M	H		H	H	H	H
CLO-2 :	List out different problematic soils and water quality standards.	1	95	85	M								M	H		H	H	H	H
CLO-3 :	Describe the chemistry behind the formation and reclamation of problematic soils.	2	85	75	H		M	M					M	H		H	H	H	H
CLO-4 :	Explain the role of Remote Sensing and GIS in the reclamation of problematic soils.	2	80	70	M								M	H		H	H	H	H
CLO-5 :	Identify the field problems solved through an integrated approach.	3	75	60	M	M							M	H		H	H	H	H

Duration (hour)		Learning Unit / Module 1	Learning Unit / Module 2	Learning Unit / Module 3	Learning Unit / Module 4	Learning Unit / Module 5
		7	8	3	3	12
S-1	SLO-1	Physical constraints	Chemical constraints	Biologically sick soils	Irrigation water quality and standards	Soil quality: definition and concepts
	SLO-2	Classification & distribution	Definition and types	Distribution and properties	Sample collection	Soil health: definition and concepts
S-2	SLO-1	Surface hard pan - characteristic & management	Acid soil	Soil biological indices	Criteria for evaluation	Soil quality: Assessing methods
	SLO-2	Subsurface hard pan- characteristic & management	Properties and management	Role and importance	Classifications with ratings	Soil health: Assessing methods
S-3	SLO-1	Highly permeable soils - characteristic & management	Acid sulphate soils	Soil OC, microbial population, respiration	Effect of poor quality water	Land capability classification
	SLO-2	Slow permeable soils - characteristic & management	Properties and management	Soil enzymes	Management of poor quality water	Importance
S-4	SLO-1	Surface crusting - characteristic & management	Calcareous soils	-	-	Land suitability classification
	SLO-2	Fluffy soil, shallow soil - characteristic & management	Properties and management	-	-	Importance
S-5	SLO-1	Waterlogged soil	Salt affected soil	-	-	Remote sensing and GIS
	SLO-2	Characteristic & management	Classification & distribution	-	-	Diagnosing problematic soils
S-6	SLO-1	Erodes soil - characteristic & management	Saline soils	-	-	Remote sensing and GIS: techniques
	SLO-2	Sand dunes - characteristic & management	Properties and management	-	-	Management of problematic soils
S-7	SLO-1	Wasteland	Sodic soils	-	-	Wetland Agroecosystem
	SLO-2	Characteristic & management	Properties and management	-	-	Problems and management
S-8	SLO-1	-	Saline-sodic soils	-	-	Fresh water Agroecosystem
	SLO-2	-	Properties and management	-	-	Problems and management
S-9	SLO-1	-	-	-	-	Coastal Agroecosystem
	SLO-2	-	-	-	-	Problems and management
S-10	SLO-1	-	-	-	-	Forest Agroecosystem
	SLO-2	-	-	-	-	Problems and management
S-11	SLO-1	-	-	-	-	Terrain Agroecosystem
	SLO-2	-	-	-	-	Problems and management
S-12	SLO-1	-	-	-	-	Tolerant crops
	SLO-2	-	-	-	-	Bioremediation

Level of Thinking		Continuous Learning Assessment (50% weightage)		End semester theory Examination (50%)
		In semester (40%)	Theory Internal (10%)	
Level 1	Remember	40 %	40 %	35 %
	Understand			
Level 2	Apply	40 %	40 %	40 %
	Analyze			
Level 3	Evaluate	20 %	20 %	25 %
	Create			
	Total	*100 %*	*100 %*	*100 %*

Learning Resources

1. Gupta, I.C and Gupta, S.K. (2019). Crop production in salt affected soils. Scientific publishers.
2. Sanjay, A., Singh, A.K and Singh Y.P. (2018). Bioremediation of salt affected soils: An Indian perspective. Springer. pp. 1-313.

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Mr.S.Suresh Senior Agricultural Officer, STL, Kanchipuram.	Dr. M.V. Sriramachandrasekharan Professor (SSAC), Annamalai University, Annamalainagar – 608002.	Dr. R. Angelin Silviya Dr. S.N. Chikkaraju

THEORY

Unit I – Physical constraints

Physical constraints - definition, classification, distribution (India and Tamil Nadu), Types - surface hard pan, Sub surface hard pan, highly permeable soil, slow permeable soil, surface crusting, fluffy soil, shallow soil, waterlogged soil, eroded soil and sand dunes - characteristic, management and reclamation; Wasteland: definition, types, extent in India and Tamil Nadu, characteristic and management.

Unit II – Chemical constraints

Chemical constraints- definition, types – Acid soil – definition, characteristic, genesis, extent of distribution, effect on soil and plants, management and reclamation; Acid sulfate soil - definition, occurrence, genesis, effect on soil and plant, management and reclamation; Calcareous soil - definition, occurrence, genesis, effect on soil and plant, management and reclamation; Salt affected soil – definition, classification, distribution; saline soil – definition, occurrence, genesis, field diagnosis, effect on soils and plants, management and reclamation; Sodic soils - definition, classification, occurrence, genesis, field diagnosis, effect on soils and plants, management and reclamation; Saline sodic soil - definition, classification, occurrence, genesis, field diagnosis, effect on soils and plants, management and reclamation

Unit III – Biological constraints

Distribution, categorization and properties of biologically sick soils in India and Tamil Nadu; Soil biological indices: Soil organic carbon, microbial population, Soil respiration, Soil enzymes.

Unit IV – Irrigation Water Quality

Irrigation water – quality and standards; Collection procedures and criteria for evaluation - Salinity hazard, sodium hazard, Salt index, Bicarbonate hazard, Boron concentration, Chloride concentration, Soluble sodium percentage, Magnesium hazard. Irrigation water quality and suitability classifications with ratings; Effect of poor quality water on soils and plants; Management of poor quality water.

Unit V – Diagnosis and Management

Soil quality and health: Concepts and assessing methods; Land capability and suitability classification; Remote sensing and GIS techniques in diagnosis and management of problem soils; Problematic soils under different Agroecosystems; Tolerant crops; Bioremediation through MPT'S of soils.

Theory - Lecture Schedule

1. Physical constraints - definition, classification and distribution.
2. Surface hard pan, Subsurface hard pan - characteristic, management and reclamation.
3. Highly permeable soils and slow permeable soil - characteristic, management and reclamation.
4. Surface crusting, fluffy soil, shallow soil - characteristic, management and reclamation.
5. Waterlogged soils - characteristic, management and reclamation.
6. Eroded soil and sand dunes - characteristic, management and reclamation.
7. Wasteland - definition, types, extent in India and Tamil Nadu, characteristic, management and reclamation.
8. Chemical constraints - definition, types.
9. Acid soil - definition, characteristic, genesis, extent of distribution, effect on soil and plants, management and reclamation.
10. Acid sulfate soil - definition, characteristic, genesis, extent of distribution, effect on soil and plants, management and reclamation.
11. Calcareous soil - definition, characteristic, genesis, extent of distribution, effect on soil and plants, management and reclamation.
12. Salt affected soil - definition, classification, distribution.
13. Saline soil - definition, characteristic, genesis, extent of distribution, effect on soil and plants, management and reclamation.
14. Sodic soil - definition, characteristic, genesis, extent of distribution, effect on soil and plants, management and reclamation.
15. Saline sodic soil - definition, characteristic, genesis, extent of distribution, effect on soil and plants, management and reclamation.
16. Distribution, categorization and properties of biologically sick soils in India and Tamil Nadu.
17. **In-semester Examination**
18. Soil biological indices: role and importance.
19. Soil biological indices: Soil organic carbon, microbial population, soil respiration, soil enzymes.
20. Irrigation water – quality and standards; Sample collection procedures.
21. Criteria for evaluation of irrigation water; Irrigation water quality and suitability classification with ratings.
22. Effect of poor quality water on soils and plants; Management of poor quality water.

23. Soil quality and health: definition and concepts.
24. Soil quality and health: Assessing methods.
25. Land capability classification.
26. Land suitability classification.
27. Remote sensing and GIS techniques in diagnosing problematic soils.
28. Remote sensing and GIS techniques in management of problematic soils.
29. Problematic soils under different Agroecosystems – Wetland.
30. Problematic soils under different Agroecosystems – Fresh water.
31. Problematic soils under different Agroecosystems - Coastal.
32. Problematic soils under different Agroecosystems – Forest
33. Problematic soils under different Agroecosystems - Terrain
34. Tolerant crops; Bioremediation through MPT'S of soils.

Textbooks

1. Das D.K. (2015) Introductory Soil Science (4th ed.). Ludhiana: Kalyani Publishers.
2. Gupta, I.C and Gupta, S.K. (2019). Crop production in salt affected soils. Scientific Publishers.
3. Mahendran, P.P. (2008). Soil Resource Inventory and Management of Problematic Soils. Agrotech Publishing Academy. pp.1- 184.
4. Ramesh, C and Singh, S.K. (2009). Fundamental and Management of soil quality. New Delhi: Westville Publishing House. pp.1- 380.
5. Somani, L.L. (2019). Textbook of problematic soils and their management. South Indian book traders.

References Books

1. Brady, N.C. and Weil, R. C. (2013). The Nature and Properties of Soils (15th ed.). Pearson Education. pp.1 - 1035.
2. Indian Society of Soil Science. (2012). Fundamentals of Soil Science (2nd ed.). New Delhi: ISSS, IARI.
3. Istvan, S. (1988). Salt-affected soils, CRC press. pp.1 - 274.
4. Madhavi, L.G and Raghuveer, R. P. (2020). Problematic soils and Geo environmental concerns. Springer. pp.1 - 804.
5. Sanjay, A., Singh, A.K and Singh, Y.P. (2018). Bioremediation of salt affected soils: An Indian perspective. Springer. pp.1 - 313.

Web References

1. http://www.fao.org/soils-portal/soil-management/management-of-some-problem-soils/salt-affectedsoils/en/#:~:text=When%20salts%20more%20soluble%20than,them%20are%20classified%20as%20Solonchakz.
2. https://www.tandfonline.com/doi/abs/10.1080/15324980590887344?journalCode=uasr20
3. https://www.noble.org/news/publications/ag-news-and-views/2008/february/management-of-salt-affected-soils/
4. https://youtu.be/yJ4pnyWdXoU
5. http://www.soilhealth.com/soil-health/management/

Journals

1. Arid land research management.
2. Journal of sustainable Agriculture.
3. Journal of the Indian Society of Soil Science (ISSS).
4. Journal of soil and water conservation.
5. Journal of soils and crops.

Course Nature: Only Theory							
Total Marks (100)							
S.No.	**Category**	**Assessment Tools**					
		In- Semester Examination	Assignment	Record	Attendance	End-Semester Examination	Marks
1	Theory-External	-	-		-	*50*	*50*
2	Theory-Internal	*40*	*05*	-	*05*	-	*50*
						Grand Total	*100*

Course Code	CRH19401	Course Name	PRINCIPLES OF INTEGRATED PEST AND DISEASE MANAGEMENT	Course Category	C	*Compulsory Core*	L	T	P	C
							2	0	1	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	Agricultural Entomology	Data Book / Codes/Standards	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1 :	*Explain the concept of integrated pest and disease management*
CLR-2 :	*Discuss Survey, ETL, EIL*
CLR-3 :	*Summarize the rules and regulations in plant disease management*
CLR-4 :	*Outline the information on plant resistant mechanism*
CLR-5 :	*Outline the principles of different approaches in IPDM*
CLR-6 :	*Explain Integrated Crop Management*

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning		
		1	*2*	*3*
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	*Summarize the concepts of IPDM*	*1*	90	75
CLO-2 :	*Outline the importance of ETL, EIL based on survey*	*2*	85	70
CLO-3 :	*Identify the plant stress phenomenon, and recommend the best cultural, chemical, and biological control methods towards management*	*3*	95	70
CLO-4 :	*Identify the suitable management practices for pest and diseases.*	*2*	80	65
CLO-5 :	*Summarize the mass production and sale of an antimicrobial bioproduct. .*	*3*	95	75
CLO6 :	*Outline the quality of a business entrepreneurship*	*3*	90	80

Program Learning Outcomes (PLO)														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Agriculture Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	Ability to solve scientific problems	Ability to implement knowledge gained	Ability to understand social and ethical responsibilities
M	M		M					M	H		H	H	H	H
M	L	M	L					H	H		H	H	H	H
M	M							M	H		H	H	H	H
L			L					L	H		H	H	H	H
M	L					M		M	H		H	H	H	H
L								L	H		H	H	H	H

Duration (hour)		Learning Unit / Module 1	Learning Unit / Module 2	Learning Unit / Module 3	Learning Unit / Module 4	Learning Unit / Module 5
		7	24	8	7	18
S-1	SLO-1	*Insect ecology*	*Pest - Definition*	*PDM*	*Epidemiology*	*Plant disease management*
	SLO-2	*Introduction & components*	*ET & EIL*	*History & principles*	*Concepts*	*Cultural methods*
S-2	SLO-1	*Insect population*	*Pest outbreak*	*Plant disease*	*AUDPC curve*	*Plant disease management*
	SLO-2	*Abiotic factors*	*Causes*	*Survey & surveillance*	*Assessment*	*Physical methods*
S 3-4	SLO-1	***Lab1:*** *Insect pest - Types of damage*	***Lab3:*** *Insect pest – Methods of sampling*	***Lab9:*** *Survey & surveillance – Disease assessment*	***Lab11:*** *Visit to plant quarantine station*	***Lab12:*** *Plant disease – Bordeaux mixture preparation*
	SLO-2					
S-5	SLO-1	*Insect population*	*Survey & surveillance*	*Plant disease*	*Environmental factors – disease development*	*Fungicides*
	SLO-2	*Biotic factors*	*Forecast*	*Detection & diagnosis*	*Disease forecasting*	*Classification & uses – I*
S-6	SLO-1		*IPM - Definition*	*Classification of disease*	*Quarantine*	*Fungicides*
	SLO-2		*Concepts*	*Disease assessment*	*Rules & regulations*	*Classification & uses – II*
S 7-8	SLO-1	***Lab2:*** *Insect pest – Measurement and assessment of yield loss*	***Lab4:*** *Identification - Predators & parasitoids*	***Lab10:*** *Plant disease diagnosis*		***Lab13:*** *Foliar spray – Types of sprayer, assessment of spray solution*
	SLO-2					
S-9	SLO-1	-	*IPM – Scope*	-	*Plant defense*	*Nematicides*
	SLO-2	-	*Limitations*	-	*Mechanism against infection*	*Classification*
S-10	SLO-1	-	*IPM tools*	-	-	*Plant disease management*
	SLO-2	-	*Cultural methods*	-	-	*Biological control, special methods, and Biotechnological approaches*
S 11-12	SLO-1	-	***Lab5:*** *Mass production – Predators,*	-	-	***Lab14:*** *Types of delivery systems*

	SLO-2		*parasitoids & entomopathogens*			
S-13	**SLO-1**	-	*Pest control*	-	-	*Integrated crop management*
	SLO-2	-	*Mechanical methods*	-	-	*Disease, pest & weeds – I*
S-14	**SLO-1**	-	*Pest control*	-	-	*Integrated crop management*
	SLO-2	-	*Physical methods*	-	-	*Disease, pest & weeds – II*
S 15-16	**SLO-1**	-	***Lab6:*** *Behavioral approaches – Pest management*	-	-	***Lab15:*** *Mass multiplication of fungal biocontrol agent*
	SLO-2					
S-17	**SLO-1**	-	*Insect pests & weeds*	-	-	
	SLO-2	-	*Biological control*	-	-	
S-18	**SLO-1**	-	*Pest control*	-	-	
	SLO-2	-	*Legal methods*	-	-	
S 19-20	**SLO-1**	-	***Lab7:*** *Pest risk analysis & partial budgeting*	-	-	***Lab16:*** *Mass multiplication of bacterial biocontrol agent*
	SLO-2					
S-21	**SLO-1**	-	*IPM*	-	-	-
	SLO-2	-	*Host plant resistance*	-	-	-
S-22	**SLO-1**	-	*Chemical control*	-	-	-
	SLO-2	-	*Classification of insecticides*	-	-	-
S 23-24	**SLO-1**	-	***Lab8:*** *IPM module*	-	-	-
	SLO-2					

Learning Resources	1. Agrios, G.N. (2005). *Plant Pathology* (5th Ed.). New York: Academic Press. pp. 1-922. 2. Dhaliwal G.S. & Ramesh Arora. (2009). *Integrated pest management*. New Delhi: Kalyani publisher.	3. Larry P. Pedigo. (2003). *Entomology and pest management*. (4th edition). Patparganj, Delhi: Pearson Education, Inc. Indian branch. pp. 1-742.

Level of Thinking		Continuous Learning Assessment (35% weightage)		University Practical Examination (15%)	End semester theory Examination (50%)
		In Semester (20%)	Practical (15%)		
Level 1	**Remember**	40 %	45%	40%	45 %
	Understand				
Level 2	**Apply**	40 %	30%	30%	30 %
	Analyze				
Level 3	**Evaluate**	20 %	25%	20%	25 %
	Create				
	Total	100 %	100%	100%	100 %

Course Designers		
Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
Mr. N. Muralitharan Regional Manager NACL Industries limited. Ph- 9677780714	Dr. G. Karthikeyan Professor, Department of Plant Pathology Tamil Nadu Agricultural University Coimbatore- 641003 agrikarthi2003@gmail.com	Dr. L.Ramazeame Dr. Rageshwari S Dr. VinodKumar S

THEORY

Unit I–Pest Categories and IPM
Categories of insect pests, IPM: Introduction, history, importance, concepts, principles and tools of IPM. Economic importance of insect pests and pest risk analysis. Methods of detection and diagnosis of insect pests.

Unit II – Components of IPM, Ecology of Pests IPM Module, Case Studeis
Calculation and dynamics of economic injury level and importance of Economic threshold level. Methods of control: Host plant resistance, cultural, mechanical, physical, legislative, biological and chemical control. Introduction to conventional pesticides for the insect pests management. Development and validation of IPM module. Implementation and impact of IPM (IPM module for insect pests). Safety issues in pesticide uses. Political, social and legal implication of IPM. Case histories of important IPM programme.

Unit III – Introduction to IDM
Basic principles of IDM in plants- Introduction, history, principles. Importance and Important terms and concepts in integrated plant disease management. Survey, surveillance, detection and diagnosis of plant disease. Types of infection. Measurement and assessment of plant disease and yield loss.

Unit IV – Role of Pathogen and Environment in Plant Disease Development
Disease epidemiology, Disease cycles- AUDPC curve, Forecasting of plant diseases, Plant Quarantine, Rules and Regulation in plant disease management- Disease resistance and plant defense mechanism in plants.

Unit V – Different Approaches in Plant Disease and Nematode Management
Management of plant diseases, phanerogamic parasites and nematodes: Cultural practices, Physical methods, Chemical management - Classification of fungicides, nematicides, Special techniques in plant disease management, Biological approaches, Biotechnological Approaches. Mechanism of development of resistance in plants against pathogens. Integrated crop management including the management of disease, pests and weeds.

Theory – Lecture Schedule
1. Definition of insect ecology and introduction to environment and its components
2. Effect of abiotic factors- temp, moist, humidity, RF, light and air on the population of insects
3. Effect of biotic factors- food competition, natural and environmental resistance on the population of insects
4. Definition of pests, Categories of pests based on ETL and EIL
5. Causes for pest outbreak
6. Survey surveillance and forecasting of Insect pests
7. Definition and concept of IPM
8. Scope and limitation of IPM
9. Tools of IPM and cultural methods of pest control
10. Mechanical methods of pests control
11. Physical methods of pests control
12. Biological control of insect pests and weeds
13. Legal methods of pest control
14. Host plant resistance in IPM
15. Chemical control- classification of insecticides
16. Case histories of important IPM programme
17. **In- semester examination**
18. History and principles of plant disease management
19. Survey and surveillance of plant diseases
20. Detection and diagnosis of plant diseases
21. Classification of diseases and their assessment
22. Epidemiology of plant disease
23. AUDPC curve
24. Role of environmental factors in plant disease development and disease forecasting.

25. Quarantine, rules and regulations in plant disease management
26. Plant defense mechanism in combating pathogen infection
27. Cultural practices for plant disease, parasites and nematode management
28. Physical methods for plant disease management
29. Classification and uses of fungicides-I
30. Classification and uses of fungicides –II
31. Classification of nematicides
32. Biological control, Special methods, and Biotechnological approaches for plant disease management
33. Integrated crop management including the management of disease, pests and weeds- I
34. Integrated crop management including the management of disease, pests and weeds-II

Practical Schedule

1. Types of damage caused by insect to plants
2. Methods of insect pests measurement and Assessment of crop yield losses
3. Different methods of insect sampling for insect population assessment
4. Identification of Predators & parasitoids
5. Mass production of predators and parasitoids & Entomopathogens
6. Behavioral approaches in pest management, Pesticide application equipment's & different methods of pesticide application
7. Pest risk analysis and partial budgeting
8. IPM module for important pests & recent invasive pests
9. Survey, surveillance and plant disease assessment
10. Detection, diagnosis and special techniques in plant disease diagnosis
11. Different approaches in plant disease and nematode management and preparation of Bordeaux mixture and Bordeaux paste
12. Types of sprayers, assessment of spray solution for the management of plant diseases
13. Types of delivery system of fungicides, biocontrol agents and nematicides
14. Pure culture and mass multiplication of fungal biocontrol agents for plant and nematode diseases.
15. Pure culture and mass multiplication of bacterial biocontrol agents for plant and nematode diseases.
16. Techniques in plant virus management
17. **University I Practical examination**

Text Books

1. Agrios, G.N. (2005). *Plant Pathology* (5th Ed.). New York: Academic Press. pp. 1-922.
2. Atwal, A.S. & Dhaliwal, G.S. (2004). *Agricultural Pests of South Asia and their management*. New Delhi: Kalyani publisher. pp. 1-487.
3. David, B.V. & Ramamurthy, V.V. (2015). *Elements of Economic Entomology*. Chennai: Namrutha Publications. pp. 1-390.
4. Dhaliwal G.S. & Ramesh Arora. (2009). *Integrated pest management.* New Delhi: Kalyani publisher.
5. Jagtap, G.P, Dhutraj, D.N. & Utpal Dey. (2014) *Principles of Plant Pathology*. Agrobios India, Pai and Sons. pp. 1-309.
6. Larry P. Pedigo. (2003). *Entomology and pest management*. (4th edition). Patparganj, Delhi: Pearson Education, Inc. Indian branch. pp. 1-742.

Reference Books

1. Chaube, H.S. & Pundhir, V.S. (2009). *Crop diseases and their management*. New Delhi: PHI Learning Private Limited. pp. 1-724.
2. Narayanasamy. P. (2019). *Soilborne Microbial Plant Pathogens and Disease Management*. Florida: CRC press. pp. 1-768.
3. Nene, Y.L. and Tapliyal, P.N. (1993). *Fungicides In Plant Disease Control*. New Delhi, India: Medtech, Oxford IBH publishing company. pp. 1-691.
4. Vidhyasekaran, P. (2006). *Principles of Plant Pathology*. CBS publishers and distributors, Higginbothams (P) Ltd. pp. 1-166.

Web-References

1. http://agritech.tnau.ac.in/crop_protection/crop_prot_crop_insect_agri_pest.html
2. www.apsnet.org/edcenter
3. http://www.celkau.in/Crops/Cereals/Rice/pests.aspx
4. https://www.agrimoon.com/crop-pests-and-stored-grain-pests-and-their-management-pdf-book/
5. https://www.youtube.com/watch?v=ARCbgCv6ln8
6. https://www.youtube.com/watch?v=Gews2FoBMZY
7. https://www.youtube.com/watch?v=hWdmL8sGCB4
8. https://www.youtube.com/watch?v=14zmmbXsyuM

Journals

1. Annals of plant protection sciences
2. Indian journal of plant protection
3. Pests' management & Economic Zoology
4. Journal of integrated pest management
5. International pest management
6. Integrated pest management reviews

Course Nature: Theory based Practical							
Total Marks (100)							
S.No.	**Category**	**Assessment Tools**					
		In- Semester Examination	**Assignment**	**Record**	**Attendance**	**End-Semester Examination**	**Marks**
1	Theory-External	-	-		-	*50*	*50*
2	Theory-Internal	*20*	-			-	*20*
3	Practical-External	-	-		-	*15*	*15*
4	Practical-Internal	-	*05*	*05*	*05*	-	*15*
						Grand Total	*100*

Course Code	GPB19401	Course Name	PRINCIPLES OF SEED TECHNOLOGY	Course Category	S	*Supportive Course*	L	T	P	C
							2	0	1	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department		*Seed science and Technology*	Data Book / Codes/Standards	*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Agriculture Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	scientific problems through plant breeding and	implement knowledge gained in the applied field of plant breeding	understand social and ethical responsibilities of plant breeding and
CLR-1 :	*Gain the knowledge on seed and quality parameters*																		
CLR-2 :	*Learn about the production seeds in cereals, pulses and oilseeds*																		
CLR-3 :	*Learn about the seed production in fodders and horticultural crops*																		
CLR-4 :	*Learn seed evaluation processes*																		
CLR-5 :	*Learn about the post harvest seed handling techniques*																		
Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*																		
CLO-1 :	*Explain the production techniques of different types of seeds*	*1*	*90*	*85*	*H*			*H*			*H*		*M*	*H*		*H*	*H*	*H*	*H*
CLO-2 :	*Explain the extraction techniques for seeds*	*2*	*95*	*85*	*H*			*H*					*L*	*H*		*H*	*H*	*H*	*H*
CLO-3 :	*List out the seed quality parameters*	*2*	*80*	*70*	*M*		*M*	*M*			*H*		*L*	*H*		*H*	*H*	*H*	*H*
CLO-4 :	*Explain the seed enhancement practices*	*3*	*85*	*75*	*M*			*H*					*M*	*H*		*H*	*H*	*H*	*H*
CLO-5 :	*Explain the management practices for storage pest*																		

Duration (hour)		Learning Unit / Module 1	Learning Unit / Module 2	Learning Unit / Module 3	Learning Unit / Module 4	Learning Unit / Module 5
		5	**23**	**11**	**13**	**13**
S-1	**SLO-1**	*Introduction to seeds*	*Foundation seed production of wheat*	*Foundation seed production of Fodder: Berseem*	*Seed certification*	*Seed drying*
	SLO-2	*Importance of seeds*	*Certified seed production of wheat*	*Certified seed production of Fodder: Berseem*	*Seed Act*	*quality assessment*
S-2	**SLO-1**	*Genetic deteriation causes in crops*	*Foundation seed production of Rice*	*Foundation seed production of vegetables: Potato cauliflower, tomato and chilli*	*Duty and powers of seed inspector*	*Seed storage*
	SLO-2	*Maintenance of genetic purity*	*certified seed production of Rice*	*Certified seed production of vegetables: Potato cauliflower, tomato and chilli*	*Offences and penalties*	*seed longevity during storage*
S-3,4	**SLO-1**	***Lab1:*** *Seed production in wheat including seed standards*	***Lab. 2.*** *Seed production in rice, maize, sorghum, and bajra including seed standards*	***Lab. 7.*** *Seed production in vegetable crops (Potato, cauliflower, tomato and chilli) including seed standard*	*Lab 11: Germination test and viability test*	***Lab.13.*** *Seed certification procedure*
	SLO-2					
S-5	**SLO-1**	*Characters of good quality seed*	*Foundation seed production of maize*	*Foundation seed production of seed spices and medicinal plants: Cumin.*	*Varietal Identification*	*Measures for pest control during storage*
	SLO-2	*Classifiations of seeds*	*Certified seed production of maize*	*certified seed production of seed spices and medicinal plants: Cumin*	*Grow Out Test*	*Measures for disease control during storage*
S-6	**SLO-1**	-	*Foundation seed production of sorghum*	-	*Electrophoresis*	*Seed marketing*
	SLO-2	-	*Certified seed production of sorghum*	-	*Molecular test*	*sales generation activities*
S-7,8	**SLO-1**	-	***Lab. 3.*** *Seed production in blackgram, greengram and cowpea including seed standards*	*Lab 8:Seed production in Seed spices (fenugreek, fennel, cumin & coriander) including seed standard*	***Lab12:*** *Seed and seedling vigour test and Genetic purity test: Grow out test*	***Lab. 14.*** *Visit to seed production farms*
	SLO-2					
S-9	**SLO-1**	-	*Foundation seed production of bajra*	-	*Biochemical test for seeds*	*Role of WTO.*
	SLO-2	-	*Certified seed production of bajra*	-	*Marker assisted selection - major genes*	*Role of OECD in seed marketing*
S-10	**SLO-1**	-	*Foundation seed production of moth bean*	*Maintenance of parental lines*	-	-
	SLO-2	-	*Certified seed production of moth bean*	*Hybrid variety – merits and demerits*	-	
S-	**SLO-1**	-	***Lab. 4.*** *Seed production in redgram, lentil and field*	***Lab. 9*** *Seed sampling methods and physical purity*	***Lab.12.*** *Germplasm preservation –*	***Lab. 15.*** *Visit to seed testing*

11,12	**SLO-2**		*pea including seed standards*	*test*	*conservation - records maintained in research stations*	*laboratories*
S - 13	**SLO-1**	-	*Foundation seed production of greengram*	*Synthetics and composites*	-	-
	SLO-2	-	*Certified seed production of greengram*	*Achievements – merits and demerits*	-	-
S - 14	**SLO-1**	-	*Foundation seed production of cowpea*	*Genetic characters of asexual reproduction – breeding methods – clonal selection*	-	-
	SLO-2	-	*Certified seed production of cowpea*	*Chimeras and its types; Tree breeding – clonal orchards.*		
S–15,16	**SLO-1**	-	*Lab5: Seed production in soybean, rapeseed and mustard including seed standards*	-	*Lab 13: Calculation of PCV, GCV, heritability, genetic advance*	*Lab 16: Visit to seed processing plant*
	SLO-2			-		
S-17	**SLO-1**	-	*Foundation seed production of pigeonpea*	-	-	-
	SLO-2	-	*Certified seed production of pigeonpea*	-	-	-
S-18	**SLO-1**	-	*Foundation and certified seed production of blackgram*	-	-	-
	SLO-2	-	*Foundation and certified seed production of blackgram*		-	-
S-19, 20	**SLO-1**	-	*Lab 6. Foundation and certified seed production of maize*	-	-	-
	SLO-2	-		-	-	-
S-21	**SLO-1**	-	*Foundation seed production of field pea*	-	-	-
	SLO-2	-	*Certified seed production of field pea*	-	-	-
S-22	**SLO-1**	-	*Seed production in Groundnut and Sesame including seed standards*	-	-	-
	SLO-2	-	*Foundation seed production of soybean*	-	-	-
S-23	**SLO-1**	-	*Certified seed production of soybean*	-	-	-
	SLO-2	-	*Foundation seed production of mustard*	-	-	-
S-24	**SLO-1**	-	*Certified seed production of mustard*	-	-	-
	SLO-2	-	*Foundation seed production of groundnut*	-	-	-
S-25	**SLO-1**	-	*Certified seed production of groundnut*	-	-	-
	SLO-2	-	*Foundation seed production of sesame*	-	-	-
S-26	**SLO-1**	-	*Certified seed production of sesame*	--	-	-
	SLO-2				-	-

Learning Resources	1. Agrawal, R.L. (2008). *Seed Technology*. New Delhi : Oxford & IBH Publishing Co. pp. 1- 821. 2. Dharmendra Jat, Sai Prasad, S. V. & Sheela Verma. (2014). *Seed Science and Technology* (2nd ed.) New Delhi: New Vishal Publications. pp. 1- 304.	3. Khare, D . (2014). *Seed Technology* (2nd ed.). Jodhpur: Scientific Publishers India. pp. 1- 944.

Level of Thinking		Continuous Learning Assessment (35% weightage)		University Practical Examination (15%)	End semester theory Examination (50%)
		In semester (20%)	Practical (15%)		
Level 1	**Remember**	40 %	30 %	35%	30 %
	Understand				
Level 2	**Apply**	40 %	40 %	35%	40 %
	Analyze				
Level 3	**Evaluate**	20 %	30 %	30%	30 %
	Create				
	Total	100 %	100 %	100%	100 %

Course Designers		
Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
Dr. S M .Prabhu, Ph. D. Senior Breeder (Paddy Breeding and Transgenic) R&D centre, Rasi Seeds (P) Ltd., Attur, Salem – 636141.	Dr. Somasundaram G Senior Scientist ICAR - Indian Institute of Oil Palm Research (IIOPR) Research Centre Palode, Pacha (PO) Thiruvananthapuram-695562, Kerala. Somasundaram.G@icar.gov.in	Dr. G. Selvakumar , Assistant Professor (GPB) Dr. R. Mahendran, Assistant Professor (GPB) Dr. J. Vanitha, Tutor (GPB)

THEORY

Unit I - Introduction To Seed and Seed Quality
Seed and seed technology: introduction, definition and importance. Deterioration causes of crop varieties and their control; Maintenance of genetic purity during seed production, seed quality; Definition, Characters of good quality seed, different classes of seed.

Unit II – Production Seeds in Cereals, Pulses and Oilseeds
Foundation and certified seed production of Cereals: Wheat, rice, maize, sorghum and bajra, Pulses: Moth bean, mung, cowpea, pigeonpea, urd, gram and field pea, Oilseeds: Soybean, rapeseed and mustard, groundnut, sesame.

Unit III - Seed Production in Fodders and Horticultural crops
Foundation and certified seed production of Fodder: Berseem, lucerne and oats. Vegetables: Potato, cauliflower, tomato and chilli, Seed spices and medicinal plants: Cumin, coriander, fennel, fenugreek, isabgol.

Unit IV - Seed Evaluation
Seed certification, phases of certification, procedure for seed certification, field inspection. Seed Act and Seed Act enforcement. Duty and powers of seed inspector, offences and penalties. Seeds Control Order 1983 and seed act. Varietal Identification through Grow Out Test and Electrophoresis, Molecular and Biochemical test.

Unit V - Post Harvest Seed Handling Techniques
Seed drying, processing and their steps, seed testing for quality assessment, seed treatment, its importance, method of application and seed packing. Seed storage; general principles, stages and factors affecting seed longevity during storage. Measures for pest and disease control during storage. Seed marketing: structure and organization, sales generation activities, promotional media. Factors affecting seed marketing, Role of WTO and OECD in seed marketing.

Theory – Lecture Schedule
1. Seed and seed technology: introduction, definition and importance
2. Deterioration causes of crop varieties and their control; Maintenance of genetic purity during seed production and seed quality
3. Definition, Characters of good quality seed, different classes of seed
4. Foundation and certified seed production of wheat
5. Foundation and certified seed production of rice
6. Foundation and certified seed production of maize
7. Foundation and certified seed production of sorghum
8. Foundation and certified seed production of bajra,
9. Foundation and certified seed production of moth bean,
10. Foundation and certified seed production of mung
11. Foundation and certified seed production of cowpea
12. Foundation and certified seed production of pigeonpea
13. Foundation and certified seed production of blackgram and greengram
14. Foundation and certified seed production of field pea
15. Foundation and certified seed production of soybean
16. Foundation and certified seed production of rapeseed
17. **In semester examination**
18. Foundation and certified seed production of mustard
19. Foundation and certified seed production of groundnut
20. Foundation and certified seed production of sesame
21. Foundation and certified seed production of Fodder: Berseem, lucerne and oats
22. Foundation and certified seed production of vegetables: Potato, cauliflower, tomato and chilli
23. Foundation and certified seed production of seed spices and medicinal plants: Cumin, coriander, fennel, fenugreek, isabgol

24. Seed certification, phases of certification, procedure for seed certification, field inspection. Seed Act and Seed Act enforcement
25. Duty and powers of seed inspector, offences and penalties.
26. Seeds Control Order 1983 and seed act
27. Varietal Identification through Grow Out Test
28. Electrophoresis - molecular test to know genetic content of the seeds
29. Biochemical test for seeds
30. Seed drying, processing and their steps, seed testing for quality assessment, seed treatment, its importance, method of application and seed packing
31. Seed storage; general principles, stages and factors affecting seed longevity during storage.
32. Measures for pest and disease control during storage
33. Seed marketing: structure and organization, sales generation activities, promotional media. Factors affecting seed marketing
34. Role of WTO. Role of OECD in seed marketing

Practical Schedule

1. Seed production in wheat including seed standards
2. Seed production in rice, maize, sorghum, and bajra including seed standards
3. Seed production in blackgram, greengram and cowpea including seed standards
4. Seed production in redgram, lentil and field pea including seed standards
5. Seed production in soybean, rapeseed and mustard including seed standards
6. Seed production in Groundnut and Sesame including seed standards
7. Seed production in vegetable crops (Potato, cauliflower, tomato and chilli) including seed standards
8. Seed production in Seed spices (fenugreek, fennel, cumin & coriander) including seed standards
9. Seed sampling methods and physical purity test
10. Germination test and viability test
11. Seed and seedling vigour test and Genetic purity test: Grow out test
12. Electrophoresis for genetic purity test
13. Seed certification procedure, field inspection and preparation of field inspection report
14. Visit to seed production farms
15. Visit to seed testing laboratories
16. Visit to seed processing plant
17. **University Practical examination**.

Text Books

1. Agrawal, R.L. (2008). *Seed Technology.* New Delhi : Oxford & IBH Publishing Co. pp. 1- 821.
2. Dharmendra Jat, Sai Prasad, S. V. & Sheela Verma. (2014). *Seed Science and Technology* (2nd ed.) New Delhi: New Vishal Publications. pp. 1- 304.
3. Khare, D. (2014). *Seed Technology* (2nd ed.). Jodhpur: Scientific Publishers India. pp. 1- 944.
4. Padmavathi, S. (2012). *A Text Book of Seed Science and Technology.* New Delhi: New India Publishing Agency. pp. 1- 282.

Reference Books

1. Basra, A. S. (2006). *Handbook of Seed Science and Technology.* New York: Food Products Press. pp. 1- 749.
2. Lawrence O. Copeland & Miller McDonald. (2001). *Principles of Seed Science and Technology.* USA: Springer Science. pp. 1- 390.
3. Sreenivas, Y.S. (2009). *Seed Production of Commercial Vegetables.* Oxford: Oxford Book Company. pp. 1- 325.
4. Subir Sen & Nabinananda Ghosh. (2012). *Seed Science and Technology.* New Delhi: Kalyani Publishers. pp. 1- 277.
5. Vanangamudi, K., Prabhu, M. & Bhaskaran. (2010). *Vegetable Hybrid Seed Production and Management.* InIdia*:* Agrobios. pp. 1- 339.

Web-References

1. https://agro.au.dk/en/research/research-areas/seed-science-and-technology/
2. www.seednet.gov.in
3. https://www.fabinet.up.ac.za/index.php/research-groups/seed-science
4. https://www.youtube.com/watch?v=j6MwsmmYql8&list=PLMwQyDnbQLRWkULTTg3wMpi8YK04PnzzP

Journals

1. Seed Science Research
2. Research Journal of Seed Science
3. Advanced Journal of Seed Science and Technology
4. Journal of Seed Science - Scimago

Course Nature: Theory based Practical							
Total Marks (100)							
S.No.	Category	Assessment Tools					
		In- Semester Examination	Assignment	Record	Attendance	End-Semester Examination	Marks
1	Theory-External	-	-		-	*50*	*50*
2	Theory-Internal	*20*	-			-	*20*
3	Practical-External	-	-		-	*15*	*15*
4	Practical-Internal	-	*05*	*05*	*05*	-	*15*
						Grand Total	*100*

Course Code	AGS19401	Course Name	AGRICULTURAL MARKETING TRADE AND PRICES	Course Category	S	Supportive Course	L	T	P	C
							2	0	1	3

Pre-requisite Courses	AGS19101	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Agricultural Economics	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1 :	Explain agricultural marketing
CLR-2 :	Discuss the market function and force
CLR-3 :	Describe the functions of Agricultural Market institutions
CLR-4 :	Discuss the efficiency of Agricultural marketing
CLR-5 :	Explain Agriculture Trade and trade policies and WTO regulations
CLR-6 :	Introduction to market integration

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Agriculture Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	Ability to solve scientific problems	Ability to implement knowledge applied field	Ability to understand social and ethical responsibilities
CLO-1	Describe the process of marketing Agriculture produces	3	90	80	M	M	H	M	H	M	M	H	M	H	H	H	H	H	H
CLO-2	Recongnize the Institutional approach to regulate prices and market structure	1	90	85	H	M	M	M	M	H	M	M	L	H	H	H	H	H	H
CLO-3	Recall the Market process, conduct and facilitations	2	75	70	M	H	M	M	M	H	M	M	H	H	H	H	H	H	H
CLO-4	Outline the Market price and exchange prices and market data analysis	3	80	75	M	H	M	H	L	M	L	M	M	H	H	H	H	H	H
CLO-5	Identify the Market promotional activities and integrations	2	85	80	M	M	H	M	M	M	M	M	M	H	H	H	H	H	H
CLO6 :	Summarize the Institutional regulations for quality control	2	85	80	M	H	M	M	H	L	M	L	M	H	H	H	H	H	H

Duration (hour)		Learning Unit / Module 1	Learning Unit / Module 2	Learning Unit / Module 3	Learning Unit / Module 4	Learning Unit / Module 5
		9	16	14	12	12
S-1	SLO-1	*Agricultural Marketing*	*Marketing process and functions*	*Market functionaries*	*International Trade*	*Market Access*
	SLO-2	*Concepts and definitions of market*	*Marketing process*	*Marketing channels*	*Free trade, Autarky and it needs..*	*Domestic Support*
S-2	SLO-1	*Market structure*	*Exchange functions*	*Integration*	*Theories of Trade*	*Agricultural Prices*
	SLO-2	*Classification and characteristics of agricultural markets*	*physical functions*	*Types of market integration.*	*Absolute and comparative advantage;*	*Concept of MSP*
S-3-4	SLO-1	***Lab 1:** Preparation of farm survey schedule*	***Lab 3:** calculation of elasticities*	***Lab 7:**Identification of marketing channels*	***Lab 11:** Visit to AGMARK Laboratory*	***Lab 14:** Time Series Analysis of prices*
	SLO-2					
S-5	SLO-1	*Demand and supply of agri-commodities:*	*Facilitating functions*	*Marketing efficiency*	*Present status and prospects of Agricultural exports*	*Price Parity*
	SLO-2	*Meaning, nature and determinants of demand and supply of farm products.*	*Quality control and labeling (AGMARK).*	*Marketing costs*	*Imports from India and their share.*	*Procurement of food grains*
S-6	SLO-1	*Approaches to the study of marketing*	*Standardization, Finance, Storage and Warehousing*	*Role of Government in agricultural marketing*	*Barriers to Trade*	*Risk in marketing*
	SLO-2	*Market functionaries*	*Processing, Value Addition and Risk Taking.*	*Role of Government in agricultural marketing*	*Tariff and non tariff barriers*	*Types of risk in marketing*
S-7-8	SLO-1	***Lab 2:** Visit to a farm on marketing practices of agricultural commodities and marketing problems*	***Lab 4** Computation of marketable and marketed surplus*	***Lab 8:** Visit to market committee and regulated market*	***Lab 12:** Farm input marketing: Visit to Farm input dealer to study marketing*	***Lab 15:** Construction of Index Numbers*
	SLO-2					
S-9	SLO-1	*Marketing of agricultural versus manufactured goods*	*Price determination under perfect*	*Public sector institutions*	*Terms of Trade.*	*Speculation and Hedging*

	SLO-2	Producer surplus	*Imperfect competition*	*FCI, and DMI – their objectives and functions.*	*Role of institutions like UNCTAD and GATT*	*Forward and Futures trading*
S-10	**SLO-1**	-	*Product Life Cycle (PLC)*	*Co-operative marketing*	*AoA and its implications*	*Role of Contract Farming in risk mitigation*
	SLO-2	-	*competitive strategies*	*Co-operative marketing functions*	*Sanitary and Phyto-sanitary issues*	*Futures trading*
S-11-`12	**SLO-1**	-	***Lab 5:** Visit to a local market*	***Lab 9:** Visit to co-operative marketing society to study its organization and functioning.*	***Lab13:** Visit to Commodity Boards.-*	***Lab 16:** Application of principles of comparative advantage*
	SLO-2	-				
S-13	**SLO-1**	-	*Pricing and promotion strategies*	*Market Intelligence*	-	-
	SLO-2	-	*pricing considerations*	*APMC Act. New EXIM policy of India.*	-	-
S-14	**SLO-1**	-	*Market promotion*	*Advantages of AEZs*	-	-
	SLO-2	-	*personal selling, sales promotion*	*Export Promotion Councils*	-	-
S-15-16	**SLO-1**	-	***Lab 6:** Study of relationship between market arrivals*	***Lab 10:**SWC and CWC of FCI*	-	-
	SLO-2	-			-	

Learning Resources	1. Acharya, S, S., and Agarwal, N, L., (2019). Agricultural Marketing in India(6ED), New Delhi: Oxford & IBH Publishing Co. Pvt. Ltd. pp1-401 2. Kohls, R. L., & Uhl Joseph, N., (1980). Marketing of Agricultural Products, New York: Collier Macmillan. pp 560-790. 3. Kym Anderson, (2016). Agricultural Trade, Policy Reforms, and Global Food Security. USA: Palgrave Macmillan Publishing Company. pp1-398 4. Sakonkvisit, John, & Shaw, J., (1999). International Marketing Analysis and Strategy. New Delhi: Prentice Hall of India. pp1-750 5. Sivarama Prasad, A., (1999). Agricultural Marketing in India. New Delhi: Mittal Publications. pp 48-52

Level of Thinking		**Continuous Learning Assessment (35% weightage)**		University Practical Examination (15%)	End semester theory Examination (50%)
		In semester (20%)	Practical (15%)		
Level 1	**Remember**	40 %	30 %	35%	30 %
	Understand				
Level 2	**Apply**	40 %	40 %	35%	40 %
	Analyze				
Level 3	**Evaluate**	20 %	30 %	30%	30 %
	Create				
	Total	*100 %*	*100 %*	*100%*	*100 %*

Course Designers		
Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
Mr. K.Arun, Business Manager, EDII Periyakulam Horti Business Incubation Forum, Periyakulam	Dr.D. Sureshkumar, Professor and Head, Department of Agricultural Economics, Centre for Agricultural and Rural Development Studies, Tamil Nadu Agricultural University, Coimbatore - 3	Dr. Anbarassan A Dr. Periasami N

THEORY

Unit I – Agricultural Marketing – Nature and Scope

Agricultural Marketing: Concepts and definitions of market, marketing, agricultural marketing, market structure, marketing mix and market segmentation, classification and characteristics of agricultural markets**;** nature and determinants of demand and supply of farm products. Producer's surplus – meaning and its types, marketable and marketed surplus, factors affecting marketable surplus of agri-commodities. Approaches to the study of marketing - Market functionaries and Market forces. Marketing of agricultural versus manufactured goods.

Unit II – Marketing Functions, Pricing and Promotion Strategies

Marketing process and functions: Marketing process - concentration, dispersion and equalization; exchange functions – buying and selling; physical functions – storage, transport and processing; facilitating functions – packaging, branding, grading, quality control and labeling (AGMARK); Standardization, Finance, Storage and Warehousing, Processing, Value Addition and Risk Taking - Market Structure, Conduct and Performance paradigm (SCP) – Market Structure: Meaning, Components, Dynamics of Conduct and Performance – Market structure and Price determination under perfect and imperfect competition. Product Life Cycle (PLC) and competitive strategies: Meaning and stages in PLC; characteristics of PLC; strategies in different stages of PLC; pricing and promotion strategies: pricing considerations and approaches – cost based and competition based pricing; market promotion – advertising, personal selling, sales promotion and publicity – their meaning and merits and demerits.

Unit III – Marketing Efficiency and Marketing Institutions

Market functionaries and marketing channels: Types and importance of agencies involved in agricultural marketing; meaning and definition of marketing channel; number of channel levels; marketing channels for different farm products; Integration over space, time and form: Meaning, definition and types of market integration; marketing efficiency; marketing costs, margins and price spread; factors affecting cost of marketing reasons for higher marketing costs of farm commodities; ways of reducing marketing costs; Modern marketing systems versus traditional agricultural marketing systems; Role of Government in agricultural marketing - Public sector institutions - CWC, SWC, FCI and DMI – their objectives and functions; cooperative marketing in India; Market Intelligence -Legal measures for improving agricultural marketing: APMC Act. New EXIM policy of India – Advantages of AEZs, ITPO, Export Promotion Councils, APEDA, MPEDA, and Commodity Boards.

Unit IV –Trade in Agricultural Products

International Trade: Concept of International Trade and its need - Free trade, Autarky and it needs - Theories of Trade: Absolute and comparative advantage; Present status and prospects of Agricultural exports / imports from India and their share - Barriers to Trade: Tariff and non tariff barriers - Trade policy instruments – Terms of Trade - Role of institutions like UNCTAD and GATT - WTO in promoting trade in agricultural products - Free Trade Agreements – AoA and its implications on Indian agriculture: Sanitary and Phyto-sanitary issues, Market Access, Domestic Support and Export Subsidies - IPR.

Unit V – Agricultural Prices and Risk Analysis

Agricultural Prices and Policy: Meaning and functions of price; administered prices; need for agricultural price policy; Objectives of Price Policy and Price Stabilization – Role of CACP – Concept of MSP, FRP (SMP) and SAP – Price Parity - Procurement of food grains and buffer stock - Risk in marketing: Meaning and Importance - Types of risk in marketing: Speculation and Hedging and Forward and Futures trading; an overview of futures trading; – Role of Contract Farming in risk mitigation.

Theory - Lecture Schedule

1. Agricultural Marketing: Concepts and definitions of market, marketing, agricultural marketing.
2. Market structure, marketing mix and market segmentation, classification and characteristics of agricultural markets.
3. Demand and supply of agri-commodities: meaning, nature and determinants of demand and supply of farm products.
4. Approaches to the study of marketing: Market functionaries and Market forces.
5. Marketing of agricultural versus manufactured goods. Producer surplus – meaning and its types, marketable and marketed surplus, factors affecting marketable surplus of agri- commodities.
6. Marketing process and functions: Marketing process - concentration, dispersion and equalization.
7. Exchange functions – buying and selling; physical functions – storage, transport and processing.
8. Facilitating functions – packaging, branding, grading, quality control and labeling (AGMARK).
9. Standardization, Finance, Storage and Warehousing, Processing, Value Addition and Risk Taking.
10. Market Structure, Conduct and Performance paradigm (SCP) – Market Structure: Meaning, Components, Dynamics of Conduct and Performance.
11. Market structure and Price determination under perfect and imperfect competition.
12. Product Life Cycle (PLC) and competitive strategies: Meaning and stages in PLC; characteristics of PLC; strategies in different stages of PLC.
13. Pricing and promotion strategies: pricing considerations and approaches – cost based and competition based pricing.
14. Market promotion – advertising, personal selling, sales promotion and publicity – their meaning and merits and demerits.

15. Market functionaries and marketing channels: Types and importance of agencies involved in agricultural marketing; meaning and definition of marketing channel; number of channel levels; marketing channels for different farm products.
16. Integration over space, time and form: Meaning, definition and types of market integration.
17. **In-Semester Examination**
18. Marketing efficiency; marketing costs, margins and price spread; factors affecting cost of marketing reasons for higher marketing costs of farm commodities; ways of reducing marketing costs.
19. Role of Government in agricultural marketing - Modern marketing systems versus traditional agricultural marketing systems.
20. Public sector institutions- CWC, SWC, FCI, and DMI – their objectives and functions.
21. Co-operative marketing in India.
22. Market Intelligence - Legal measures for improving agricultural marketing: APMC Act. New EXIM policy of India.
23. Advantages of AEZs, ITPO, Export Promotion Councils, APEDA, MPEDA, and Commodity Boards.
24. International Trade: Concept of International Trade and its need - Free trade, Autarky and it needs.
25. Theories of Trade: Absolute and comparative advantage;
26. Present status and prospects of Agricultural exports / imports from India and their share.
27. Barriers to Trade: Tariff and non tariff barriers - Trade policy instruments.
28. Terms of Trade - Role of institutions like UNCTAD and GATT - WTO in promoting trade in agricultural products - Free Trade Agreements.
29. AoA and its implications on Indian agriculture: Sanitary and Phyto-sanitary issues,.
30. Market Access, Domestic Support and Export Subsidies - IPR.
31. Agricultural Prices: Meaning and functions of price; administered prices; need for agricultural price policy; Objectives of Price Policy and Price Stabilization – Role of CACP – Concept of MSP, FRP (SMP) and SAP.
32. Price Parity - Procurement of food grains and buffer stock.
33. Risk in marketing: Meaning and Importance - Types of risk in marketing.
34. Speculation and Hedging and Forward and Futures trading: an overview of futures trading. Role of Contract Farming in risk mitigation.

Practical Schedule

1. Preparation of farm survey schedule
2. Visit to a farm to collect information on marketing practices of agricultural commodities and marketing problems.
3. Plotting and study of demand and supply curves and calculation of elasticities.
4. Computation of marketable and marketed surplus of important commodities.
5. Visit to a local market / weekly *shandy* / farmers' market to study various marketing functions performed by different agencies.
6. Study of relationship between market arrivals and prices of some selected commodities.
7. Identification of marketing channels for selected commodity, collection of data regarding marketing costs, margins; price spread estimation for major agricultural and allied agricultural products to assess their marketing efficiency; and presentation of report in the class.
8. Visit to market committee and regulated market to study their organization and functioning.
9. Visit to co-operative marketing society to study its organization and functioning.
10. Visit to market institutions – SWC / CWC to study their organization and functioning.
11. Visit to AGMARK Laboratory / Grading institutions.
12. Farm input marketing: Visit to Farm input dealer to study marketing of farm inputs.
13. Visit to Commodity Boards / AEZ / Export oriented units.
14. Time Series Analysis of prices–TCSI Study of price behaviour over time for some selected commodities.
15. Construction of Index Numbers and their uses.
16. Application of principles of comparative advantage of international trade.
17. **University Practical Examination**

Text Books

1. Acharya, S, S., & Agarwal, N, L., (2019). Agricultural Marketing in India (6ED), New Delhi: Oxford & IBH Publishing Co. Pvt. Ltd. pp1-401
2. Kym Anderson, (2016). Agricultural Trade, Policy Reforms, and Global Food Security. USA: Palgrave Macmillan Publishing Company,. pp1-398
3. Sakonkvisit, John, & Shaw, J., (1999). International Marketing Analysis and Strategy. New Delhi: Prentice Hall of India. pp1-750

Reference Books

1. Kohls, R. L., & Uhl Joseph, N., (1980). Marketing of Agricultural Products, New York: Collier Macmillan. pp 560-790.

2. Sivarama Prasad, A., (1999). Agricultural Marketing in India. New Delhi: Mittal Publications. pp 48-52

Web-References

1. www.nimsme.org
2. www.nsic.co.in
3. www.nabard.org
4. www.archive.mu.ac.in/myweb_test/M.A.%20PART%20-%20I%20Agriculture%20Economics%20-%20Eng.pdf
5. www.rvskvv.net/images/Principles-of-Agricultural-Economics_17.04.2020.pdf
6. www.rvskvv.net/images/II-Year-II-Sem_Agri-Marketing_ANGRAU_20.04.2020.pdf
7. www.rvskvv.net/images/II-Year-II-Sem_Agri-Marketing_TNAU_20.04.2020.pdf

Journals

1. Indian journal of agricultural marketing
2. Indian journal of marketing
3. The Journal of Agricultural Marketing
4. American Journal of Environmental and Resource Economics

Course Nature: Theory based Practical							
Total Marks (100)							
S.No.	**Category**	**Assessment Tools**					
		In- Semester Examination	Assignment	Record	Attendance	End-Semester Examination	Marks
1	Theory-External	-	-		-	*50*	*50*
2	Theory-Internal	*20*	-			-	*20*
3	Practical-External	-	-		-	*15*	*15*
4	Practical-Internal	-	*05*	*05*	*05*	-	*15*
						Grand Total	*100*

Course Code	SKE19401	Course Name	COMPREHENSION AND COMMUNICATION SKILLS IN ENGLISH	Course Category	S	*Supportive Course*	L	T	P	C
							1	0	1	2

Pre-requisite Courses	*Nil*	**Co-requisite Courses**	*Nil*	**Progressive Courses**	*Nil*
Course Offering Department		*Skill Education*	**Data Book / Codes/Standards**	*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1 :	*Describe appropriate communication skills across settings, purposes, and audiences.*
CLR-2 :	*Demonstrate knowledge of communication theory and application.*
CLR-3 :	*Illustrate healthy and effective relationships*
CLR-4 :	*Identify the technologies to communicate effectively in various settings and contexts.*
CLR-5 :	*Demonstrate appropriate and professional ethical behavior.*
CLR-6 :	

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	**Learning**			**Program Learning Outcomes (PLO)**														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Horticulture Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project mgt. & Finance	Life Long Learning	Ability to become a enterpreuner in the field of Floriculture	Ability to establish a garden	Ability to produce value added products from the commercial flowers
CLO-1 :	*Demonstrate critical and innovative thinking.*	*1*	*95*	*85*		*H*				*H*	*M*	*H*	*H*	*H*		*H*			
CLO-2 :	*Illustrate competency in oral, written, and visual communication.*	*2*	*80*	*75*		*H*				*H*		*H*	*H*	*H*		*H*			
CLO-3 :	*Identify the cultural communication differences.*	*3*	*80*	*86*		*M*				*H*	*M*	*H*	*H*	*H*		*H*			
CLO-4 :	*Outline ethical Communication*	*3*	*75*	*85*		*M*	*H*			*H*		*H*	*M*	*H*		*H*			
CLO-5 :	*Demonstrate positive group communication*	*2*	*80*	*75*		*H*	*H*			*H*		*H*	*H*	*H*		*H*			
CLO6 :	*Identify the opportunities in the field of communication*																		

Duration (hour)		**Learning Unit / Module 1**	**Learning Unit / Module 2**	**Learning Unit / Module 3**	**Learning Unit / Module 4**	**Learning Unit / Module 5**
		3	**3**	**4**	**3**	3
S-1	**SLO-1**	*Elements of Communication Skills*	*Writing Skills*	*Drafting News articles*	*SWOT analysis*	*LSWR Skills*
	SLO-2	*Purpose of Communication*	*Reading Comprehension*	*Content writing*	*Career orientation*	*Memo, minutes, agenda, email, fax*
S-2	**SLO-1**	*Need of Communication in current Scenario*	*Precise Writing, report writing*	*Vocabulary Building*	*Group discussion*	*Resume and curriculum Vitae*
	SLO-2	*Types of Communication*	*Paragraph writing, summarizing*	*Words often confused*	*Conducting interviews online*	*Dialogue writing, Delivering speech Extempore*
S-3	**SLO-1**	*Barriers to Communication*	*Proposal writing*	*Homophones & Homonyms*	*Team work, Mass communication*	*Degree of comparison, parts of speech, direct & Indirect*
	SLO-2	*Applications of Communication Skills*	*Style & techniques in writing*	*Note Making*	*Review writing*	*English for Competitive exams, GRE, TOEFL*
S-4	**SLO-1**	-	*Importance of Professional Writing*	*Story writing*	*Etiquette, values and Professional Ethics*	-
	SLO-2	-	-	-	-	-

Learning Resources	

Level of Thinking		Continuous Learning Assessment (35% weightage)		University Practical Examination (15%)	End semester theory Examination (50%)
		In semester (20%)	Practical (15%)		
Level 1	**Remember**	40 %	30 %	35%	30 %
	Understand				
Level 2	**Apply**	40 %	40 %	35%	40 %
	Analyze				
Level 3	**Evaluate**	20 %	30 %	30%	30 %
	Create				
Total		*100 %*	*100 % 1*	*100%*	*100 %*

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
-	-	Dr.U.S.Akshara Govind Mr. Bharath Suresh Kumar

THEORY

UNIT 1: Communication Skills
Basic Elements of Communication Skills – Purpose of Communication Skills – Need of Communication Skills in Current society – Types of Communication Skills – Applications of Communication Skills

UNIT 2: Comprehension
War Minus Shooting- The Sporting Spirit by George Orwell, A Dilemma- A layman looks at science by Raymond B. Fosdick, You and Your English – Spoken English and Broken English by G B Shaw, Reading Comprehension, Written Skills: Paragraph writing, Precise writing, Report writing and Proposal writing. The Style: Importance of professional writing.

UNIT 3 Vocabulary Building
Vocabulary-building using Journals, Word Walls, Using words in context. Antonym, Synonym, Homophones, Homonyms, often confused words, Writing of Stories, Drafting News articles, Note making and content development.

Unit No. 4 Professional and Life Skills
Career–orientation – Ambition, dream job – Motivation, building self-confidence, Inter-personal skills- Team work- Mass communication - Group discussion, writing exercises – Articles, conducting an interview with any ambassador and writing the interview, Review writing - visiting places and meeting people to write review

Unit No. 5 Language Skills
LSRW (listening, speaking, reading & writing) - Written English - correspondences- letters, memos, minutes, agenda, resume, curriculum vitae and bio-data, writing project report and project proposal. Spoken English - phonetics, dialogues, conversations, extempore, delivering speech. Grammar - subject-verb agreement, jumbled words, sentences, parts of speech, degrees of comparison, sentence structure, Voice forms, Vocabulary and Conditionals. English for competitive exams – IELTS, TOEFL, GRE and others.

Lecture Schedule
1. War Minus Shooting (A lesson from the Text Book, "The Sporting Spirit" by George Orwell) textual grammar pertaining to factual comprehension and inferential comprehension & referential comprehension.
2. War Minus Shooting (A lesson from the Text Book, "The Sporting Spirit" by George Orwell) textual grammar pertaining to global comprehension and attitudinal comprehension.
3. War Minus Shooting (A lesson from the Text Book, "The Sporting Spirit" by George Orwell) textual grammar on synonyms – antonyms – prefix – suffix – homonyms - homophones – TOEFL & IELTS vocabulary.
4. War Minus Shooting (A lesson from the Text Book, "The Sporting Spirit" by George Orwell) textual grammar – English articles – preposition – conjunctions and its types.
5. A Dilemma (A lesson from the Text Book, Layman looks at Science by Raymond Fosdick) textural grammar – verbs – auxiliary verbs - modals and basic tense forms.
6. A Dilemma (A lesson from the Text Book, Layman looks at Science by Raymond Fosdick) textural grammar – sentence pattern and sentence forms (simple, compound and complex sentences).
7. A Dilemma (A lesson from the Text Book, Layman looks at Science by Raymond Fosdick) textural grammar – subject – verb – agreement.
8. A Dilemma (A lesson from the Text Book, Layman looks at Science by Raymond Fosdick) textural grammar – transformation of sentences.
9. **In-Semester Examination**
10. You and Your English (A lesson from the Text Book, Spoken English and Broken English by G.B. Shaw) textural grammar – synthesis of sentences – reported speech (direct and indirect speech).
11. You and Your English (A lesson from the Text Book, Spoken English and Broken English by G.B. Shaw) textural grammar – paragraph writing (thesis sentences, supporting statements, inferential statements).
12. You and Your English (A lesson from the Text Book, Spoken English and Broken English by G.B. Shaw) textural grammar – four principles of writing.
13. You and Your English (A lesson from the Text Book, Spoken English and Broken English by G.B. Shaw) textural grammar - professional writing – summary writing and paraphrasing, synopsis writing and citation.
14. Graham's flow chart on writing skills
15. Letter writing – personal and social correspondence – job application
16. Precise writing – report writing and proposal writing
17. Interview skills - kinds – importance and process

Practical Schedule

1. Listening - introduction - Listening vs Hearing - listening modes - types of listening - intensive and extensive listening – practice
2. Process of listening - methods of enhancing listening - barriers to listening and ways to overcome them – practice
3. Oral communication - organs of speech – English phonemes (consonant table, vowel table) - practice
4. English stress and intonation - exercises.
5. Conversation techniques and practice
6. Rate of speech (slow pace, medium pace, rhetoric)
7. Reading - types - skimming and scanning - SQ4R - critical reading - analytical reading – exercises
8. Principles and practice of presentation skills - PowerPoint preparation and presentation
9. Handout preparation - lecture notes preparation - practice and evaluation
10. Writing skills - note taking – precise writing – abstract writing – practice
11. Mind-mapping and article writing
12. Letter writing and rejoinder writing
13. Text writing - practice on table to text conversion
14. Interview skills – types of interview (group interview – panel interview – telephone interview – behavioral interview – videoconferencing interview – mock interview)
15. Practice on speaking skills – welcome address - vote of thanks - short extemporal speech
16. Group discussion – techniques – types and practice
17. **Universityl Practical Examination**

References

1. Goodale, Malcolm, (2005) *Professional Presentations,* (2nd Ed)Cambridge University, London PP 1-670
2. Green Baum Sidney, (2009) *Oxford English Grammar*, (3rd Ed) New Delhi, Oxford University Press.Peregoy PP 1-800
3. Jones Daniel, (2006) *English Pronouncing Dictionary*, (5th Ed)Cambridge University Press London PP1-490
4. Lynch, Tony and Kenneth Anderson, (1992) *Study Speaking*, (2nd Ed)Cambridge University, London PP 1-520
5. Martin Cutts, (2004) *Oxford Guide to Plain English*, (3rd Ed) Oxford University Press, London PP1-500.
6. SahaneyaWandy, et.al., (2005) *IELTS, Preparation and Practice*, (5th Ed) Oxford University, London PP1-850

Web Resources

www.orwell.ru/library/articles/spirit/english/e_spirit
www.essays.com
www.onestopenglish.com
www.bogglesworld.com
www.eltweb.com
www.reportingskills.com
www.writing-skills.com
www.negotiation.com
www.teachersdesk.com
www.flexbilelearning.net.an

Course Nature: Theory based Practical							
Total Marks (100)							
S.No.	Category	Assessment Tools					
		In- Semester Examination	Assignment	Record	Attendance	End-Semester Examination	Marks
1	Theory-External	-	-		-	*50*	*50*
2	Theory-Internal	*20*	-			-	*20*
3	Practical-External	-	-		-	*15*	*15*
4	Practical-Internal	-	*05*	*05*	*05*	-	*15*
						Grand Total	*100*

Course	*SUP19401*	Course Name	FARM MACHINERY AND POWER	Course Category	*S*	*Supplementary Course*	L	T	P	C

Code							1	0	1	2

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Agricultural Engineering	Data Book / Codes/Standards		Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1 :	Discuss the contributions of different scientists in the development of field of farm machinery
CLR-2 :	Identify different implements and their role in agricultural operations
CLR-3 :	Describe different implements and their uses
CLR-4 :	Summarize the technical knowledge on the engines, tillage tools and different implements used for harvesting and planting
CLR-5 :	Identify the advanced technologies present in farm machinery
CLR-6 :	Outline the technologies used in farm machinery

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Agriculture Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	Ability to solve scientific problems through Agricultural Engineering	Ability to implement knowledge gained in the applied field of Agricultural Engineering	Ability to understand social and ethical responsibilities of Agricultural Engineering
CLO-1 :	Identify and differentiate between two stroke and four stroke I.C engines	3	90	80	M								M	H		H	H	H	H
CLO-2 :	Distinguish the different components and systems of IC engines	1	95	85	H								L	H		H	H	H	H
CLO-3 :	Compare and identify the different tillage implements used for various agricultural purposes	2	80	70	M		L	L					L	H		H	H	H	H
CLO-4 :	Classify various farm implements and comprehend its calibration methods	3	75	65	M			L	L				M	H		H	H	H	H
CLO-5 :	Identify the cost benefit economics of various farm implements	2	75	60	L	L							M	H		H	H	H	H
CLO6 :	Recall and describe different equipment used in agricultural fields from planting to harvesting	2	75	65	L						H		M	H		H	H	H	H

Duration (hour)		Learning Unit / Module 1	Learning Unit / Module 2	Learning Unit / Module 3	Learning Unit / Module 4	Learning Unit / Module 5
		3	3	3	4	3
S-1	SLO-1	Energy: Basics	**Practical 3:** Primary and secondary tillage implemets	Tillage- Objectives	**Practical 8:** Practice in driving tractor	**Practical 11:** Power tiller handling
	SLO-2	Types of Energy		Tillage types		
S-2	SLO-1	**Practical 1:**Calculation on force power and energy	IC Engines	**Practical 6:** Study of tractors	Seedling equipment	Intercultural equipment's
	SLO-2		Operations- 2 and 4 stroke		Metering mechanism devices	Crop harvest equipment
S-3	SLO-1	Units of Energy	**Practical 4:** Spraying equipment calibration	Construction tillage implements	**Practical 9:** Mounted implement- tractor	**Practical 12:**Paddy transplanter handling
	SLO-2	Dimensions of Energy		Function tillage implements		
S-4	SLO-1	**Practical 2:** IC Engines	Air cooling	**Practical7:** Learning to driver tractor	Seed Driill	Fruit pluckers
	SLO-2		Lubrication system		Planters	Farm machinery cost analysis
S5	SLO-1	Energy Loss	**Practical 5:** Handling plant protection equipment's	Hill agriculture	**Practical 10:** Tools for hill agriculture	**Practical 13:** Threshing machinery
	SLO-2	Energy efficiency		Implements	-	
		-		-	-	
S6	SLO-1	-	Tractors types	--	Drill calibration	Tractor
	SLO-2	-	Performance	-	Sprayers	Implement selection
S7		-	-	-	Particle Size	Practical 14: Harvester root crops
S8		-	-	-	Dusters	Practical15: Problems on cost operation
S9		-	-	-	-	Practical 16: Industrial Visit

Learning Resources	
	4. Surendra Singh- Farm machinery –Principles and applications, ICAR, New Delhi
	5. Jagadishwar Sahay, 2010. Elements of Agricultural Engineering. Standard Publishers Distributors, Delhi. ISBN: 978-8180140440

Level of Thinking	Continuous Learning Assessment (35% weightage)		University Practical Examination (15%)	End semester theory Examination (50%)
	In Semester (20%)	Practical (15%)		

Level 1	**Remember**	40 %	30 %	35%	30 %
	Understand				
Level 2	**Apply**	40 %	40 %	35%	40 %
	Analyze				
Level 3	**Evaluate**	20 %	30 %	30%	30 %
	Create				
	Total	100 %	100 %	100%	100 %

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
-	-	Dr. Suresh Nivritti Khatawkar

THEORY

Unit I - Basic Concepts Energy and Power
Energy: Basics and forms: Radiation, Solar, Chemical, Potential, Kinetic, Thermal, Mechanical and Electrical, farm power status in India; Units of energy and dimensions: Basic SI, Derived SI, conversion of non-SI, SI prefixes; Energy losses and efficiency; Equivalence and replacement of energy forms; Process energy requirements and gross energy requirements;

Unit II - Principles of IC Engines
IC Engines: Basic principles, operations, compression, ignition and spark ignition engines, two stroke and four stroke engines; air, cooling and lubrication system; Fuel supply and hydraulic system; power transmission system: clutch, gear box, differential and final drive of a tractors; Tractor types, Electric motors: types, construction and performance comparison.

Unit III – Basics of Tillage and its Types
Tillage: Objectives, types; method of ploughing; Construction and function of primary tillage implements and Secondary tillage implements; Implements for hill agriculture.

Unit IV - Sowing and Fertilizer Application Equipments
Seeding equipment: Devices for metering mechanism of seeds, furrow openers, Types of seed drills and planters; potato planters, seedling transplanter; Tools for horticultural crop propagation; Drill calibration: application of fertilizers, metering devices; seed come fertilizer drill; application of liquid fertilizers; Sprayers: classification, accessories; determination of particle size and distribution; dusters: types;

Unit V - Inter Cultural and Harvesting Equipments
Inter-culture equipment: blade harrow, dry land weeders, sweeps, junior hoe, power operated weeders, long handle weeders; Crop harvesting equipments: diggers for potato, groundnut and other tubers; combined harvester for rice and sugarcane; cotton pickers and corn harvester; fruit pluckers. Cost analysis of farm machinery: Tractor and implement selection

Theory- Lecture Schedule
1. Energy: Basics and forms: Radiation, Solar, Chemical, Potential, Kinetic, Thermal, Mechanical and Electrical; farm power status in India.
2. Units of energy and dimensions: Basic SI, Derived SI, conversion of non-SI, SI prefixes;
3. Energy losses and efficiency; Equivalence and replacement of energy forms; Energy balance, Process energy requirements and gross energy requirements;
4. IC Engines: Basic principles, operations, compression, ignition and spark ignition engines, two stroke and four stroke engines;
5. Air, cooling and lubrication system; Fuel supply and hydraulic system: clutch, gear box, differential and final drive of a tractors
6. Tractors types,; Electric motors: types, construction and performance comparison.
7. Tillage: objectives, Types of ploughing, Method of ploughing;
8. Construction and function of Primary tillage implements;
9. **In Semester Examination**
10. Construction and function of Secondary tillage implements; Implement for hill agriculture.
11. Seeding Machines: devices in metering seeds, furrow openers, furrow closers, Types of seed drills and planters; potato planters, seedling transplanter;
12. Tools for horticultural crop propagation; Drill calibration: application of fertilizers, metering devices; seed come fertilizer drill;
13. Application of liquid fertilizers; Sprayers: classification, accessories; determination of particle size and distribution; dusters: types;
14. Inter-culture equipment: blade harrow, dry land weeders, sweeps, junior hoe, power operated weeders, long handle weeders;
15. Crop harvesting equipments: diggers for potato, groundnut and other tubers; combined harvester for rice and sugarcane;
16. cotton pickers and corn harvester; fruit pluckers. Cost of operation of farm machinery: Tractor and implement selection

Practical Schedule
1. Calculation on force, power and energy
2. IC engines – showing the components of dismantled engines and motors
3. Handling primary and secondary tillage implements, hitching, adjustments and operations
4. Handling spraying equipment, calibration and operation
5. Handling plant protection equipment, calculation of dilution ratio and operation
6. Study of tractors - their operation and maintenance
7. Learning to drive the tractor
8. Practice in driving tractor
9. Learning to operate tractor with mounted implement
10. Study of tools for Hill agriculture and horticultural crops – propagation tools, vegetable transplanter, harvesting tools -lawn mower, hole diggers, tree climber, shredders for crop residue.

11. Handling power tiller and observing their operation and maintenance
12. Handling paddy transplanter - allied machinery for raising mat nursery
13. Threshing machinery for paddy and identification of its components- different threshing drums - calculation of efficiency and losses.
14. Study of harvesters for root crops - turmeric and tapioca and groundnut diggers
15. Problems on cost of operation of tractor operated machinery.
16. Visit to Industry.
17. **University Practical Examination**

Text Books

1. Senthilkumar, T., R. Kavitha and V.M.Duraisamy 2015. A Text Book of Farm Machinery, Thannambikkai Publications, Coimbatore . ISBN: 978-9381102305
2. Jagadishwar Sahay, 2010. Elements of Agricultural Engineering. Standard Publishers Distributors, Delhi. ISBN: 978-8180140440

Reference Books

1. Ojha, T.P and A.M. Michael. 2005. Principles of Agricultural Engineering Vol-I. Jain Brothers, New Delhi. ISBN: 978-8186321638.
2. Nakra C.P 1970. Farm Machinery and Equipment,: Dhanpat Rai Publishing Company Ltd, New Delhi ISBN: 978-8187433231.
3. Jain, S.C. and C.R.Rai. Farm Tractor and maintenance and repair. Standard Publishers, 1705-B, Naisarak,. Delhi- 110006
4. Surendra Singh- Farm machinery –Principles and applications, ICAR, New Delhi
5. S.C. Jain & Grace Philip, Farm Machinery- An approach, Standard publishers Delhi

e – References

1. https://www.agroengineering.org
2. https://www.sciencedirect.com › journal › journal-of-agricultural-engineering.
3. https://publons.com › journal › journal-of-agricultural-engineering-and-technology
4. https://www.agriculturejournals.cz
5. https://ecourses.icar.gov.in/
6. https://nptel.ac.in/courses
7. https://ciae.nic.in
8. https.//cmeri.res.in

Journals

1. Journal of Agricultural Engineering
2. Journal of Agriucltural Engineering Research
3. International Journal of Agricultural Engineering

Course Nature: Theory based Practical							
Total Marks (100)							
S.No.	**Category**	**Assessment Tools**					
		In- Semester Examination	Assignment	Record	Attendance	End-Semester Examination	Marks
1	Theory-External	-	-		-	*50*	*50*
2	Theory-Internal	*20*	-			-	*20*
3	Practical-External	-	-		-	*15*	*15*
4	Practical-Internal	-	*05*	*05*	*05*	-	*15*
						Grand Total	*100*

Course Code	**ELC19401**	**Course Name**	**AGRICULTURAL JOURNALISM**	**Course Category**	*E*	**Elective Course**	**L**	**T**	**P**	**C**
							1	**0**	**1**	**2**

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Agricultural Economics	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1 :	Explain agricultural journalism and its role in agricultural development
CLR-2 :	Recongnize the skills in script writing for different media
CLR-3 :	Summarize the knowledge on newspapers and magazines
CLR-4 :	To know more about agricultural story and its types and structure
CLR-5 :	Summarize the editorial mechanics for agricultural journalism

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Agriculture Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	Ability to solve scientific problems through Agricultural Journalism	Ability to implement knowledge gained in the applied field of Agricultural Journalism	Ability to understand social and ethical responsibilities of Agricultural Journalism
CLO-1 :	Compare the difference between agricultural journalism and other types of journalism	1	80	75	M					H			M	H		H		H	H
CLO-2 :	Summarize on photojournalism	2	85	80	H					H			L	H		H		H	H
CLO-3 :	Discuss the writing skills for news and agricultural stories to magazines	3	80	75	M					H			L	H		H		H	H
CLO-4 :	Outline the various types of agricultural stories	3	75	70	M					H			M	H		H		H	H
CLO-5 :	Recall script writing, proof reading, Editing and lay outing	2	80	75	L					H			M	H		H		H	H

Duration (hour)		Learning Unit / Module 1	Learning Unit / Module 2	Learning Unit / Module 3	Learning Unit / Module 4	Learning Unit / Module 5
		15	9	9	9	6
S-1	SLO-1	Journalism – meaning, concepts, types, principles	Characteristics, kinds and functions of newspapers	The agricultural story	Writing the story-Organizing the material, treatment of the story.	Editorial mechanics-Copy reading-headline
	SLO-2	Scope, importance and functions.	Characteristics, kinds and functions of magazines	Types of agricultural stories	writing the news lead and the body	Title writing
S-2-3	SLO-1	Lab 1: Practice in interviewing.	Lab 6: Abstracting stories from research and scientific materials	Lab 9: Selecting pictures and artwork for the agricultural story.	Lab 12: Practice in proofreading and layouting	Lab 15: Visit to Doordarshan office
	SLO-2					
S-4	SLO-1	Elements/qualities of news, nose of news, ABC of journalism.	Characteristics of newspaper readers	Subject matter of the agricultural story	Readability measures - I	Proof reading
	SLO-2	Embedded journalism, Inverted pyramid and types of leads	Characteristics of magazine readers	Structure of the agricultural story	Readability measures - II	lay outing
S-5-6	SLO-1	Lab 2: Interview with agricultural officers	Lab 7: Abstracting stories from wire services.	Lab 10: Practice in editing	Lab 13: Testing copy with a readability formula.	Lab 16: Visit to All India Radio/ Community Radio station
	SLO-2					
S-7	SLO-1	The nature of agricultural journalism	Form and content of newspapers and magazines:	Sources of agricultural information-interviews, coverage of events, abstracting from research and scientific materials, wire services.	Illustrating agricultural stories-Use of photographs, use of artwork (graphs, charts, maps, etc.)	
	SLO-2	Scope of agricultural journalism	Style and language of newspapers and magazines, Parts of newspapers and magazines.	other agricultural news sources	writing the captions	
S-8-9	SL0-1	Lab 3: Interview with farmers	Lab 8: Writing different types of	Lab 11: Practice in copy reading and	Lab 14: Visit to a Publishing office	

	SLO-2		*agricultural stories.*	*headline and title writing*		
S-10	**SLO-1**	*Characteristics of agricultural journalist.*		-	-	
	SLO-2	*Training of the agricultural journalist.*		-	-	
S-11-12	**SLO-1**	*Lab 4: Covering agricultural events*				
	SLO-2					
S-13	**SLO-1**	*How agricultural journalism is similar to other types of journalism*		-	-	-
	SLO-2	*How agricultural journalism is different from other types of journalism*		-	-	-
S-14-15	**SLO-1**	*Lab 5: Interacting with journalist*				
	SLO-2					

Learning Resources	1. Ahuja, B.N. (1997). Theory and Practice of Journalism.New Delhi:Surjeet Publications .pp:1-150. 2. Bhaskaran C. (2008). Farm Journalism and Media Management. Jaipur:Agrotech Publishing Academy.pp:1-150. 3. Jana B.L. (2014). Agricultural Journalism. Jaipur:Agro Tech Publishing Agency.pp:1-234.	4. Singh, A.K. (2014). Agricultural Extension and Farm Journalism. India:Agrobios Publishing Academy.pp.150-240. 5. Trullinger, RW. (2018). Needed, a Profession of Agricultural Journalism 1. United kingdom:Forgotten Books publisher.pp.1-34.

Level of Thinking		Continuous Learning Assessment (35% weightage)		University Practical Examination (15%)	End semester theory Examination (50%)
		In Semester (20%)	Practical (15%)		
Level 1	**Remember**	40 %	30 %	30%	40 %
	Understand				
Level 2	**Apply**	40 %	40 %	40%	40 %
	Analyze				
Level 3	**Evaluate**	20 %	30 %	30%	20 %
	Create				
	Total	*100 %*	*100 %*	*100%*	*100 %*

Course Designers		
Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
R.Sasikala, Uzhavarin Valarum Velanmai/Community Radio Station, Coimbatore.	Dr. C. Karthikeyan, Professor & Head (Social Sciences), Agricultural College and Research Institute, TNAU, Killikulam, Vallandu Thoothukudi dt-628 252	Dr. Mohanraj K

THEORY

UNIT I Basis of Journalism and Agricultural Journalism

Journalism – meaning, concepts, types, principles, scope, importance, elements/qualities of news, nose of news, ABC of journalism, Functions of journalism, embedded journalism, Inverted pyramid,types of leads. The nature and scope of agricultural journalism. Characteristics and training of the agricultural journalist, how agricultural journalism is similar to and different from other types of journalism

UNIT II Newspapers and magazines as communication media

Characteristics, kinds and functions of newspapers and magazines, characteristics of newspaper and magazine readers. Form and content of newspapers and magazines: Style and language of newspapers and magazines, parts of newspapers and magazines.

UNIT III The Agricultural Story

Types of agricultural stories, subject matter of the agricultural story, structure of the agricultural story. Gathering agricultural information: Sources of agricultural information, interviews, coverage of events, abstracting from research and scientific materials, wire services, other agricultural news sources

UNIT IV Writing the story

Organizing the material, treatment of the story, writing the news lead and the body, readability measures. Illustrating agricultural stories: Use of photographs, use of artwork (graphs, charts, maps, etc.), writing the captions

UNIT V Writing the Story

Editorial mechanics: Copy reading, headline and title writing, proofreading, lay outing.

Theory - Lecture Schedule

1. Journalism – meaning, concepts, types, principles, scope, importance and functions
2. Elements/qualities of news, nose of news, ABC of journalism, Embedded journalism, Inverted pyramid and types of leads
3. The nature and scope of agricultural journalism
4. Characteristics and training of the agricultural journalist.
5. How agricultural journalism is similar to and different from other types of journalism.
6. Characteristics, kinds and functions of newspapers and magazines
7. Characteristics of newspaper and magazine readers
8. Form and content of newspapers and magazines: Style and language of newspapers and magazines, Parts of newspapers and magazines.
9. **In-semester Examination**
10. The agricultural story-Types of agricultural stories
11. Subject matter of the agricultural story, Structure of the agricultural story
12. Sources of agricultural information-interviews, coverage of events, abstracting from research and scientific materials, wire services, other agricultural news sources
13. Writing the story-Organizing the material, treatment of the story, writing the news lead and the body
14. Readability measures
15. Illustrating agricultural stories-Use of photographs, use of artwork (graphs, charts, maps, etc.), writing the captions
16. Editorial mechanics-Copy reading-headline and title writing
17. Proof reading, lay outing.

Practical Schedule

1. Practice in interviewing.
2. Interview with agricultural officers
3. Interview with farmers
4. Covering agricultural events.
5. Interacting with journalist
6. Abstracting stories from research and scientific materials
7. Abstracting stories from wire services.
8. Writing different types of agricultural stories.
9. Selecting pictures and artwork for the agricultural story.
10. Practice in editing
11. Practice in copy reading and headline and title writing
12. Practice in proofreading and layouting

13. Testing copy with a readability formula.
14. Visit to a Publishing office
15. Visit to Doordarshan office
16. Visit to All India Radio/ Community Radio station
17. **University practical examination**

Text Books

1. Ahuja, B.N. (1997). Theory and Practice of Journalism. New Delhi:Surjeet Publications .pp:1-150.
2. Bhaskaran C. (2008). Farm Journalism and Media Management. Jaipur: Agrotech Publishing Academy.pp:1-150.
3. Jana B.L. (2014). Agricultural Journalism. Jaipur: Agro Tech Publishing Agency.pp:1-234.

Reference Books

1. Singh, A.K. (2014). Agricultural Extension and Farm Journalism. India: Agrobios Publishing Academy.pp.150-240.
2. Trullinger, RW. (2018). Needed, a Profession of Agricultural Journalism 1. United kingdom:Forgotten Books publisher.pp.1-34.

Web References

1. The Hindu - https://www.thehindu.com/
2. The Indian Express https://indianexpress.com/
3. The Hindu (Tamil) - https://www.hindutamil.in/
4. Thinamani (Tamil) - https://www.dinamani.com/
5. https://www.youtube.com/user/PTTVOnlineNews
6. https://www.youtube.com/c/News18TamilNadu/featured
7. https://www.youtube.com/c/indiatoday/featured

Journals

1. Uzhavarin Valarum Velanmai
2. Pasumai Vikatan
3. International journal on Media Management
4. Newspaper Research journal
5. Canadian Journal of communication
6. Asian Journal of communication

Course Nature: Theory based Practical							
Total Marks (100)							
S.No.	**Category**	**Assessment Tools**					
		In- Semester Examination	Assignment	Record	Attendance	End-Semester Examination	Marks
1	Theory-External	-	-		-	*50*	*50*
2	Theory-Internal	*20*	-			-	*20*
3	Practical-External	-	-		-	*15*	*15*
4	Practical-Internal	-	*05*	*05*	*05*	-	*15*
						Grand Total	*100*

Course Code	ELC19402	Course Name	FOOD SAFETY AND STANDARDS	Course Category	E	*Elective Course*	L	T	P	C
							1	0	1	2

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Food Science & Nutrition*	Data Book / Codes/Standards	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1	*Discuss the basics of food safety*
CLR-2	*Outline the food standards of national and international level*
CLR-3	*Explain the the methods of assessing food adulteration*
CLR-4	*Explain the technical knowledge on quality criteria of food*
CLR-5	*Aoutline the on hygienic practices*
CLR-6	*Summarize the food safety management*

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning 1 Level of Thinking (Bloom)	Learning 2 Expected Proficiency (%)	Learning 3 Expected Attainment (%)	PLO 1 Agriculture Knowledge	PLO 2 Problem Analysis	PLO 3 Design & Development	PLO 4 Analysis, Design, Research	PLO 5 Modern Tool Usage	PLO 6 Society & Culture	PLO 7 Environment & Sustainability	PLO 8 Ethics	PLO 9 Individual & Team Work	PLO 10 Communication	PLO 11 Project Mgt. & Finance	PLO 12 Life Long Learning	PLO 13 Ability to solve scientific problems through Food Safety	PLO 14 Ability to implement knowledge gained in the applied field of Food Safety	PLO 15 Ability to understand social and ethical responsibilities of Food Safety
CLO1	*Identify the skills to assess food storage pertaining to safety and hygiene*	*3*	*90*	*80*	*M*								*M*	*H*		*H*	*H*	*H*	*H*
CLO2	*Outline the analysis of stored food based on food safety standards*	*1*	*95*	*85*	*H*								*L*	*H*		*H*	*H*	*H*	*H*
CLO3	*Summarize the food laws, rules and regulations*	*2*	*80*	*70*	*M*		*L*	*L*					*L*	*H*		*H*	*H*	*H*	*H*
CLO4	*Describe scientific food test as per the FSSAI standards*	*3*	*75*	*65*	*M*			*L*	*L*				*M*	*H*		*H*	*H*	*H*	*H*
CLO5	*Summarize the knowledge on health programmes*	*2*	*75*	*60*	*L*	*L*							*M*	*H*		*H*	*H*	*H*	*H*
CLO6	*Outline the food safety management tools*	*2*	*75*	*65*	*L*						*H*		*M*	*H*		*H*	*H*	*H*	*H*

Duration (hour)		Learning Unit / Module 1	Learning Unit / Module 2	Learning Unit / Module 3	Learning Unit / Module 4	Learning Unit / Module 5
		2	3	4	3	4
S-1	SLO-1	*Food quality and safety*	*Evaluation of food quality*	*General principles of hygiene*	*Physical contamination of food*	*Health programmes*
	SLO-2	*Importance and general principles*	*Method of evaluation of food*	*Hygiene relation to food preservation*	*Chemical contamination of food*	*Food safety management tools*
S-2	SLO-1	*Factors affecting food safety*	*Quality criteria of food grains and animal product*	*Food poisoning general principle*	*Microbial contamination of food*	*Total quality management concept*
	SLO-2	*Hazard and risk*	*Quality criteria of fruits and vegetables*	*Food borne intoxication and infection*	*Food adulteration*	*Risk analysis*
S-3	SLO-1	*Types of hazard*	*Quality criteria of processed foods*	*Water impurities and purification*	*Detection method of food adulteration*	*Food standard*
	SLO-2	*Management of hazard*	*Food storage technique*	*Water borne diseases*	*Destruction of microbes*	*Kosher and halal food laws*

Learning Resources	
1.	Early, R. (2010). Guide to Quality Management systems for Food Industries, Blackie Academic Publication.
2.	Radonit Lassztity. (2008). Food Quality and Standards. Encyclopedia of Life effort systems. USA.
3.	The Food Safety and Standards Act (2006) alone with Rules and Regulations. Commercial Law Publisher (India) Pvt. Ltd.

Level of Thinking		Continuous Learning Assessment (35% weightage)		University Practical Examination (15%)	End semester theory Examination **(50%)**
		In semester (20%)	Practical (15%)		
Level 1	Remember	40 %	30 %	35%	30 %
	Understand				
Level 2	Apply	40 %	40 %	35%	40 %
	Analyze				
Level 3	Evaluate	20 %	30 %	30%	30 %
	Create				
Total		*100 %*	*100 %*	*100%*	*100 %*

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Burea Veritas Indian Pvt, Ltd, F2, Thiru.Vi.Ka Industrial Estate, Phase III, Ekkattuthangal, Guidy, Chennai – 600032	Dr. UmaMaheswari T, Assistant Professor, Department of Food Science and Technology, Community Science College and Research Institute, TNAU, Madurai-625104	Dr.P. Sheela

THEORY

Unit I – Introduction to Food quality and Safety

Food quality and safety – importance and general principles. Factors affecting food safety. Hazards and risks, types of hazards – biological, chemical, physical hazards. Management of hazards – need, control of parameters, temperature control.

Unit II – Quality criteria of Foods

Evaluation of food quality – subjective and objective methods of evaluation. Quality criteria of foods – food grains, fruits, vegetables and animal foods. Quality criteria of processed foods. Food storage system.

Unit III– Hygiene, sanitation and Food borne infection

General principles of hygiene – its relation to food preparation – personal hygiene and food handling habits. Food poisoning – causes and types – control measures food borne intoxication and infection – source – effects and prevention. Water supply sources- impurities and purification of water. Water borne disease and air borne disease

Unit IV – Contaminants and adulterants in Foods

Physical, chemical and microbial contamination of foods. Food adulteration - common adulterants – health hazards. Tests to detect adulterants in food. Destruction of microbes – disinfection, physical, mechanical and chemical methods.

Unit V – Food Safety measure

Health programmes in India. Food safety management tools – GHPs, GMPs, SSOPs, HACCP, ISO series. TQM – concept and need for quality, components of TQM, Risk analysis. International Food Standards – Concept of Codex Alimentarius Commission, Food and Drug Administration (FDA). The Kosher and Halal Food Laws.

Theory - Lecture schedule

1. Food quality and safety- importance and general principles; Factors affecting food safety, hazards and types of hazards;
2. Management of hazards - need, control of parameters
3. Evaluation of food quality - subjective and objective methods of evaluation
4. Quality criteria of foods - food grains, fruits, vegetables, animal foods and processed foods
5. Food storage system and types of food storage
6. Principles of hygiene its relation to food preparation and food handling practices
7. Food poisoning - causes and types and control measures
8. Food borne intoxication and infection - source, effects and prevention
9. **In semester examination**
10. Water borne disease and air borne diseases
11. Physical, chemical and microbiological contamination of foods
12. Food adulteration - common adulterants and their detection method
13. Destruction of microbes - disinfection, physical, mechanical and chemical methods
14. Health programmes in India
15. Food safety standards
16. Total quality management system
17. The Kosher and Halal food

Practical Schedule

1. Preparation of media for microbial analysis
2. Biochemical test for identification of bacteria
3. Estimation of quality parameters of cereals and cereal products
4. Estimation of quality parameters of pulses and pulses products
5. Estimation of quality parameters of fruits and fruit products
6. Estimation of quality parameters of vegetables and vegetables products
7. Estimation of quality parameters of milk and milk product

8. Estimation of quality parameters of meat and meat product
9. Estimation of quality parameters of fish and fish product
10. Estimation of quality parameters of water quality
11. Market survey and quality analysis of processed foods
12. Detection of food adulterants in food
13. Visit to food corporation of India
14. Visit to quality control laboratory
15. Visit to food processing unit to study the role of Halal food laws in food safety
16. Visit to food processing industry to study the Hazard Analysis Critical Control Point (HACCP) concept
17. **University practical examination**

Text Books

1. Early, R, (2010). Guide to quality Management System for Food Industries , Blackie Academic Publication
2. Patricia and Curing A. (2005). An operational Text book, guide to Food Laws and Regulations. Wiley-Blackwell publisher.
3. Radonit Lassztity. (2008). Food Quality and Standards. Encyclopedia of Life effort systems. USA.
4. The Food Safety and Standards Act (2006), alone with Rules and Regulations. Commercial Law Publisher (India) Pvt. Ltd.

Reference Books

1. Srilakshmi. (2018). Food Science. 7th Edition, New age international publisher, New Delhi
2. William, C., Frazierad Dennie. C Westheff and N M Vanitha. (2013). Food Microbiology 4thEditions, Tata McGraw hill Company Limited

Web-References

1. www.fda.gov
2. www.food.gov.uk/safeeating
3. www.foodstandards.gov.uk

Journals

1. Journal of Food Quality
2. Journal of Food Science
3. Journal of Food Science and Technology

Course Nature: Theory based Practical							
Total Marks (100)							
S.No.	**Category**	**Assessment Tools**					
		In- Semester Examination	Assignment	Record	Attendance	End-Semester Examination	Marks
1	Theory-External	-	-		-	*50*	*50*
2	Theory-Internal	*20*	-			-	*20*
3	Practical-External	-	-		-	*15*	*15*
4	Practical-Internal	-	*05*	*05*	*05*	-	*15*
						Grand Total	*100*

Course Code	ELC19403	Course Name	HI-TECH. HORTICULTURE	Course Category	E	Elective Course	L	T	P	C
							1	0	1	2

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Horticulture	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1 :	Explain scope, importance of Hi tech horticulture
CLR-2 :	Describe the modern technology on mechanization in horticulture
CLR-3 :	Explain hi tech nursery management techniques
CLR-4 :	Outline the micro irrigation and fertigation system in a greenhouse
CLR-5 :	Discuss the canopy management techniques and high density planting
CLR-6 :	Describe precision farming technologies in horticulture crops

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Horticulture Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	Ability to solve scientific problems through temperate vegetables	Ability to implement knowledge gained in the applied field of temperate vegetables	Ability to understand social and ethical responsibilities of temperate vegetables
CLO-1 :	Recall modern mechanization technologies in horticulture	3	95	90	L									H		H	H	H	H
CLO-2 :	Identify canopy management technology on fruit crops	3	90	80	H				M		M		H	H		H	H	H	H
CLO-3 :	Summarize precision farming technology in horticultural crops.	2	85	80	H								M	H		H	H	H	H
CLO-4 :	Outline the maintainance of a commercial hi tech nursery	3	75	65	H	M								H		H	H	H	H
CLO-5 :	Summarize the establishment and management of high density fruit orchards	3	85	70	H	L								H		H	H	H	H
CLO-6 :	Describe and manage the protected structures	3	70	65	H	H								H		H	H	H	H

Duration (hour)		Learning Unit / Module 1	Learning Unit / Module 2	Learning Unit / Module 3	Learning Unit / Module 4	Learning Unit / Module 5
		3T+3P	2T+2P	3T+3P	3T+3P	5T+5P
S-1	SLO-1	Hi-tech horticulture – Introduction - Scope and importance	Modern field preparation methods	Protected cultivation- Advantages	Canopy management – Importance of canopy management-	Precision farming – Definition – Scope
	SLO-2	Perspectives of Hi-tech horticulture in India.	Raised bed preparation, Plastic mulching.	Types of protected structures - Glass house, poly house, rain shelters, poly tunnels, hotbeds and cold flames, shade nets	Principles of canopy management.	Status of precision farming in India-
S-2-3	SLO-1	**LAB -** Study of types of polyhouses.	**LAB -** Identification and application of tools and equipments	**LAB -** Estimation of E C and pH of soil and water	**LAB -** Pest and disease management in protected cultivation.	**LAB -** Canopy management in Guava.
	SLO-2					
S-4	SLO-1	Nursery management, Quality control of planting material, Plastics in nursery management	Modern planting methods – Container planting	Greenhouse – Advantages- Controlled conditions – Light, Humidity, Temperature, CO2 -	Tools of canopy management (Rootstocks, plant density, training and pruning)	Components of precision farming.
	SLO-2	Advantages of plant propagation under greenhouses (Hi-tech nursery).	Soil less culture – Hydroponics, aerophonics.	Ventilation and cooling in a green house	Tools of canopy management (nutrient management, growth retardants etc.).	Components of precision farming.
S-5-6	SLO-1	**LAB -** Study of shade net houses	**LAB -** Study of micro-irrigation system and its components	**LAB -** Fertilizer scheduling	**LAB -** Nursery raising in portrays.	**LAB -** Canopy management in Grapes
	SLO-2					
S-7	SLO-1	Mechanization – Importance of mechanization	-	Naturally ventilated, fan and pad cooling,	High Density orcharding – Concept – HDP systems – Components of HDP	Precision farming – Applications of precision farming in horticultural crops (fruits)
	SLO-2	Mechanization of nursery, sowing and transplanting	-	Forced air cooling	Impact of HDP- Advantages- Constraints in HDP.	Applications of precision farming in horticultural crops (vegetables and ornamental crops).

S-8-9	**SLO-1** **SLO-2**	***LAB -*** *Study of Soil less culture*	-	***LAB -*** *Nutrient management techniques in protected cultivation*	***LAB -*** *Canopy management in Mango*	***LAB -*** *Visit to Hi-Tech orchard*
S-10	**SLO-1**	Micro - irrigation, EC, pH based fertilizer scheduling, fertigation	-	-	-	*Mechanized harvesting of produce – Advantages and disadvantages of mechanical harvesting*
	SLO-2	Pest and disease control, weed control, harvesting.	-	-	-	*Mechanical harvesters developed for different horticultural crops.*
S-11-12	**SLO-1**	***LAB -*** *Intercultural operations in Hi – tech horticulture*	-	-	-	***LAB -****. Visit to Hi-Tech nursery.*
	SLO-2			-	-	

Learning Resources	1. Dashora, L.K., Jitendar Singh and S.K. Jain. (2013). Precision Farming in Horticulture. New India Publishing Agency. pp 1-382 2. Kumar, N. (2020). Introduction to Horticulture. Oxford & I.B.H. Publishing, New Delhi. pp 1-452

Level of Thinking		Continuous Learning Assessment (35% weightage)		University Practical Examination (15%)	End semester theory Examination **(50%)**
		In Semester (20%)	Practical (15%)		
Level 1	**Remember** **Understand**	60 %	50 %	50 %	60 %
Level 2	**Apply** **Analyze**	25 %	30 %	30 %	30 %
Level 3	**Evaluate** **Create**	15 %	20 %	20 %	10 %
	Total	*100 %*	*100 %*	*100%*	*100 %*

Course Designers		
Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
-	-	Dr. B. Gopu Mr. Harish. A

THEORY

Unit I Introduction

Hi-tech horticulture – Introduction - Scope and importance – Perspectives of Hi-tech horticulture in India. Nursery management – Quality control of planting material- Plastics in nursery management. Advantages of plant propagation under greenhouses (Hi-tech nursery). Mechanization – Importance of mechanization in Hi-tech horticulture - Mechanization of nursery, sowing and transplanting, plastic mulching, Micro - irrigation, EC, pH based fertilizer scheduling, fertigation, pest and disease control, weed control, harvesting

Unit II Hi-tech Cultivation

Modern field preparation methods – Raised bed preparation – Plastic mulching. Modern planting methods – Container planting - Soil less culture – Hydroponics, aerophonics.

Unit III Protected Cultivation

Protected cultivation- Advantages- Types of protected structures - Glass house, poly house, rain shelters, poly tunnels, hotbeds and cold flames, shade nets etc. Greenhouse – Advantages- Controlled conditions – Light, Humidity, Temperature, CO2 - Ventilation and cooling in a greenhouse - Naturally ventilated, fan and pad cooling, forced air cooling.

Unit IV HDP and Canopy Management

Canopy management – Importance of canopy management- principles of canopy management – Tools of canopy management (Rootstocks, plant density, training and pruning, nutrient management, growth retardants etc.). High Density orcharding – Concept – HDP systems – Impact of HDP- Advantages- Constraints in HDP.

Unit V Precision Farming

Precision farming – Definition – Scope and status of precision farming in India - Components of precision farming. Application of precision farming in horticultural crops (fruits, vegetables and ornamental crops); mechanized harvesting of produce.

THEORY –LECTURE SCHEDULE

1. Hi-tech horticulture – Introduction - Scope and importance – Perspectives of Hi-tech horticulture in India.
2. Nursery management – Quality control of planting material- Plastics in nursery management – Advantages of plant propagation under greenhouses (Hi-tech nursery).
3. Mechanization – Importance of mechanization in Hi-tech horticulture – Mechanization of nursery, sowing and transplanting, plastic mulching
4. Micro - irrigation, EC, pH based fertilizer scheduling, fertigation, pest and disease control, weed control, harvesting.
5. Modern field preparation methods – Raised bed preparation – Plastic mulching.
6. Modern planting methods – Container planting - Soil less culture – Hydroponics, aerophonics.
7. Protected cultivation- Advantages- Types of protected structures - Glass house, poly house, rain shelters, poly tunnels, hotbeds and cold flames, shade nets etc.
8. Greenhouse – Advantages- Controlled conditions – Light, Humidity, Temperature, CO2 - Ventilation and cooling in a green house
9. **In - Semester examination**
10. Naturally ventilated, fan and pad cooling, forced air cooling.
11. Canopy management – Importance of canopy management- principles of canopy management.
12. Tools of canopy management (Rootstocks, plant density, training and pruning, nutrient management, growth retardants etc.).
13. High Density orcharding – Concept – HDP systems – Components of HDP (use of genetically dwarf scion cultivars, dwarf rootstocks, pruning and training, use of growth retardants, induction of viral infection, use of incompatible rootstocks etc.) – Impact of HDP- Advantages- Constraints in HDP.
14. Precision farming – Definition – Scope and status of precision farming in India
15. Components of precision farming.
16. Precision farming – Applications of precision farming in horticultural crops (fruits, vegetables and ornamental crops).
17. Mechanized harvesting of produce – Advantages and disadvantages of mechanical harvesting - Mechanical harvesters developed for different horticultural crops.

Practical Schedule

1. Study of types of polyhouses.
2. Study of shade net houses
3. Study of Soil less culture
4. Intercultural operations in Hi – tech horticulture.
5. Identification and application of tools and equipments

6. Study of micro-irrigation system and its components
7. Estimation of EC and pH of soil and water
8. Fertilizer scheduling
9. Nutrient management techniques in protected cultivation
10. Pest and disease management in protected cultivation
11. Nursery raising in portrays.
12. Canopy management in Mango
13. Canopy management in Guava
14. Canopy management in Grapes
15. Visit to Hi-Tech orchard.
16. Visit to Hi-Tech nursery.
17. **University Practical Examination**

Text Books

1. Dashora, L.K., Jitendar Singh and S.K. Jain. (2013). Precision Farming in Horticulture. New India Publishing Agency. pp 1-382
2. Kumar, N. (2020). Introduction to Horticulture. Oxford & I.B.H. Publishing, New Delhi. pp 1-452
3. Prasad, S. And Kumar, U. (2012). Greenhouse Management of Horticultural Crops. 2nd edition, Agribios publishers, New Delhi. pp 1-520
4. Srivasthava, K.K. (2007). Canopy Management of Fruit Crops. International book distributing co., Lucknow. pp 1-95

Reference Books

1. Chadha, K.L. (2019). Handbook of Horticulture. Vol. II (2nd revised edition) ICAR, New Delhi. pp 1-299
2. Dhillon W.S. (2013). Fruit production in India. Narendra Publishing House, Delhi. pp 1-678

Web-References

1. http://ecourses.iasri.res.in
2. http://agritech.tnau.ac.in/horticulture/horti_fruits.html
3. http://www.ishs.org

Journals

1. Indian Journal of Horticulture
2. Indian Horticulture
3. Journal of Horticultural Sciences
4. Journal of the American Society for Horticultural Science
5. HortScience
6. HortTechnolgy
7. Acta Horticulturae

Course Nature: Theory based Practical							
Total Marks (100)							
S.No.	**Category**	**Assessment Tools**					
		In- Semester Examination	Assignment	Record	Attendance	End-Semester Examination	Marks
1	Theory-External	-	-		-	*50*	*50*
2	Theory-Internal	*20*	-			-	*20*
3	Practical-External	-	-		-	*15*	*15*
4	Practical-Internal	-	*05*	*05*	*05*	-	*15*
						Grand Total	*100*

Course Code	PHE19401	Course Name	HUMAN VALUES AND ETHICS	Course Category	NG	Extension Activity-Non- Gradial	L	T	P	C
							0	0	0	0

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department		Physical and Health Education	Data Book / Codes/Standards		Nil

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1 :	Process of dialog within themselves to know what they 'really want to be' in their life and profession
CLR-2 :	The meaning of happiness and prosperity for a human being.
CLR-3 :	Harmony at all the levels of human living, and live accordingly.
CLR-4 :	the understanding of harmony in existence in their profession and lead an ethical life
CLR-5 :	
CLR-6 :	

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning 1 Level of Thinking (Bloom)	Learning 2 Expected Proficiency (%)	Learning 3 Expected Attainment (%)	PLO 1 Horticulture Knowledge	PLO 2 Problem Analysis	PLO 3 Design & Development	PLO 4 Analysis, Design, Research	PLO 5 Modern Tool Usage	PLO 6 Society & Culture	PLO 7 Environment & Sustainability	PLO 8 Ethics	PLO 9 Individual & Team Work	PLO 10 Communication	PLO 11 Project Mgt. & Finance	PLO 12 Life Long Learning	PLO 13 Ability to become a enterpreuner in the field of Floriculture	PLO 14 Ability to establish a garden	PLO 15 Ability to produce value added products from the commercial flowers
CLO-1 :	The significance of value inputs in a classroom and start applying them in their life and profession	1	95	85		H				H		H	H	M		H			
CLO-2 :	Distinguish between values and skills, happiness and accumulation of physical facilities, the Self and the Body, Intention and Competence of an individual, etc.	2	80	75		H				H		H	H	M		H			
CLO-3 :	The value of harmonious relationship based on trust and respect in their life and profession	3	80	86		M				H		H	H	H		H			
CLO-4 :	The role of a human being in ensuring harmony in society and nature.	3	75	85		M	H			H		H	M	H		H			
CLO-5 :	Ethical and unethical practices, and start working out the strategy to actualize a harmonious environment wherever they work.	2	80	75		H	H			H		H	H	H		H			
CLO6 :																			

Duration (hour)		Learning Unit / Module 1	Learning Unit / Module 2	Learning Unit / Module 3	Learning Unit / Module 4	Learning Unit / Module 5
		3	3	4	3	3
S-1	SLO-1	Basic guidelines, content and process	Co-existence	Harmony in the family	Harmony in nature	Ethical Human Conduct
	SLO-2	Natural acceptance & experiential Validation	Self and body	Human –Human relationship	Recyclability and self-regulation in nature	Professional Ethics
S-2	SLO-1	Happiness and Harmony	Sanyam and Swasthya	Trust and Respect	Existence as Co-existence	Case study of management, system & organization
	SLO-2	Understanding relationships	Characteristics and Activities	Intention and Competence- Difference	Holistic perception of harmony	-
S-3	SLO-1	Human Aspirations	Harmony with the body	Meaning of Samman	-	-
	SLO-2	Moral and Human Values	Activities of 'I' and harmony in 'I'	Harmony in the society	-	-
S-4	SLO-1	Responsibility and Rights		Universal order – society wisdom	-	-
	SLO-2	-	-	-	-	-

Learning Resources	1. R R Gaur, R Sangal, G P Bagaria, 2009, A Foundation Course in Human Values and Professional Ethics.

Level of Thinking		Continuous Learning Assessment (50% weightage)		End semester Theory Examination (50%)
		In Semester (40%)	Theory internal (10%)	
Level 1	**Remember**	40 %	40 %	30 %
	Understand			
Level 2	**Apply**	40 %	40 %	40 %
	Analyze			
Level 3	**Evaluate**	20 %	20 %	30 %
	Create			
Total		*100 %*	*100%*	*100 %*

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
-	-	

Unit - I:

Course Introduction - Need, basic Guidelines, Content and Process for Value Education: Understanding the need, basic guidelines, content and process for Value Education. Self Exploration - what is it? - its content and process; 'Natural Acceptance' and Experiential Validation - as the mechanism for self exploration. Continuous Happiness and Prosperity - A look at basic Human Aspirations.Right understanding, Relationship and Physical Facilities - the basic requirements for fulfillment of aspirations of every human being with their correct priority.Understanding Happiness and Prosperity correctly - A critical appraisal of the current scenario. Method to fulfill the above human aspirations: understanding and living in harmony at various levels.

Unit - II:

Harmony in the Human Being - Harmony in Myself! : Understanding human being as a co- existence of the sentient 'I' and the material 'Body'. Understanding the needs of Self ('I') and 'Body' - Sukh andSuvidha. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer). Understanding the harmony of I with the Body: Sanyam and Swasthya; correct appraisal of Physical needs, meaning of Prosperity in detail. Programs to ensure Sanyam and Swasthya.

Unit - III:

Harmony in the Family and Society - Harmony in Human - Human Relationship: Understanding harmony in the Family the basic unit of human interaction. Understanding values in human - human relationship; meaning of Nyayaand program for its fulfillment to ensure Ubhay-tripti; Trust (Vishwas) and Respect (Samman) as the foundational values of relationship. Understanding the meaning of Vishwas; Difference between intention and competence. Understanding the meaning of Samman, Difference between respect and differentiation; the other salient values in relationship. Understanding the harmony in the society (society being an extension of family): Samadhan, Samridhi, Abhay, Sah-astiva as comprehensive Human Goals. Visualizing a universal harmonious order in society - Undivided Society (AkhandSamaj), Universal Order (Sarvabhaum Vyawastha) - from family to worldfamily!

Unit - IV:

Harmony in the nature and Existence - Whole existence as Co- existence: Understanding the harmony in the Nature. Interconnectedness and mutual fulfillment among the four orders of nature - recyclability and self-regulation in nature.Understanding Existence as Co-existence (Sah-astiva) of mutually interacting units in all-pervasive space. Holistic perception of harmony at all levels of existence.

Unit - V:

Implications of the above Holistic Understanding of Harmony on Professional Ethics: Natural acceptance of human values, Definitiveness of Ethical Human Conduct, Basic for Humanistic Education, Humanistic Constitution and Humanistic Universal Order Competence inprofessionalethics:

a. Ability to utilize the professional competence for augmenting universal humanorder,
b. Ability to identify the scope and characteristics of people-friendly andeco-friendly productionsystems,
c. Ability to identify and develop appropriate techologies and management patternsfor above productionsystems.

Case studies of typical holistic technologies, management models and production systems. Strategy for transition from the present state to Universal Human Order.

a. At the level of individual: as socially and ecologically responsibleengineers, technologists andmanagers
b. At the level of society: as mutually enriching institutions andorganizations.

Text Books:

a. R. R. Gaur, R Sangal, G P Bagaria, 2009, A Foundation Course in Human Valuesand ProfessionalEthics.
b. Prof. K. V. SubbaRaju, 2013, Success Secrets for Engineering Students, Smart Student Publications, 3rdEdition.

Reference Books

1. Ivan Illich,1974,Energy & Equity,The Trinity Press,Worcester, and HarperCollins, USA,67-90
2. E. F. Schumancher, 1973, Smallis Beautiful: a study of economics as if people mattered. Blond & Briggs, Britain,156-190
3. A Nagraj, 1998 JeevanVidyaekParichay, Divya Path Sansthan, Amarkantak,120-145
4. Sussan George, 1976, How the Other Half Dies, Penguin Press, New Delhi,241-250
5. P. L. Dhar, R. R. Gaur, 1990, Science and Humanism, Commonwealth Publishers.
6. A. N. Tripathy, 2003, Human Values, New Age International Publishers, Kolkatta, 25-90
7. SubhasPalekar, 2000, How to practice Natural Farming, Pracheen(Vaidik) KrishiTantraShodh, Amravati,34-89
8. Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, Limits to Growth - Club of Rome's report, Universe Books, London,67-130

9. E G Seebauer& Robert L.Berry, 2000, Fundamentals of Ethics for Scientists &Engineers, Oxford University Press, London,145-180
10. M Govindrajan, S Natrajan& V. S Senthilkumar, Engineering Ethics (includingHumna Values), Eastern Economy Edition, Prentice Hall of India Ltd,127-160

Course Nature: Only Theory							
Total Marks (100)							
S. No.	**Category**	**Assessment Tools**					
		In- Semester Examination	Assignment	Record	Attendance	End-Semester Examination	Marks
1	Theory-External	-	-		-	*50*	*50*
2	Theory-Internal	*40*	*05*	-	*05*	-	*50*
						Grand Total	*100*

Course Code	NRM19501	Course Name	MANURES, FERTILIZERS AND SOIL FERTILITY MANAGEMENT	Course Category	C	Compulsory Course	L	T	P	C
							2	0	1	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Soil Science	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1 :	Identify the nutrient deficiency symptoms in plants and soil
CLR-2 :	Describe the chemistry of essential nutrients
CLR-3 :	Explain Chemical fertilizer manufacturing process and application methodology
CLR-4 :	Outline the Importance of organic manures in maintaining soil fertility
CLR-5 :	Demonstrate soil health management practices in the field

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Agriculture knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	Ability to solve scientific problems through Soil science	Ability to implement knowledge gained in the applied field of Soil science	Ability to understand social and ethical responsibilities of Soil science
CLO-1 :	List out the essential nutrients	1	85	75	H			H			H		M	H		H	H	H	H
CLO-2 :	Outline the importance of nutrients in plant growth	1	80	70	H			H					L	H		H	H	H	H
CLO-3 :	Explain the nutrient transformations in different soil conditions	2	80	70	M		M	M			H		L	H		H	H	H	H
CLO-4 :	Calculate the fertilizer doses	3	85	75	M			H					M	H		H	H	H	H
CLO-5 :	Demonstrate soil health management practices	3	85	80	M								M	H		H	H	H	H

Duration (hour)		Learning Unit / Module 1	Learning Unit / Module 2	Learning Unit / Module 3	Learning Unit / Module 4	Learning Unit / Module 5
		3	7	8	3	12
S-1	SLO-1	Soil fertility and productivity: definition	Nitrogen: Sources and forms	Chemical fertilizers	Organic manures	Soil fertility evaluation
	SLO-2	Criteria of essentiality	Transformations	Classification and composition	Classification and importance	Nutrient mobility
S-2	SLO-1	Essential nutrients: role	Phosphorous: Sources and forms	Nitrogen fertilizers	Bulky and concentrated manures	DRIS approach
	SLO-2	Deficiency and toxicity symptoms	Transformations	Properties and manufacturing	Methods of preparation	Uses
S-3,4	SLO-1	**Lab.1.** Preparation of analytical reagents and standardization	**Lab.2.** Estimation of soil organic carbon	**Lab. 6.** Estimation of available Ca, Mg in soil	**Lab.10.** Estimation of P and K in plant sample	**Lab.12.** Estimation of ammoniacal and nitrate N
	SLO-2					
S-5	SLO-1	Mechanism of nutrient transport	Potassium: Sources and forms	Phosphatic fertilizers	Green manuring and Green leaf manuring	Soil testing, rapid tests
	SLO-2	Factors affecting nutrient transport	Transformations	Properties and manufacturing	Compost and composting	Indicator plants
S-6	SLO-1	-	Ca, Mg, S: Sources and forms	Potassic fertilizers	**Lab.11.** Estimation of N in fertilizer/manure samples	Nutrient use efficiency
	SLO-2	-	Transformations	Properties and manufacturing		Nutrient budgeting
S-7,8	SLO-1	-	**Lab.3.** Estimation of available N	**Lab. 7.** Estimation of available S in soil		**Lab.13.** Estimation of water soluble P in fertilizer/manure samples
	SLO-2					
S-9	SLO-1	-	Micronutrients: Sources and forms	Secondary and micronutrient fertilizers	-	INM
	SLO-2	-	Transformations	Properties and manufacturing processes	-	Uses
S-10	SLO-1	-	Waterlogged soils	Complex and nano-fertilizers	-	STCR
	SLO-2	-	Transformations	Properties and manufacturing processes	-	Uses
S-11,12	SLO-1	-	**Lab.4.** Estimation of available P in soil	**Lab.8.** Estimation of soil micronutrients	-	**Lab.14.** Estimation of K in fertilizer/manure samples
	SLO-2					
S - 13	SLO-1	-	Nutrient interactions	Bio-fertilizers: definition	-	IPNS
	SLO-2	-	Critical level of different soil nutrients	Classification and importance	-	Uses
S - 14	SLO-1	-	**Lab.5.** Estimation of available K in soil	Fertilizer storage	-	SSNM

	SLO-2	-		*Fertilizer control order*	-	*Uses*
S–15, 16	**SLO-1**	-	-	***Lab.9.** Estimation of N content in plants*	-	***Lab.15.** Soil test based fertilizer prescriptions*
	SLO-2	-	-		-	
S-17	**SLO-1**	-	-	-	-	*RTNM*
	SLO-2	-	-	-	-	*Uses*
S-18	**SLO-1**	-	-	-	-	*PME*
	SLO-2	-	-	-	-	*LTFE*
S-19,20	**SLO-1**	-	-	-	-	***Lab.16.** Visit to STL*
	SLO-2	-	-	-	-	
S-21	**SLO-1**	-	-	-	-	*Fertilizer recommendation approaches*
	SLO-2	-	-	-	-	*Models*
S-22	**SLO-1**	-	-	-	-	*Fertilizer application: rainfed condition*
	SLO-2	-	-	-	-	*Fertilizer application: irrigated condition*

Learning Resources	1. Brady, N.C and Raymond C.W. (2013). The nature and properties of soils (15th ed.). Pearson Education. pp. 1 - 1035..	2. Biswas, T.D and Mukherjee S.K. (2017). Textbook of soil science (2nd ed.). New Delhi: Tata McGraw Hill Publishing Co.Ltd . pp. 1 - 433.

Level of Thinking		Continuous Learning Assessment (35% weightage)		University Practical Examination (15%)	End semester theory Examination **(50%)**
		In semester (20%)	Practical (15%)		
Level 1	**Remember**	40 %	30 %	35 %	30 %
	Understand				
Level 2	**Apply**	40 %	40 %	35 %	40 %
	Analyze				
Level 3	**Evaluate**	20 %	30 %	30 %	30 %
	Create				
	Total	*100 %*	*100 %*	*100 %*	*100 %*

Course Designers		
Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
Dr.Joshwa Fenn Suresh Proprietor Naruveli , CMDA Industrial Estate, Maraimalai Nagar-603209	Dr.T.Chikkaramappa Professor, Dept.of Soil Science UAS,GKVK,Bnagalore-560065 Karnataka	Dr. S.N.CHIKKARAJU Dr. R. ANGELIN SILVIYA

THEORY

Unit I – Soil Fertility and Productivity
Soil fertility and productivity; History of soil fertility and plant nutrition; Criteria of essentiality; Essential nutrients: role, deficiency and toxicity symptoms; Mechanism of nutrient transport to plant, factors affecting nutrient availability to plants.

Unit II - Nutrient Dynamics
Chemistry of soil nitrogen, phosphorus, potassium, calcium, magnesium, sulphur and micronutrients. Nutrient transformations in waterlogged soils; Nutrient interactions; Critical levels of different nutrients in soil.

Unit III – Fertilizers
Chemical fertilizers: classification, composition and properties of major nitrogenous, phosphatic, potassic fertilizers, secondary and micronutrient fertilizers, complex fertilizers, Nano-fertilizers; Bio-fertilizers; Manufacturing processes; Soil amendments; Fertilizer storage; Fertilizer control order.

Unit IV – Organic Manures
Organic manures: Introduction, classification, importance of organic manures, properties, and methods of preparation of bulky and concentrated manures. Green manuring and green leaf manuring; Compost and composting.

Unit V - Nutrient Management
Soil fertility evaluation; DRIS approach; Soil testing, rapid plant tissue test, indicator plants; Nutrient use efficiency and nutrient budgeting; Nutrient management concepts: INM, STCR, IPNS, SSNM and RTNM; Permanent Manurial Experiments, Long Term Fertilizer Experiments; Fertilizer recommendation approaches; Methods of fertilizer recommendation to crops: Fertilizer recommendation models and crop growth models; Method of fertilizer application in rainfed and irrigated conditions

Theory – Lecture Schedule
1. Soil fertility and productivity; History of soil fertility and plant nutrition; Criteria of essentiality.
2. Essential nutrients: role, deficiency and toxicity symptoms.
3. Mechanism of nutrient transport to plants and factors affecting.
4. Sources, forms, mobility, transformation, fixation, losses and availability of soil N.
5. Sources, forms, mobility, transformation, fixation, losses and availability of soil P.
6. Sources, forms, mobility, transformation, fixation, losses and availability of soil K.
7. Sources, forms, mobility, transformation, fixation, losses and availability of soil Ca, Mg, S.
8. Sources, forms, mobility, transformation, fixation, losses and availability of soil Micronutrients.
9. Nutrient transformations in waterlogged soils.
10. Nutrient interactions; Critical level of different nutrients in soil.
11. Chemical fertilizers: classification and composition.
12. Properties and manufacturing process of nitrogen fertilizers (Urea, ammonium sulphate, ammonium nitrate and CAN); its reaction in soil.
13. Properties and manufacturing processes of phosphatic fertilizers (Rock phosphate, SSP, DAP, TAP, basic slag); its reaction in soil.
14. Properties and manufacturing processes of potassic fertilizers (MOP, SOP); its reaction in soil.
15. Secondary and micronutrient fertilizers: properties and manufacturing process.
16. Complex and Nano fertilizers: definition, properties and manufacturing processes.
17. **In-semester Examination**
18. Bio-fertilizers: definition, classification and importance.
19. Soil amendments; Fertilizer storage; Fertilizer control order.
20. Organic manures: Introduction, classification, properties and importance.
21. Methods of preparation of bulky and concentrated manures.
22. Green manuring and green leaf manuring; Compost and composting.
23. Soil fertility evaluation: Liebig's law, Mitscherlich's law, Brays nutrient mobility concept.
24. Soil fertility evaluation: DRIS approach
25. Soil testing, rapid plant tissue test, indicator plants: importance.
26. Nutrient use efficiency and nutrient budgeting.

27. Nutrient management concepts: INM
28. Nutrient management concepts: STCR
29. Nutrient management concepts: IPNS
30. Nutrient management concepts: SSNM
31. Nutrient management concepts: RTNM
32. PME and LTFE
33. Fertilizer recommendation approaches; Fertilizer recommendation models and crop growth models
34. Method of fertilizer applications in rainfed and irrigated conditions

Practical Schedule

1. Preparation of analytical reagents and standardization.
2. Estimation of soil organic carbon
3. Estimation of alkaline $KMnO_4$ N in soil (available N).
4. Estimation of Olsen P and Bray P in soil (available P).
5. Estimation of Neutral Normal NH_4OAc K in soil (available K).
6. Estimation of available Ca and Mg in soil.
7. Estimation of available S in soil.
8. Estimation of micronutrients in soil (DTPA extractable) and plants.
9. Estimation of N content in plant sample.
10. Estimation of P and K content in plant sample.
11. Estimation of N in urea and FYM / Compost.
12. Estimation of ammoniacal and nitrate N in ammonium nitrate.
13. Estimation of water-soluble P in SSP/FYM/compost.
14. Estimation of K in KCl and K_2SO/FYM/Compost.
15. Soil test-based fertilizer prescriptions.
16. Visit to soil, plant, water and fertilizer testing laboratory.
17. **University practical examination**.

Textbooks

1. Biswas, T.D. and Mukherjee S.K. (2017). Textbook of Soil Science (2nd ed.). New Delhi: Tata McGraw Hill Publishing Co. Ltd. pp. 1 - 433.
2. Chopra, S.C and Kanwar J.S. (2014). Analytical Agricultural Chemistry. Ludhiana, Kalyani publishers.
3. Das, D.K. (2015). Introductory Soil Science (4th ed.). Ludhiana: Kalyani Publisher.
4. Indian Society of Soil Science. (2012). Fundamentals of Soil Science (2nd ed.). New Delhi: ISSS, IARI.
5. Brady, N.C. and Raymond, C. W. (2013).The Nature and Properties of Soils (15th ed.). Pearson Education. pp. 1 - 1035.

Reference books

1. Epstein, E. and Bloom, A.J. (2005). Mineral Nutrition of Plants: Principles and perspectives (2nd ed.). Sinauer Associates, Sunderland, MA. pp. 1 - 380.
2. Jackson, M.L. (2012). Soil chemical analysis: Advanced course, Scientific Publisher.
3. John, L. H., Beaton J.D, Tisdale S.L and Nelson W.L. (2016). Soil Fertility and Fertilizers - An Introduction to Nutrient Management. (2nd ed.). New Delhi, PHL Learning Pvt. Ltd. pp. 1 - 433.
4. Tan K.H. (2018). Principles of Soil Chemistry, Special Indian edition (4th ed.). Taylor & Francis.
5. Mengel, K and Kirkby, E.A. (2001). Principles of Plant Nutrition (5th ed.). Springer. pp. 1 - 849.

Web-references

1. https://www.usda.gov/
2. https://www.springer.com/gp/environmental-sciences/soil-science
3. https://www.soils.org.uk/students
4. https://youtu.be/zrjL5J_U1iE
5. https://youtu.be/OcEuG-NzmqQ

Journals

1. Journal of the Indian Society of Soil Science (ISSS)
2. Soil Science and Plant Nutrition
3. International journal of Plant and Soil Sciences
4. Journal of soil and water conservation
5. Journal of soils and crops

Course Nature: Theory based Practical							
Total Marks (100)							
S.No.	**Category**	**Assessment Tools**					
		In- Semester Examination	Assignment	Record	Attendance	End-Semester Examination	Marks
1	Theory-External	-	-		-	*50*	*50*
2	Theory-Internal	*20*	-			-	*20*
3	Practical-External	-	-		-	*15*	*15*
4	Practical-Internal	-	*05*	*05*	*05*	-	*15*
						Grand Total	*100*

Course Code	CRH19501	Course Name	DISEASES OF FIELD AND HORTICULTURAL CROPS AND THEIR MANAGEMENT -I	Course Category	C	*Compulsory Course*	L	T	P	C
							2	0	1	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*CRH19601*
Course Offering Department	*Plant Pathology*	Data Book / Codes/Standards	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1 :	*Understanding the symptoms of diseases in field and Horticultural Crops*
CLR-2 :	*Knowledge about the host pathogen interaction*
CLR-3 :	*Relate the role of environmental factors in disease development*
CLR-4 :	*Understanding the survival and mode of spread of a pathogen*
CLR-5 :	*Recognize Integrated disease management*
CLR-6 :	-

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Agriculture Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	Ability to solve scientific problems	Ability to implement knowledge gained in the applied field	Ability to understand social and ethical responsibilities
CLO-1 :	*Identify and interpret different crop related issues*	*2*	*90*	*75*	*M*	*M*		*M*					*M*	*H*		*H*	*H*	*H*	*H*
CLO-2 :	*Correlate host parasite relationship for different crops*	*2*	*85*	*70*	*M*	*L*	*M*	*L*					*H*	*H*		*H*	*H*	*H*	*H*
CLO-3 :	*Identify the causal organisms of the disease*	*1*	*95*	*70*	*M*	*M*							*M*	*H*		*H*	*H*	*H*	*H*
CLO-4 :	*Relate the abiotic factors responsible for the development of disease development*	*2*	*80*	*65*	*L*			*L*					*L*	*H*		*H*	*H*	*H*	*H*
CLO-5 :	*Identify different approaches for the management of diseases*	*1*	*85*	*70*	*M*	*L*					*M*		*M*	*H*		*H*	*H*	*H*	*H*
CLO6 :	*Employ their knowledge as a potential etrepreuner*	*3*	*75*	*65*	*L*								*L*	*H*		*H*	*H*	*H*	*H*

Duration (hour)		Learning Unit / Module 1	Learning Unit / Module 2	Learning Unit / Module 3	Learning Unit / Module 4	Learning Unit / Module 5
		12	10	12	12	19
S-1	SLO-1	*Disease symptoms - Rice*	*Disease symptoms – Pigeon pea*	*Disease symptoms – Tobacco*	*Disease symptoms – Crucifers*	*Disease symptoms – Coconut*
	SLO-2	*Epidemiology and IDM in Rice*	*Epidemiology and IDM in Pigeon pea*	*Epidemiology and IDM in tobacco*	*Epidemiology and IDM in crucifers*	*Epidemiology and IDM in coconut*
S-2	SLO-1	*Disease symptoms in Rice*	*Disease symptoms – Urd bean, mung bean, cowpea*	*Disease symptoms – Jute & mulberry*	*Disease symptoms – Tomato*	*Disease symptoms – Arecanut & oilpalm*
	SLO-2	*Epidemiology and IDM in Rice*	*Epidemiology and IDM in urd bean, mung bean, cowpea*	*Epidemiology and IDM in jute & mulberry*	*Epidemiology and IDM in tomato*	*Epidemiology and IDM in arecanut & oilpalm*
S 3-4	SLO-1	***Lab1:*** *Symptomology, host parasite relationship and IDM - Rice*	***Lab4:*** *Symptomology, host parasite relationship and IDM - Pulses*	***Lab6:*** *Symptomology, host parasite relationship and IDM – Tobacco, jute, mulberry*	***Lab9:*** *Symptomology, host parasite relationship and IDM – Crucifers*	***Lab12:*** *Symptomology, host parasite relationship and IDM – Coconut, arecanut, oilpalm, and vanilla*
	SLO-2					
S-5	SLO-1	*Disease symptoms - Maize*	*Disease symptoms – Soybean*	*Disease symptoms – Banana*	*Disease symptoms – Brinjal*	*Disease symptoms – Vanilla*
	SLO-2	*Epidemiology and IDM in Maize*	*Epidemiology and IDM in soybean*	*Epidemiology and IDM in Banana*	*Epidemiology and IDM in brinjal*	*Epidemiology and IDM in vanilla*
S-6	SLO-1	*Disease symptoms - Sorghum*	*Disease symptoms – Groundnut*	*Disease symptoms – Guava, papaya & sapota*	*Disease symptoms – Okra*	*Disease symptoms – Tea*
	SLO-2	*Epidemiology and IDM in Sorghum*	*Epidemiology and IDM in groundnut*	*Epidemiology and IDM in guava, papaya & sapota*	*Epidemiology and IDM in okra*	*Epidemiology and IDM in tea*
S 7-8	SLO-1	***Lab2:*** *Symptomology, host parasite relationship and IDM - Maize & sorghum*	***Lab5:*** *Symptomology, host parasite relationship and IDM – Oilseeds*	***Lab7:*** *Symptomology, host parasite relationship and IDM – Banana, guava, papaya, sapota*	***Lab10:*** *Symptomology, host parasite relationship and IDM – Tomato, brinjal & okra*	***Lab13:*** *Symptomology, host parasite relationship and IDM – Tea & coffee*
	SLO-2					
S-9	SLO-1	*Disease symptoms – Pearl millet & finger millet*	*Disease symptoms – Sesamum & castor*	*Disease symptoms – Pomegranate & pineapple*	*Disease symptoms – Sweet potato, beans & peas*	*Disease symptoms – Coffee*

	SLO-2	*Epidemiology and IDM in Pearl millet & finger millet*	*Epidemiology and IDM in sesamum & castor*	*Epidemiology and IDM in pomegranate & pineapple*	*Epidemiology and IDM in sweet potato, beans & peas*	*Epidemiology and IDM in coffee*
S 10	**SLO-1**	*Disease symptoms – Small millet*	*Diseases of stored grains*	*Disease symptoms – Jackfruit, ber & aonla*	*Disease symptoms – Carrot & beetroot*	*Disease symptoms – Rubber*
	SLO-2	*Epidemiology and IDM in small millets*	*Management*	*Epidemiology and IDM in jackfruit, ber & aonla*	*Epidemiology and IDM in carrot & beetroot*	*Epidemiology and IDM in rubber*
S 11-12	**SLO-1**	***Lab3:*** *Symptomology, host parasite relationship and IDM – Millets*	-	***Lab8:*** *Symptomology, host parasite relationship and IDM – Pomegranate, pineapple, jack fruit, ber and aonla*	***Lab11:*** *Symptomology, host parasite relationship and IDM – Sweet potato, beans, peas, carrot, beetroot*	***Lab14:*** *Symptomology, host parasite relationship and IDM – Rubber & Cocoa*
	SLO-2					
S-13	**SLO-1**	-	-	-	-	*Disease symptoms – Cocoa*
	SLO-2	-	-	-	-	*Epidemiology and IDM in Cocoa*
S 14	**SLO-1**	-	-	-	-	*Disease symptoms – Gloriosa, Coleus, Stevia, aloe vera*
	SLO -2	-	-	-	-	*Epidemiology and IDM in gloriosa, coleus, stevia, aloe vera*
S 15-16	**SLO-1**	-	-	-	-	***Lab15:*** *Symptomology, host parasite relationship and IDM – Gloriosa, coleus, stevia, and aloe vera*
	SLO-2	-	-	-	-	
S-17	**SLO-1**	-	-	-	-	*Post-harvest diseases*
	SLO-2	-	-	-	-	*Fruits and vegetables*
S 18	**SLO-1**	-	-	-	-	-
	SLO-2					
S 19-20	**SLO-1**	-	-	-	-	***Lab16:*** *Post-harvest diseases of fruits and vegetables*
	SLO-2					

Learning Resources	1. Girish Chand and Santhosh Kumar. (2016). *Crop Diseases and Their Management*. Florida: CRC press. pp. 1-285. 2. Sanjeev Kumar. (2016). *Diseases of Field Crops and Their Integrated Management*. India: New India publishing agency. pp. 1-296.	3. Sonia Ahuja. (2005). *Plant Diseases*. New Delhi: Vishvabharti.pp. 1-268.

Level of Thinking		Continuous Learning Assessment (35% weightage)		University Practical Examination (15**%**)	End semester theory Examination **(50%)**
		In semester (20%)	Practical (15%)		
Level 1	**Remember**	*40 %*	*45%*	*40%*	*45 %*
	Understand				
Level 2	**Apply**	*40 %*	*30%*	*30%*	*30 %*
	Analyze				
Level 3	**Evaluate**	*20 %*	*25%*	*20%*	*25 %*
	Create				
	Total	*100 %*	*100%*	*100%*	*100 %*

Course Designers		
Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
Dr. A. Bharani deppan, Ph.D. E.I. DuPont India Pvt Ltd. The V-Ascendas, Atria Block, 12th Floor, Plot.17 SoftwareUnits Layout, Madhapur, Hyderabad, Telangana Ph: 936666899, Mail: bharani-deepan.a@corteva.com	Dr. A. Kamalakannan, Professor Department of Plant Pathology Tamil Nadu Agricultural University Coimbatore- 641003 Ph: 9790620313, E-Mail: kamals2k@yahoo.co.in	Dr. Rageshwari S Assistant Professor (Plant Pathology) Dr. Vinod Kumar S Assistant Professor (Plant Pathology)

THEORY

Symptoms, etiology, mode of spread, survival, epidemiology and integrated management of diseases and nematode disease complex.

Unit I – Diseases of Cereals and Millets Crops

Cereals: Rice - Blast, brown spot, sheath rot, sheath blight, foot rot, stem rot, false smut, stack burn, grain discoloration, leaf blight, leaf streak, Tungro, grassy stunt, Hoja Blanca. Maize – smut, rust, downy mildew, stalk rot, leaf spot. Millets: Sorghum, pearl millet, finger millet and small millets - Smut, rust, downy mildew and other minor diseases.

Unit II – Diseases of Pulses and Oilseed Crops

Pulses: Pigeon pea, black gram, mung bean, cowpea, soybean – wilt, powdery mildew, sterility mosaic, powdery mildew, root rot, leaf spot, anthracnose, rust, bacterial leaf spot and blight, mosaic, leaf crinkle. Oilseeds: Groundnut- leaf spot, rust, collar rot, wilt, root rot, rosette, mosaic, peanut bud necrosis, Castor and sesame – leaf spot, rust, root rot, stem rot, powdery mildew, downy mildew, white rust, mosaic, phytoplasma. Diseases of stored grains

Unit III – Diseases of Cash Crops and Fruit Crops

Cash crops: Tobacco, - damping off, black shank, frog eye leaf spot, powdery mildew, mosaic, leaf curl. Jute - root rot, powdery mildew, anthracnose, Mulberry - wilt, root rot, powdery mildew, rust. Fruit crops: Banana - Panama wilt nematode complex, Moko wilt, anthracnose, sigatoka leaf spot, freckle leaf spot, cordana leaf spot, tip over disease, banana bunchy top disease, banana streak virus, banana mosaic virus, infectious chlorosis, bract mosaic. Guava - wilt, root rot, gray blight, leaf spot, algal leaf spot, sooty mold, Sapota- gray blight, leaf spot, sooty mold, flat stem, Papaya- foot rot, fruit rot, papaya ring spot, papaya mosaic, Pomegranate - bacterial leaf spot, fungal blight, anthracnose, Pineapple - butt rot, heart rot, wilt, Jack fruit- fruit rot, Aonla- powdery mildew, leaf spot, fruit rot and Ber-powdery mildew, fruit rot.

Unit IV – Diseases of Vegetables Crops

Vegetable crops: Crucifers- damping off, black rot, club root, leaf spot, white blister, head rot, leaf blight, white blister, downy mildew, Tomato - early blight, late blight, damping off, root rot, wilt, bacterial wilt and nematode complex, canker, spotted wilt, big bud, Brinjal- damping off, leaf spot, rust, fruit rot, wilt, root rot, little leaf, Okra- powdery mildew, leaf spot, vein clearing, Sweet potato – violet root rot, Beans - anthracnose, root rot, rust, mosaic disease, bacterial blight, Peas- powdery mildew, fusarium wilt, rust, Carrot and beetroot - leaf spot, leaf blight, powdery mildew, bacterial soft rot, curly top.

Unit V – Diseases of Plantation and Medicinal Crops, Post Harvest Diseases

Plantation crops: Coconut - bud rot, stem bleeding, root wilt, leaf blight, Thanjavur wilt, coconut yellows, Arecanut - koleroga/mahali disease, foot rot, stem bleeding, leaf spot, leaf blight, Oilpalm –bud rot, wilt, leaf spot, Vanilla- stem rot, fruit rot, bean shedding, blight, Tea- blister blight, algal leaf spot, gray blight, leaf spot, root rot, Coffee- anthracnose, rust, root rot, leaf spot, sooty mould, Rubber- stem rot, powdery mildew, leaf spot, root rot, Cocoa – black pod rot, charcoal pod rot, gray blight, wilt, root rot, and swollen shoot, Medicinal crops: Gloriosa, coleus, stevia and aloe. Post-harvest diseases of fruits and vegetables.

Theory –Lecture Schedule

Symptoms, etiology, mode of spread, survival, epidemiology and integrated management of

1. Diseases of rice I
2. Diseases of rice II
3. Diseases of maize
4. Diseases of sorghum
5. Diseases of pearl millet and finger millet
6. Diseases of small millets
7. Diseases of pigeonpea

8. Diseases of urdbean, mungbean and cowpea
9. Diseases of soybean
10. Diseases of groundnut
11. Diseases of sesame and castor
12. Diseases of stored grains and their management
13. Diseases of tobacco
14. Diseases of jute and mulberry
15. Diseases of banana
16. Diseases of guava, papaya and sapota
17. **In-semester examination**
18. Diseases of pomegranate and pineapple
19. Diseases of jack fruit, ber and aonla
20. Diseases of crucifers
21. Diseases of tomato
22. Diseases of brinjal
23. Diseases of okra
24. Diseases of sweet potato, beans and peas
25. Diseases of carrot and beetroot
26. Diseases of coconut
27. Diseases of arecanut and oilpalm
28. Diseases of vanilla
29. Diseases of tea
30. Diseases of coffee
31. Diseases of rubber
32. Diseases of cocoa
33. Diseases of gloriosa, coleus, stevia, aloe vera
34. Post-harvest diseases of fruits and vegetables

Practical Schedule

Symptomatology, host parasite relationship and management of

1. Diseases of rice
2. Diseases of maize and sorghum
3. Diseases of pearl millet, finger millet and small millets
4. Diseases of pigeonpea, urdbean, mungbean, soybean and cowpea
5. Diseases of groundnut, sesame and castor
6. Diseases of tobacco, jute and mulberry
7. Diseases of banana, guava, papaya, sapota
8. Diseases of pomegranate, pineapple, jack fruit, ber and aonla
9. Diseases of crucifers
10. Diseases of tomato, brinjal and okra
11. Diseases of sweet potato, beans, peas, carrot and beetroot
12. Diseases of coconut, arecanut, oilpalm and vanilla
13. Diseases of tea and coffee
14. Diseases of rubber and cocoa
15. Diseases of gloriosa, coleus, stevia and aloe Vera
16. Post-harvest diseases of fruits and vegetables
17. **University Practical Examination**

Note: Students should submit 50 well preserved disease specimens.

Text Books

1. Agrios, G.N. (2005). *Plant Pathology* (5th Ed.). New York: Academic Press. pp. 1-922.
2. Chaube, H.S. and Pundhir, V.S. 2009. *Crop diseases and their management*. New Delhi: PHI Learning Private Limited. pp. 1-724.
3. Girish Chand and Santhosh Kumar. (2016). *Crop Diseases and Their Management*. Florida: CRC press. pp. 1-285.
4. Rangaswami, G & Mahadevan, A. (2004). *Diseases of Crop Plants in India*. New Delhi: Prentice Hall of India Pvt. Ltd. pp. 1-548.
5. Sanjeev Kumar. (2016). *Diseases of Field Crops and Their Integrated Management*. India: New India publishing agency. pp. 1-296.

Reference Books

1. Nene, Y.L. and Tapliyal, P.N. (1993). *Fungicides in Plant Disease Control*. New Delhi: MEDTECH, Oxford and IBH publishing company. pp. 1-691.
2. Roland N Perry, Maurice Moens. (2013). *Plant Nematology*. UK: CABI. pp. 1-568.
3. Sonia Ahuja. (2005). *Plant Diseases*. New Delhi: Vishvabharti. pp. 1-268.
4. Suresh, Borkar, G. and Rupert, A.Y. (2017). *Bacterial diseases of crop plants*. Boca Raton: CRC Press. pp. 1-594.

Web-References

1. http://www.biologydiscussion.com
2. https://www.microscopemaster.com/fungi
3. www.apsnet.org/edcenter
4. www.Tolweb.org
5. http://www.hillagric.ac.in/edu/coa/ppath/lectures.htm
6. http://ecoursesonline.iasri.res.in/course/view.php?id=143
7. www.ucmp.berkeley.edu/fungi
8. www.ictv.org
9. www.vivo.library.cornell.edu
10. https://www.youtube.com/c/MTutorEdu/search?query=plant+pathology
11. https://www.youtube.com/channel/UCsqovy3LIp-dB8pMxU2VZ7A
12. https://www.youtube.com/user/uwipm/search?query=diseases

Journals

1. Phytopathology
2. Plant Pathology
3. Australasian Plant Pathology
4. Indian Phytopathology
5. Studies in Mycology
6. Journal of Plant Pathology

Course Nature: Theory based Practical							
Total Marks (100)							
S.No.	**Category**	**Assessment Tools**					
		In- Semester Examination	Assignment	Record	Attendance	End-Semester Examination	Marks
1	Theory-External	-	-		-	*50*	*50*
2	Theory-Internal	*20*	-			-	*20*
3	Practical-External	-	-		-	*15*	*15*
4	Practical-Internal	-	*05*	*05*	*05*	-	*15*
						Grand Total	*100*

Course Code	CRH19502	Course Name	PESTS OF CROPS AND STORED GRAIN AND THEIR MANAGEMENT	Course Category	C	*Compulsory Core*	L	T	P	C
							2	0	1	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Agricultural Entomology*	**Data Book / Codes/Standards**	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	**Learning**		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	*Knowledge on distribution, bionomics, symptoms of damage and management strategies for insects and non-insect pests of major filed crops*			
CLR-2 :	*To know the distribution, bionomics, symptoms of damage and management strategies for insects and non-insect pests of cotton, sugarcane, forage and fodder crops*			
CLR-3 :	*Knowledge on distribution, bionomics, symptoms of damage and management strategies for insects and non-insect pests of vegetables and leafy vegetables*			
CLR-4 :	*Acquire knowledge on pests fruit crops, plantation and aromatic crops and their management*			
CLR-5 :	*Obtain basic information on major ornamental crop pest and their management*			
CLR-6 :	*Comprehend the stored product pest, non insect pest and locust and their management*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	**Learning**			**Program Learning Outcomes (PLO)**														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Agriculture Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	Ability to solve scientific problems through Agricultural Entomology	Ability to implement knowledge gained in the applied field of Agricultural Entomology	Ability to understand social and ethical responsibilities of Agricultural Entomology
CLO-1 :	*Imparting skills on management of insects and non-insect pests of major filed crops*	*3*	*90*	*80*	*M*								*M*	*H*		*H*	*H*	*H*	*H*
CLO-2 :	*Gaining knowledge of management strategies for insects and non-insect pests of cotton, sugarcane, forage and fodder crops*	*2*	*95*	*85*	*H*								*L*	*H*		*H*	*H*	*H*	*H*
CLO-3 :	*Understand the pests of vegetables and leafy vegetables and their management*	*1*	*75*	*70*	*M*			*L*					*M*	*H*		*H*	*H*	*H*	*H*
CLO-4 :	*Obtain basic knowledge on pests fruit crops, plantation and aromatic crops and their management*	*3*	*80*	*65*	*M*		*L*		*L*				*L*	*H*		*H*	*H*	*H*	*H*
CLO-5 :	*Gaining knowledge on the major ornamental crop pest and their management*	*2*	*75*	*60*	*L*	*L*		*L*					*M*	*H*		*H*	*H*	*H*	*H*
CLO6 :	*Understand the stored product pest, non insect pest and locust and their management*	*2*	*75*	*65*	*L*						*H*		*M*	*H*		*H*	*H*	*H*	*H*

Duration (hour)		Learning Unit / Module 1	Learning Unit / Module 2	Learning Unit / Module 3	Learning Unit / Module 4	Learning Unit / Module 5
		13	8	13	16	15
S-1	SLO-1	*Rice – Sucking pests*	*Cotton – Sucking pests*	*Brinjal, bhendi and tomato*	***Lab:9** Pests of crucifers and cucurbits*	***Lab:13**Pests of coconut, cashew, cocoa, betelvine, coffee and tea*
	SLO-2	*Rice – Borers and defoliators*	***Lab:4** Pests of groundnut, gingelly sunflower and castor*	***Lab:6** Pests of sugarcane*	*Pomegranate, papaya and aonla*	*Rose, jasmine, crossandra, chrysanthemum and tuberose*
S-2	SLO-1	***Lab: 1** Pests of rice*	*Cotton – Bollworms, borers and defoliators*	*Chillies, onion, garlic, moringa and amaranthus*	*Apple, pine apple, custard apple and jack*	*Cut flowers Glory lily, coleus and stone breaker*
	SLO-2	*Pests of Maize, sorghum and Cumbu*	*Sugarcane*	*Crucifers*	***Lab: 10** Pests of mango, citrus, sapota, banana, grapevine and guava*	*Aswagantha, senna, periwinkle and lawn*
S-3	SLO-1	*Pests of Wheat, ragi and tenai*	***Lab:5** Pests of cotton*	***Lab:7** Pests of brinjal, bhendi and tomato*	*Potato, sweet potato, tapioca*	***Lab:14** Pests of turmeric, ginger, coriander, cardamom, pepper and curry leaf*
	SLO-2	***Lab:2** Pests of maize, sorghum , cumbu, ragi and tenai*	*Green manures and forage crops - sunnhemp, sesbania, daincha, lucerne, subabul and glyricidia*	*Cucurbits*	*Coconut and arecanut*	*Role of physical, biological, mechanical and chemical factors in deterioration of grain by Stored product pests*
S-4	SLO-1	*Pests of Redgram, bengalgram, blackgram, greengram and cowpea*	-	*Mango*	***Lab:11**. Pests of pomegranate, aonla, papaya, jack, pine apple, custard apple, ber and apple*	*Stored product pests and their management*

	SLO-2	*Groundnut, Gingelly and sunflower*	-	***Lab: 8** Pests of chillies,onion, garlic, moringa and amaranthus*	*Tea and coffee*	***Lab:15** Pests of rose, jasmine, crossandra, chrysanthemum and tuberose*
S-5	**SLO-1**	***Lab:3** Pests of pulses*	-	*Citrus and banana*	*Cashew, cocoa and betelvine*	*Locusts and their management*
	SLO-2	*Castor, soybean, safflower, Jatropha and mustard*	-	*Guava, grapevine and sapota*	***Lab:12** Pests of potato, sweet potato and tapioca*	*Rodents and birds of agricultural importance and their management*
S-6	**SLO-1**	-	-	-	*Ginger, turmeric and coriander,*	***Lab: 16.** Pests of stored products*
	SLO-2	-	-	-	*Cardamom, pepper, curry leaf and tamarind*	-

Learning Resources	1. David, B.V. and Ramamurthy, V.V. (2011). *Elements of Economic Entomology*, Namrutha Publications, Chennai. pp1- 386.	2. Manisegaran, S. and.Soundararajan, R.P (2010). *Pest Management in Field Crops-Principles and Practices.* Agrobios, Jodhpur, India. Pp 1-316.	

Level of Thinking		Continuous Learning Assessment (35% weightage)		University Practical Examination (15%)	End semester theory Examination (50%)
		In Semester (20%)	Practical (15%)		
Level 1	**Remember**	40 %	40 %	35%	30 %
	Understand				
Level 2	**Apply**	30 %	40 %	30%	40 %
	Analyze				
Level 3	**Evaluate**	30 %	20 %	35%	30 %
	Create				
	Total	*100 %*	*100 %*	***100%***	*100 %*

Course Designers		
Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
Dr. K. Ramesh Ph.D Principal Biologist –Rice Insecticide and Nematicide, South Asia Co-chair for insecticide resistance action committee(IRAC), India Corteva agrisciences (Dow Dupont), Madhapur, Hyderabad, India e- mail :ramesh.kaliaperumal@corteva.com , mobile : 9952885708	Dr. M. Kandibane Associate professor, Department of Agricultural Entomology, PAJANCOA&RI, Karaikal-609603	Dr. L.Ramazeame Ph.D

THEORY

Unit-I: Distribution, bionomics, symptoms of damage and management strategies for insects and non-insect pests of rice, wheat, maize, sorghum, cumbu, ragi, tenai, redgram, green gram, black gram, bengal gram, cowpea, groundnut, castor, gingelly, sunflower, safflower, jatropa, soybean and mustard.

Unit-II. Distribution, bionomics, symptoms of damage and management strategies of insects and non-insect pests of cotton and sugarcane, green manures (Sunnhemp, Sesbania, Daincha. Glyricidia), forage crops (Lucerne and Subabul)

Unit-III: Distribution, bionomics, symptoms of damage and management strategies of insect and non insect pests of Brinjal, Bhendi, Tomato, Chillies, Onion, Garlic, Moringa, Amaranthus, Crucifers, Cucurbits, Mango, Citrus, Banana, Guava, Grapevine and Sapota

Unit-IV: Distribution, bionomics, symptoms of damage and management strategies of insect and non insect pests of Pomegranate, Papaya, Aonla, Apple, Pine apple, Custard apple and Jack, Potato, Sweet potato, Tapioca, Yam, Colocasia, Coconut, Arecanut, Tea, Coffee, Cashew, Cocoa, Betelvine, Ginger, Turmeric, Coriander, Cardamom, Pepper, Curry leaf and Tamarind

Unit -V: Distribution, bionomics, symptoms of damage and management strategies of insect and non insect pests of Rose, Jasmine, Crossandra, Chrysanthemum, Tuberose, Cut flowers, Glory lily, Coleus, Stonebreaker, Aswagantha, Senna, Periwinkle and Lawn. Distribution, bionomics, symptoms of damage and management strategies of pests of and stored products. Rodents and birds of agricultural importance and their management. Locusts and their management.

Practical

Identification of symptoms of damage and life stages of important pests of different field crops *viz*., cereals, millets, pulses, oilseeds, cotton, sugarcane and green manure crops and horticultural crops *viz*., vegetables, fruits, spices, tubers, plantation crops, flower crops, medicinal plants, lawn and stored products.

Assignment

1. Collection and submission of 50 pests of field and horticultural crops.
2. Rearing a minimum of 20 insect pests and preparation of two riker mounts of pests of field and horticultural crops

Theory Lecture schedule

Distribution, bionomics, symptoms of damage and management strategies for insects and noninsect pests of

1. Rice – Sucking pests
2. Rice – Borers and defoliators
3. Maize, sorghum and cumbu
4. Wheat, ragi and tenai
5. Redgram, bengalgram, blackgram, greengram and cowpea
6. Groundnut, gingelly and sunflower
7. Castor, soybean, safflower, jatropha and mustard
8. Cotton – Sucking pests
9. Cotton – Bollworms, borers and defoliators
10. Sugarcane
11. Green manures and forage crops - sunnhemp, sesbania, daincha, lucerne, subabul and glyricidia
13. Brinjal, bhendi and tomato
14. Chillies, onion, garlic, moringa and amaranthus
15. Crucifers
16. Cucurbits
17. Mango
18. **In- semester examination**
19. Citrus and banana
20. Guava, grapevine and sapota,
21. Pomegranate, papaya and aonla
22. Apple, pine apple, custard apple and jack

23. Potato, sweet potato, tapioca
24. Coconut and arecanut
25. Tea and coffee
26. Cashew, cocoa and betelvine
27. Ginger, turmeric and coriander,
28. Cardamom, pepper, curry leaf and tamarind
29. Rose, jasmine, crossandra, chrysanthemum and tuberose
30. Cut flowers Glory lily, coleus, stone breaker,
31. Aswagantha, senna, periwinkle and lawn
32. Role of physical, biological, mechanical and chemical factors in deterioration of grain by Stored product pests
33. Stored product pests and their management
34. Locusts and their management
35. Rodents and birds of agricultural importance and their management

Practical Schedule

Identification of symptoms of damage and life stages of pests of

1. Pests of rice
2. Pests of maize, sorghum , cumbu, ragi and tenai
3. Pests of pulses
4. Pests of groundnut, gingelly sunflower and castor
5. Pests of cotton
6. Pests of sugarcane
7. Pests of brinjal, bhendi and tomato
8. Pests of chillies,onion, garlic, moringa and amaranthus
9. Pests of crucifers and cucurbits
10. Pests of mango, citrus, sapota, banana, grapevine and guava
11. Pests of pomegranate, aonla, papaya, jack, pine apple, custard apple, ber and apple
12. Pests of potato, sweet potato and tapioca
13. Pests of coconut, cashew, cocoa, betelvine, coffee and tea
14. Pests of turmeric, ginger, coriander, cardamom, pepper and curry leaf
15. Pests of rose, jasmine, crossandra, chrysanthemum and tuberose
16. Pests of stored products
17. **University Practical Examination**

Text Books

1. Awasthi, V.B. (2007). *Agricultural Insect Pests and their Control,* Scientific publishers (India), Jodhpur, {ISBN 81-7233-491-5} pp1-267.
2. David, B.V and Ramamurthy,V.V.(2011). *Elements of Economic Entomology*, Namrutha Publications, Chennai.. {ISBN: 978-81-921477-0-3} pp1-386
3. Dhaliwal, G.S. and Ramesh Arora. (2004). *Integrated pest management Concepts and Approaches,* Kalyani Publishers, Ludhiana, {ISBN: 81-7663-904-4} pp1-427.
4. Manisegaran, S. and R.P.Soundararajan. (2010). *Pest Management in Field Crops- Principles and Practices.* Agrobios, Jodhpur, India.. {ISBN (10): 81-7754-321-0} pp1-316.
5. Muthukrishnan,N., Ganapathy, N., Nalini R and Rajendran, R.(2005). *Pest Management in Horticultural Crops.* New Madura Publishers, Madurai.. {ISBN: 81-902832-0-0} pp1-325.
6. Regupathy, A and Ayyasamy. R. (2013). *A Guide on Crop Pests*. Namrutha Publications, Chennai, {ISBN: 978-81-921477-1-0} pp1-368.
7. Srivastava, K.P. and Dhaliwal, G.S. (2011). *A text book of Applied Entomology*. Vol. II, Kalyani Publishers, Ludhiana. {ISBN: 978-81-272-6752-0} pp1-368.

Reference Books

1. Ayyar, T.V.R. (1963). *Hand Book of Economics Entomology for South India.* Govt. Press Madras.pp1-516
2. Butani, D.K. and M.G.Jotwani. (2013). *Insects in Vegetables.* Daya Publishing House,NewDelhi. pp1-356.
3. Nair, M.R.G.K.(1986). *Insects and mites of crops in India.* Publications and Information Division, ICAR, NewDelhi. pp1-408.
4. Nair, M.R.G.K. 1995. *Insects and Mites of Crops in India.* Indian council of Agricultural Research, New Delhi, pp1-408.
5. Parvatha Reddy.(2010). *Insect, Mite and Vertebrate Pests and their Management in Horticultural Crops.* Scientific Publishers, Jodhpur.. {ISBN: 978-81-7233-628-8} pp1-384
6. Regupathy,A. and Ayyasamy. R.(2013). *A Guide on Crop Pests.* Namrutha Publications,Chennai.{ISBN: 978-81-921477-1-0}, pp1-368.
7. Sivasubramanian, P., Samiayyan, K. Ganapathy, N. Bhuvaneswari K. and Jayaprabhavathi S. (2012). *Atreatise on Integrated Pest Management.* Associated Publishing Company, New Delhi.pp1- 287.
8. Srivastava, K.P and Butani, D.K.(2009). *Pest Management in Vegetables* (Vol. I & II). Studium Press (India) Pvt. Ltd., New Delhi . {ISBN: 978-81-907577-3-7} pp1-777.
9. Sathe,T.V.(2012). *Pests of Ornamental Plants.* Daya Publishing House, New Delhi.{ISBN: 978-81-7035-757-5}, pp1-199.

Web References

1. http://www.ncipm.org.in
2. http://agritech.tnau.ac.in/
3. http://www.nbaii.res.in/
4. http://www.nrcg.res.in/
5. ipm.illinois.edu
6. https://youtu.be/8u6YneQdPZY
7. https://youtu.be/io-jT0sPxrM

Journals

1. Annals of plant protection sciences
2. Arthropod Pests of Horticultural Crops in Tropical Asia
3. Indian journal of plant protection
4. International Journal of Pest Management
5. Journal of Integrated Pest Management
6. Pests management & Economic Zoology

Course Nature: Theory based Practical							
Total Marks (100)							
S.No.	**Category**	**Assessment Tools**					
		In- Semester Examination	Assignment	Record	Attendance	End-Semester Examination	Marks
1	Theory-External	-	-		-	*50*	*50*
2	Theory-Internal	*20*	-			-	*20*
3	Practical-External	-	-		-	*15*	*15*
4	Practical-Internal	-	*05*	*05*	*05*	-	*15*
						Grand Total	*100*

Course Code	GBP19501	Course Name	CROP IMPROVEMENT -I (*KHARIF CROPS)*	Course Category	*S*	*Supportive Course*	L	T	P	C
							1	0	1	2

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Genetics and Plant Breeding*	Data Book / Codes/Standards		*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1 :	*Acquire knowledge on cereal breeding*
CLR-2 :	*Gain knowledge on breeding of pulses*
CLR-3 :	*Gain knowledge on breeding of oilseeds and fibres*
CLR-4 :	*Learn about the breeding of vegetables and cash crops*
CLR-5 :	*Gain the knowledge on breeding for biotic and abiotic stresses*

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Agriculture Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	Ability to solve scientific problems through plant breeding and genetics	Ability to implement knowledge gained in the applied field of plant breeding and genetics	Ability to understand social and ethical responsibilities of plant breeding and genetics
CLO-1 :	*Describe the emasculation and artificial pollination in crops*	*3*	*90*	*80*	*M*								*M*	*H*		*H*	*H*	*H*	*H*
CLO-2 :	*Explain the production of hybrids in different crops*	*1*	*95*	*85*	*H*								*L*	*H*		*H*	*H*	*H*	*H*
CLO-3 :	*Discuss the difficulties on crop improvement and rectifications*	*2*	*80*	*70*	*M*		*L*	*L*					*L*	*H*		*H*	*H*	*H*	*H*
CLO-4 :	*Explain the development of the varieties in crops*	*3*	*75*	*65*	*M*			*L*	*L*				*M*	*H*		*H*	*H*	*H*	*H*
CLO-5 :	*Explain the design of experimental plots for evaluation of crops*	*2*	*80*	*70*	*M*		*L*	*L*					*L*	*H*		*H*	*H*	*H*	*H*

Duration (hour)		Learning Unit / Module 1	Learning Unit / Module 2	Learning Unit / Module 3	Learning Unit / Module 4	Learning Unit / Module 5
		8	11	10	10	9
S-1	SLO-1	*Centers of origin and floral biology in rice*	*breeding objectives and procedures in blackgram and greengram*	*breeding objectives and procedures in Soybean*	*Breeding objectives and procedures in chilli, tomato and brinjal*	*Breeding for pest and disease resistance; Breeding for Abiotic stress*
	SLO-2	*Breeding objectives and procedures in rice*	*hybrid seed production in blackgram and greengram*	*Hybrid seed production in Soybean*	*Hybrid seed production in chilli, tomato and brinjal*	*Breeding for Abiotic stress*
S-2	SLO-1	*Floral biology, breeding objectives in maize*	*Floral biology, breeding objectives and procedures in cowpea*	*Breeding objectives in sesame*	*Floral biology, breeding objectives and procedures in caster*	*Salinity and alkalinity*
	SLO-2	*Hybrid seed production in maize*	*Hybrid seed production in cowpea*	*Hybrid seed production in sesame*	*hybrid seed production in caster*	*Ideotype breeding*
S-3,4	SLO-1	***Lab.1.** Emasculation and hybridization techniques in rice*	***Lab. 4.** Emasculation and hybridization techniques in blackgra and greengram*	***Lab. 7.** Emasculation and hybridization techniques in groundnut and cotton*	***Lab.10** Study of field techniques for seed production and hybrid seeds production in Kharif crops*	***Lab.14.** Donor parents for different characters*
	SLO-2					
S-5	SLO-1	*Breeding objectives and procedures*	*Centers of origin, distribution of species, breeding objectives and procedures in redgram and moth bean*	*Centers of origin, breeding objectives and procedures in groundnut*		*Plant genetic resources,*
	SLO-2	*hybrid seed production in sorghum*	*hybrid seed production in redgram and moth bean*	*Hybrid seed production in groundnut*		*Climate resilient crop varieties for future*
S-6	SLO-1	*Breeding objectives and procedures in pearl millet.*		*Floral biology, breeding objectives and procedures for cotton and mesta*		
	SLO-2	*Breeding of finger millet*		*Hybrid seed production in cotton and mesta*		
S-7,8	SLO-1	***Lab.2** Emasculation and hybridization techniques in maize*	***Lab. 5.** Emasculation and hybridization techniques in cowpea and redgram*	***Lab. 8.** Maintenance breeding of different kharif crops*	***Lab: 11** Estimation of heterosis, inbreeding depression and heritability*	***Lab 15:** Visit to seed production plots*
	SLO-2					
S-9	SLO-1	-	-	-	-	-

	SLO-2	-	-	-	-	-
S-10	**SLO-1**	-	-	-	-	-
	SLO-2	-	-	-	-	
S-11,12	**SLO-1**	***Lab 3:*** *Emasculation and hybridization techniques in sorghum and pearl millet*	***Lab 6:*** *Emasculation and hybridization techniques in soybean and sesame*	***Lab 9:*** *Handling of germplasm and segregating populations by different methods like pedigree, bulk and single seed decent methods*	***Lab 12:*** *Layout of field experiments*	***Lab 16:*** *Visit to AICRP plots of different field crops*
	SLO-2					
S - 13	**SLO-1**	-	-	-	-	-
	SLO-2	-	-	-	-	-
S - 14	**SLO-1**	-	-	-	-	-
	SLO-2	-	-	-	-	-
S–15,16	**SLO-1**	-	-	-	***Lab 13:*** *Study of quality characters*	-
	SLO-2					

Learning Resources	1. Bharadwaj, D.N. (2012). *Breeding Field Crops.* Jodhpur: Agrobios (India), pp. 1- 934. 2. Hari Har Ram. (2011). *Vegetable Breeding– Principles and Practice.* New Delhi: Kalyani Publishers. pp. 1- 421.	3. Harihar Ram & Hari Govind Singh. (1994). *Crop breeding and Genetics.* New Delhi: Kalyani Publishers. pp. 1- 510.

Level of Thinking		Continuous Learning Assessment (35% weightage)		University Practical Examination (15%)	End semester theory Examination **(50%)**
		In Semester (20%)	Practical (15%)		
Level 1	**Remember**	40 %	30 %	35%	30 %
	Understand				
Level 2	**Apply**	40 %	40 %	35%	40 %
	Analyze				
Level 3	**Evaluate**	20 %	30 %	30%	30 %
	Create				
Total		*100 %*	*100 %*	*100%*	*100 %*

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Dr. S M .Prabhu, Ph. D. Senior Breeder (Paddy Breeding and Transgenic) R&D centre,Rasi Seeds (P) Ltd., Attur, Salem – 636141.	Dr. T. Sabesan Associate rofessor Department of Genetics and Plant Breeding Faculty of Agriculture, Annamalai University,Annamalai nagar , Chidambaram - 608 002, sabavani@gmail.com	**Dr. G**. Selvakumar Assistant Professor (GPB) Dr. R. Mahendran Assistant Professor (GPB) Dr. J. Vanitha Tutor, (GPB)

THEORY

Unit I - Cereals

Place of origin – putative parents – related wild species – classification – objectives of breeding – methods of breeding – quantity – quality – stress – conventional – innovative – heterosis breeding – distant hybridization and important varieties in following crops: Cereals: rice, fodder and grain maize, fodder and grain sorghum, fodder and grain pearl millet, and finger millet.

Unit II - Pulses

Place of origin – putative parents – related wild species – classification – objectives of breeding – methods of breeding – quantity – quality – stress – conventional – innovative – heterosis breeding – distant hybridization and important varieties in following pulses crops: blackgram, greengram, cowpea, redgram and moth bean.

Unit III - Oilseeds and Fibres

Place of origin – putative parents – related wild species – classification – objectives of breeding – methods of breeding – quantity – quality – stress – conventional – innovative – heterosis breeding – distant hybridization and important varieties in oilseeds: soybean, sesame and groundnut. Fibre: cotton and mesta.

Unit IV – Vegetables and Cash Crops

Objectives of breeding – methods of breeding – quantity – quality – stress – conventional – innovative – heterosis breeding – vegetable crops – chilli, brinjal and tomato. Cash crops - caster.

Unit V - Breeding for Biotic and Abiotic Stresses and Quality

Breeding for pest and disease resistance - mechanisms of resistance; Breeding for Abiotic stress – drought and cold – salinity and alkalinity- mechanisms of resistance; Breeding for Abiotic stress –mechanisms of resistance; Breeding for quality produce; Ideotype breeding. Plant genetic resources, their utilization and conservation. Ideotype concept and climate resilient crop varieties for future.

Theory –Lecture Schedule

1. Centres of origin, distribution of species, floral biology, breeding objectives and procedures etc hybrid seed production in rice
2. Centres of origin, distribution of species, floral biology, breeding objectives and procedures etc hybrid seed production in maize
3. Centres of origin, distribution of species, floral biology, breeding objectives and procedures etc hybrid seed production in sorghum
4. Centres of origin, distribution of species, floral biology, breeding objectives and procedures etc hybrid seed production in pearl millet. Breeding of finger millet
5. Centres of origin, distribution of species, floral biology, breeding objectives and procedures etc hybrid seed production in blackgram and greengram
6. Centres of origin, distribution of species, floral biology, breeding objectives and procedures etc hybrid seed production in cowpea
7. Centres of origin, distribution of species, floral biology, breeding objectives and procedures etc hybrid seed production in redgram and moth bean
8. **In Semester examination**
9. Centres of origin, distribution of species, floral biology, breeding objectives and procedures etc hybrid seed production in Soybean
10. Centres of origin, distribution of species, floral biology, breeding objectives and procedures etc hybrid seed production in sesame
11. Centres of origin, distribution of species, floral biology, breeding objectives and procedures etc hybrid seed production in groundnut
12. Centres of origin, distribution of species, floral biology, breeding objectives and procedures for hybrid seed production in cotton and mesta
13. Centres of origin, distribution of species, floral biology, breeding objectives and procedures etc hybrid seed production in chilli, tomato and brinjal
14. Centres of origin, distribution of species, floral biology, breeding objectives and procedures etc hybrid seed production in caster
15. Breeding for pest and disease resistance - mechanisms of resistance; Breeding for Abiotic stress – drought and cold – salinity and alkalinity- mechanisms of resistance
16. Breeding for Abiotic stress – salinity and alkalinity - mechanisms of resistance; Breeding for quality produce; Ideotype breeding
17. Plant genetic resources, their utilization and conservation. Ideotype concept and climate resilient crop varieties for future

Practical Schedule

1. Emasculation and hybridization techniques in rice
2. Emasculation and hybridization techniques in maize
3. Emasculation and hybridization techniques in sorghum and pearl millet
4. Emasculation and hybridization techniques in blackgram and greengram
5. Emasculation and hybridization techniques in cowpea and redgram
6. Emasculation and hybridization techniques in soybean and sesame

7. Emasculation and hybridization techniques in groundnut and cotton
8. Maintenance breeding of different kharif crops
9. Handling of germplasm and segregating populations by different methods like pedigree, bulk and single seed decent methods
10. Study of field techniques for seed production and hybrid seeds production in Kharif crops
11. Estimation of heterosis, inbreeding depression and heritability
12. Layout of field experiments
13. Study of quality characters
14. Donor parents for different characters
15. Visit to seed production plots
16. Visit to AICRP plots of different field crops
17. **University Practical Examination**

Text Books

1. Bharadwaj, D.N. (2012). *Breeding Field Crops.* Jodhpur: Agrobios (India), pp. 1- 934.
2. Hari Har Ram. (2011). *Vegetable Breeding – Principles and Practice.* New Delhi: Kalyani Publishers. pp. 1- 421.
3. Harihar Ram & Hari Govind Singh. (1994). *Crop breeding and Genetics.* New Delhi: Kalyani Publishers. pp. 1- 510.
4. Kumar, N. (2006). *Breeding of horticultural crops - Principles and Practices.* New Delhi: New India Publishing Agency. pp. 1- 220.
5. Phoelman, J.N. & Borthakur. (1969). *Breeding Asian field crops.* New Delhi: Oxford & IBH Publishing Co. pp. 1- 385.
6. Ram, H.H. (2011). *Crop Breeding and Biotechnology.* New Delhi: Kalyani Publishers. pp. 1-735.
7. Sleper, D. A. & Poehlman, J. M. (2007). *Breeding Field Crops.* USA: Blackwell Publishing Professional. pp. 1- 424.

Reference Books

1. Annaliese S. Mason. (2017). *Polyploidy and hybridizaton for crop improvement*. USA: CRC Press. pp. 1- 490.
2. Chopra, V. L. (1990). *Plant Breeding. Theory and Practice*. New Delhi: Oxford and IBH Publishing Co. pp. 1- 490.
3. David A. Sleper & Poehlman, J. M. (2006). *Breeding Field Crops* (5th ed.). USA: Blackwell. pp. 1- 432.
4. Sharma, J. R. (1994). *Principles and practice of Plant Breeding.* New Delhi: Tata McGraw - Hill Publishing Co. Ltd. pp. 1- 599.

Web-References

1. http://agritech.tnau.ac.in/crop_improvement/crop_imprv_breed.html
2. https://www.cropscience.bayer.com/innovations/seeds-traits/plant-breeding
1. 3.https://research.wur.nl/en/publications/some-remarks-on-the-breeding-of-field-crops-in-the-netherlands/fingerprints/
4. https://www.cwrdiversity.org/project/pre-breeding/
5. https://qaafi.uq.edu.au/speed-breeding

Journals

1. Turkish Journal of Field Crops
2. Field Crops Research - Journal - Elsevier
3. Journal of Plant Breeding and Crop Science
4. Journal of Crop Improvement
6. Crop Breeding, Genetics and Genomics

Course Nature: Theory based Practical							
Total Marks (100)							
S.No.	Category	Assessment Tools					
		In- Semester Examination	Assignment	Record	Attendance	End –Semester Examination	Marks
1	Theory-External	-	-		-	*50*	*50*
2	Theory-Internal	*20*	-			-	*20*
3	Practical-External	-	-		-	*15*	*15*
4	Practical-Internal	-	*05*	*05*	*05*	-	*15*
						Grand Total	*100*

Course Code	GPB19502	Course Name	PLANT BIOTECHNOLOGY	Course Category	C	*Compulsory Core*	L	T	P	C
							2	0	1	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department		*Genetics and Plant Breeding*	Data Book / Codes/Standards	*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1 :	*Explain the basic techniques in tissue culture*
CLR-2 :	*Summarize basic molecular biology*
CLR-3 :	*Gain knowledge about the different strategies transgenesis*
CLR-4 :	*Inculcate the knowledge about the molecular markers*
CLR-5 :	*Inculcate the knowledge about the DNA sequences*

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Agriculture Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	Ability to solve scientific problems through Biotechnology	Ability to implement knowledge gained in the applied field of Biotechnology	Ability to understand social and ethical responsibilities of Biotechnology
CLO-1 :	*Demonstrate tissue culture in crop plants*	*3*	*90*	*80*	*M*								*M*	*H*		*H*	*H*	*H*	*H*
CLO-2 :	*Produce virus free plants*	*1*	*95*	*85*	*H*								*L*	*H*		*H*	*H*	*H*	*H*
CLO-3 :	*Demonstrate genetic transformation in crops*	*2*	*80*	*70*	*M*		*L*	*L*					*L*	*H*		*H*	*H*	*H*	*H*
CLO-4 :	*Use DNA markers in plant breeding*	*3*	*75*	*65*	*M*			*L*	*L*				*M*	*H*		*H*	*H*	*H*	*H*
CLO-5 :	*Demonstrate DNA extrations to sequencing*	*2*	*75*	*60*	*L*	*L*							*M*	*H*		*H*	*H*	*H*	*H*
CLO 6 :	*Describe DNA fingerprinting of plants*	*2*	*75*	*65*	*L*						*H*		*M*	*H*		*H*	*H*	*H*	*H*

Duration (hour)		Learning Unit / Module 1	Learning Unit / Module 2	Learning Unit / Module 3	Learning Unit / Module 4	Learning Unit / Module 5
		11	11	16	21	12
S-1	SLO-1	*Plant tissue culture concepts,*	*Micropropagation - banana*	*Genome organization*	*Polymerases,*	*DNA markers - hybridization based markers (RFLP)*
	SLO-2	*History and scope*	*Micropropagation - ornamental plants*	*Prokaryotes vs eukaryotes*	*Restriction endonucleases and ligases*	*Applications*
S-2	SLO-1	*Media and Culture Conditions*		*Central dogma of life*	*Plasmids and phagemids*	
	SLO-2	*Sterilization techniques*		*Structure of nucleicacids*	*cosmids and BAC*	
S-3, 4	SLO-1	***Lab 1.** Biotech Laboratory organization, safety regulations*	***Lab 3.** Plant tissue culture media preparation- shoot tip culture (rose)*	***Lab 6.** Callus culture*	***Lab 10.** Competent cell preparation and Bacterial transformation*	***Lab 14**. DNA fingerprinting using RAPD/SSR markers*
	SLO-2					
S-5	SLO-1	*Morphogenesis,*	*National certification*	*DNA*	*Construction of recombinant DNA molecules*	*RAPD and SSR,*
	SLO-2	*Organogenesis and embryogenesis*	*Quality management of TC plants*	*Replication*	*Bacterial transformation*	*AFLP and SNPs.*
S-7	SLO-1	*Callus culture and cell suspension culture*	*Meristem tip culture (virus free plants)*	*Aminoacids and classification*	*Direct and indirect gene transfer methods in plants*	*DNA fingerprinting of crop varieties*
	SLO-2	*Shoot tip and meristem tip culture*	*Anther culture (doubled haploids)*	*Genetic codes and transcription*	*Agrobacterium mediated method*	*Applications*
S-8, 9	SLO-1	***Lab 2.** Basics of reagents and solution preparation*	***Lab 4.** Meristem culture (tapioca)*	***Lab 7.** Culturing of E.coli and determination of growth curve*	***Lab 11.** Confirmation of transformation through colony screening*	***Lab 15.** NTSys- analysis of diversity in crop plants*
	SLO-2					
S-10	SLO-1	*Anther and pollen culture*	*Protoplast isolation and fusion*	*Introduction to translation*	*Tissue specific promoters*	*Development of mapping populations*
	SLO-2	*Ovule and embryo culture*	*Somaclonal variation and synthetic seeds*	*Protein synthesis*	*Selectable markers and reporter genes*	*Linkage and QTL analysis*
S- 11	SLO-1	-	*Secondary metabolite production*	*Fine structure of a gene*	*Molecular analysis of transgenic plants*	*Principles, methods and applications*
	SLO-2	-	*Invitro* germplasm conservation	Components of gene	Screening	Marker Assisted Selection in crop improvement
S-12, 13	SLO-1	-	***Lab 5.** Micro propagation of banana*	***Lab 8.** Isolation of bacterial plasmid DNA*	***Lab 12.** DNA extraction from plants*	***Lab 16.** Visit to tissue culture units /biotech*

	SLO-2	-				*lab in seed industry/Bt cotton field/tissue culture banana field*
S-14	**SLO-1**	-	-	*Regulation of gene expression*	*Herbicide, pest and disease resistant*	*Applications of Plant Genomics*
	SLO-2	-	-	*Operon concept Blotting techniques and Polymerase chain reaction*	*Abiotic stress resistant*	*Genome databases*
S-15	**SLO-1**	-	-	*DNA sequencing methods*	*Nutritional enhancement and*	-
	SLO-2	-	-	*Applications*	*Traits for improved quality*	-
S-16, 17	**SLO-1**	-	-	***Lab 9.** Restriction Digestion and Ligation*	***Lab 13.** Quantification of DNA and quality check through Agarose gelelectrophoresis*	-
	SLO-2	-	-			
S- 18	**SLO-1**	-	-	-	*Detection of GMOs*	-
	SLO-2	-	-	-	*Regulations and biosafety*	-

Learning Resources	1. Chawla, H S. (2009). *Introduction to Plant Biotechnology* (3rd ed.). London : CRC Press. pp. 1 - 698. 2. George, E.F, Hall M. A. & Geert-Jan De Klerk. (2009). *Plant Propagation by Tissue Culture* (3rd ed.). The Netherlands: Springer. pp. 1 - 504.	3. Neal Stewart, Jr. C. (2008). *Plant Biotechnology and Genetics: Principles, Techniques and Applications.* New Jersey: John Wiley & Sons, Inc. pp. 1 - 432.

Level of Thinking		Continuous Learning Assessment (35% weightage)		University Practical Examination (15%)	End semester theory Examination **(50%)**
		In semester (20%)	Practical (15%)		
Level 1	**Remember**	40 %	30 %	35%	30 %
	Understand				
Level 2	**Apply**	40 %	40 %	35%	40 %
	Analyze				
Level 3	**Evaluate**	20 %	30 %	30%	30 %
	Create				
	Total	100 %	100 %	100%	100 %

Course Designers		
Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
Dr. N. Jagadeeshselvam Scientist – I, MBL – I – LAB Rasi Seeds (P) Ltd., Athur, Salem – 636 141.	Dr. T. Sabesan Associate rofessor Department of Genetics and Plant Breeding Faculty of Agriculture, Annamalai University, Annamalai nagar , Chidambaram - 608 002, sabavani@gmail.com	Dr. G. Selvakumar , Assistant Professor(GPB) Dr. R. Mahendran, Assistant Professor(GPB) Dr. J. Vanitha, Tutor (GPB)

THEORY

Unit I - Basics of Plant Tissue culture

Plant tissue culture: Concepts, history and scope, Media and Culture Conditions, Sterilization techniques, Regeneration methods - morphogenesis, organogenesis and embryogenesis, culture types, callus culture and cell suspension culture, shoot tip and meristem tip culture, anther and pollen culture, ovule and embryo culture.

Unit II - Applied Plant Tissue Culture

Micropropagation - banana and ornamental plants; National certification and Quality management of TC plants- Applications of organ culture - Meristem tip culture (virus free plants) and anther culture (doubled haploids)- Protoplast isolation and fusion, somaclonal variation, synthetic seeds, secondary metabolite production and invitro germplasm conservation.

UNIT III - Basic Molecular Biology

Genome organization- prokaryotes vs eukaryotes - Central dogma of life - Structure of nucleic acids - DNA replication, amino acids and their classification- genetic codes- transcription, translation and protein synthesis- Structure of a gene, regulation of gene expression, Operon concept- basic techniques in molecular biology-Blotting techniques- Polymerase chain reaction- DNA sequencing methods.

Unit IV - Recombinant DNA Technology and Genetic Transformation

DNA manipulation enzymes: Polymerases, restriction endonucleases and ligases - Different types of vectors: plasmids, phagemids, cosmids, BAC - Construction of recombinant DNA molecules- Bacterial transformation **-** Direct and indirect gene transfer methods in plants: microinjection, electroporation, particle bombardment, Agrobacterium mediated method - Tissue specific promoters, selectable and scorable markers, reporter genes- Molecular analysis of transgenic plants – Transgenic plants: herbicide, pest and disease resistant, abiotic stress resistant, nutritional enhancement and traits for improved quality-Detection of GMOs regulations and biosafety.

Unit V- Molecular Marker Technology and Molecular Breeding

DNA markers - hybridization based markers (RFLP) - PCR based markers: RAPD, SSR, AFLP, and SNPs - DNA fingerprinting of crop varieties – Development of mapping populations- linkage and QTL analysis- principles, methods and applications of Marker Assisted Selection in crop improvement- Applications of Plant Genomics and genome databases

Theory –Lecture Schedule

1. Plant tissue culture: Concepts, history and scope
2. Media and Culture Conditions and Sterilization techniques
3. Regeneration methods - morphogenesis, organogenesis and embryogenesis
4. Culture types - callus culture and cell suspension culture; shoot tip and meristem tip culture
5. Anther and pollen culture; ovule and embryo culture
6. Micropropagation - banana and ornamental plants
7. National certification and Quality management of TC plants
8. Meristem tip culture (virus free plants) and anther culture (doubled haploids)
9. Protoplast isolation and fusion- somaclonal variation-synthetic seeds
10. Secondary metabolite production, *invitro* germplasm conservation
11. Genome organization- prokaryotes vs eukaryotes
12. Central dogma of life - Structure of nucleic acids
13. DNA replication
14. Amino acids and their classification and genetic codes,transcription
15. Translation and protein synthesis
16. Fine structure of a gene
17. **In semester Examination**
18. Regulation of gene expression, Operon concept Blotting techniques and Polymerase chain reaction
19. DNA sequencing methods
20. DNA manipulation enzymes: Polymerases, restriction endonucleases and ligases
21. Different types of vectors: plasmids, phagemids, cosmids and BAC
22. Construction of recombinant DNA molecules- Bacterial transformation

23. Direct and indirect gene transfer methods in plants: microinjection, electroporation, particle bombardment, *Agrobacterium* mediated method
24. Tissue specific promoters, selectable and scorable markers, reporter genes
25. Molecular analysis of transgenic plants
26. Transgenic plants: herbicide, pest and disease resistant and abiotic stress resistant
27. Transgenic plants: nutritional enhancement and traits for improved quality
28. Detection of GMOs – regulations and biosafety
29. DNA markers - hybridization based markers (RFLP)
30. PCR based markers: RAPD, SSR, AFLP, and SNPs.
31. DNA fingerprinting of crop varieties
32. Development of mapping populations, Linkage and QTL analysis
33. Principles, methods and applications of Marker Assisted Selection in crop improvement
34. Applications of Plant Genomics and genome databases

Practical Schedule

1. Biotech Laboratory organization, safety regulations
2. Basics of reagents and solution preparation
3. Plant tissue culture media preparation- shoot tip culture (rose)
4. Meristem culture (tapioca)
5. Micro propagation of banana
6. Callus culture
7. Culturing of *E.coli* and determination of growth curve
8. Isolation of bacterial plasmid DNA
9. Restriction Digestion and Ligation
10. Competent cell preparation and Bacterial transformation
11. Confirmation of transformation through colony screening
12. DNA extraction from plants
13. Quantification of DNA and quality check through Agarose gel electrophoresis
14. DNA fingerprinting using RAPD/SSR markers
15. NTSys- analysis of diversity in crop plants
16. Visit to tissue culture units /biotech lab in seed industry/Bt cotton field/tissue culture banana field
17. **University Practical Examination**

Text Books

1. Chawla, H S. (2009). *Introduction to Plant Biotechnology* (3rd ed.). London: CRC Press. pp. 1 - 698.
2. George, E.F, Hall M. A. & Geert-Jan De Klerk. (2009). *Plant Propagation by Tissue Culture* (3rd ed.). The Netherlands: Springer. pp. 1 - 504.
3. Neal Stewart, Jr. C. (2008). *Plant Biotechnology and Genetics: Principles, Techniques and Applications.* New Jersey: John Wiley & Sons, Inc. pp. 1 - 432.
4. Nelson, D.S. & Cox, M.M. (2012). *Lehninger's Principles of Biochemistry* (6th ed.). New York*:* W.H. Freeman and Company. pp. 1 – 1336.
5. Xu,Y. (2010). *Molecular Plant Breeding. International Maize and Wheat Improvement Centre (CIMMYT)*. pp 1 - 338.

Reference Books

1. Colin Ratledge & Bjorn Kristiansen. (2006). *Basic Biotechnology.* England: Cambridge University Press. pp. 1 – 573.
2. Colin Ratledge & Bjorn Kristiansen. (2006). *Basic Biotechnology.* England: Cambridge University Press. pp. 1 – 573.
3. Denis Murphy. (2007). *Plant Breeding and Biotechnology.* England: Cambridge University Press. pp. 1 – 453.
4. John E. Smith. (2004). *Biotechnology*. England: Cambridge University Press. pp. 1 – 207.
5. Singh, H.P., Uma, S., Selvarajan, R. & Karihaloo, J.L.. (2011). *Micropropagation for Production of Quality Banana Planting Material in Asia-Pacific.* New Delhi:Asia-Pacific Consortium on Agricultural Biotechnology. pp. 1 – 79.

Web-References

1. https://www.usda.gov/topics/biotechnology/biotechnology-frequently-asked-questions-faqs

2. https://www.greenfacts.org/en/gmo/3-genetically-engineered-food/1-agricultural-biotechnology.htm
3. https://www.fda.gov/food/consumers/agricultural-biotechnology
4. https://science.howstuffworks.com/life/genetic/agricultural-biotechnology.htm
5. https://www.nature.com/scitable/knowledge/library/history-of-agricultural-biotechnology-how-crop-development-25885295/

Journals

1. Agricultural Biotechnology
2. Chinese Journal of Agricultural Biotechnology
3. Journal of Crop Science and Biotechnology
5. Biocatalysis and Agricultural Biotechnology
6. Agricultural biotechnology (Nature)

Course Nature: Theory based Practical							
Total Marks (100)							
S.No.	**Category**	**Assessment Tools**					
		In- Semester Examination	Assignment	Record	Attendance	End-Semester Examination	Marks
1	Theory-External	-	-		-	50	50
2	Theory-Internal	20	-			-	20
3	Practical-External	-	-		-	15	15
4	Practical-Internal	-	05	05	05	-	15
						Grand Total	100

Course Code	AGE19501	Course Name	PRACTICAL CROP PRODUCTION-I (*KHARIF* CROPS)	Course Category	C	Compulsory Core	L	T	P	C
							0	0	1	1

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department		*AGRONOMY*	Data Book / Codes/Standards	*Nil*	

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1:	Acquire adequate knowledge and skills of crop production and cropping system
CLR-2:	Acquire the knowledge of soil fertility and weed management besides plant protection and crop harvesting
CLR-3:	Agricultural Technology needs to learn about package of practices for various seasonal crops
CLR-4:	Learn the principles of the scientific basis of crop and plant production sciences
CLR-5:	Familiarize with the preparation of cost estimates for production of kharif crops
CLR-6:	-

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Agriculture Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	Ability to solve scientific problems	Ability to implement knowledge gained	Ability to understand social and ethical responsibilities
CLO-1:	Demonstrate a conceptual understanding of key aspects of cultivation practices required to grow the major crops (Rice) successfully.	2	80	75	H						H		M	H		H	L	M	M
CLO-2:	Evaluate the critical management factors involved in profitable crop production	2	80	75	H					L	H					H	H	H	H
CLO-3:	Demonstrate a thorough and deep understanding of the agronomic factors involved in producing crops in integrated, sustainable crop production system	3	90	85	H		H	M		L			H	H		H	M	H	M
CLO-4:	Demonstrate in-depth practical knowledge in crop production	3	85	70	H					L						H	M	M	M
CLO-5:	Appraise the practical knowledge of major crop production	2	90	85	H	M				L	H		H			H	H	H	
CLO6:	-																		

Lab/Practical (2 hrs.)		Learning Unit / Module 1	Learning Unit / Module 2	Learning Unit / Module 3	Learning Unit / Module 4	Learning Unit / Module 5
		8	8	8	8	
S-1	SLO-1	*Study of rice ecosystems*	*Practicing field preparatory operations*	*Acquiring skill in nutrient management*	*Estimation of yield and yield parameters in rice*	-
	SLO-2	*Seasons and varieties of Tamil Nadu.*	*Sectioning of field bunds and plastering, leveling and basal application of fertilizers*	*Practicing top dressing techniques*		-
S-2	SLO-1	*Selection of nursery area, preparation of nursery*	*Practicing transplanting techniques in lowland rice*	*Water management practices for lowland rice*	*Harvesting, threshing and Cleaning*	-
	SLO-2	*Application of manures and fertilizer to nursery*			*Drying and calculating the yield of produce*	-
S-3	SLO-1	*Acquiring skill in seed treatment, seed soaking*	*Estimation of plant population*	*Observation of insect pests and diseases*	*Working out cost of cultivation and economics*	-
	SLO-2	*Nursery sowing and management*	*Acquiring skill in gap filling and thinning*			-
S-4	SLO-1	*Practice of main field preparation*	*Weeds and weed management in rice*	*Recording growth characters of rice*	-	-
	SLO-2	*Puddling operations*			-	-

Learning Resources	1. Crop Production Guide. (2020). Directorate of Agriculture, Chennai and Tamil Nadu Agricultural University, Coimbatore. pp. 1-460. 2. Mukund Joshi., (2015). *Text Book of Field Crops.* PHI Learning Private limited. New Delhi. pp. 1-28.	3. Rajendra Prasad. (2016). *Textbook of Field Crops Production (Volume 1).* Indian Council of Agricultural Research (ICAR), New Delhi. pp. 1-64. 4. Shouichi Yoshida. (1981). *Fundamentals of Rice.* IRRI. Philippines. pp. 1- 268.

Level of Thinking		Continuous Learning Assessment (60% weightage)		University Practical Examination (40%)
		In semester (40%)	Practical (20%)	
Level 1	**Remember**	35%	35%	35%
	Understand			
Level 2	**Apply**	40%	40%	40%
	Analyze			
Level 3	**Evaluate**	25%	25%	25%
	Create			
	Total	100%	100%	100%

Course Designers		
Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
Mr. Sivakumar Madras iyer thottam organic farm, Kondappa naicken palayam, Sathyamangalam, Tamil Nadu 638503.	Dr. S. Sanbagavalli, Associate Professor (Agronomy), Department of Agronomy, Tamil Nadu Agricultural University, Coimbatore - 3	Dr. S. Marimuthu Dr. N. Krishnaprabu Dr. D. Selvakumar

Practical Schedule:

- Rice *(Transplanted rice or Direct sown rice):*

Transplanted rice:

Rice ecosystems - Climate and weather - Seasons and varieties of Tamil Nadu. Preparation of nursery - Application of manures to nursery - seed treatment - Forming nursery beds and sowing seeds - Weed management and plant protection to nursery. Preparation of main field - Application of organic manures - Green manuring - Bio-fertilizers - Pulling out seedlings and transplanting - Rajarajan 1000 (SRI) - Application of herbicides - Water management - Nutrient management - Plant protection measures - Mechanization in rice cultivation - Recording growth, yield attributes and yield. Harvesting, threshing, drying and cleaning the produce - Working out cost of cultivation and economics.

Practical Schedules

Transplanted rice:

1. Study of rice ecosystems, climate, weather, seasons and varieties of Tamil Nadu.
2. Selection of nursery area, preparation of nursery, application of manures and fertilizer to nursery.
3. Acquiring skill in seed treatment, seed soaking and incubation, nursery sowing and management.
4. Study and Practice of main field preparation and puddling operations.
5. Practicing of field preparatory operations - sectioning of field bunds and plastering, leveling and basal application of fertilizers.
6. Practicing transplanting techniques in lowland rice.
7. Estimation of plant population and acquiring skill in gap filling and thinning.
8. Study of weeds and weed management in rice.
9. **In-Semester examination**
10. Acquiring skill in nutrient management and practicing top dressing techniques.
11. Study of water management practices for lowland rice.
12. Observation of insect pests and diseases and their management.
13. Recording growth characters of rice.
14. Estimation of yield and yield parameters in rice.
15. Harvesting, threshing and Cleaning, drying and calculating the yield of produce
16. Working out cost of cultivation and economics
17. **University Practical Examination**

Text Books

1. Mukund Joshi., (2015). *Text Book of Field Crops.* PHI Learning Private limited. New Delhi. pp. 1-28.
2. Rajendra Prasad. (2016). *Textbook of Field Crops Production (Volume 1).* Indian Council of Agricultural Research (ICAR), New Delhi. pp. 1-64.
3. Reddy, S.R. (2012). *Agronomy of field crops.* Kalyani publishers, New Delhi. pp. 1- 794.
4. Singh. S.S. (2015). *Crop management under irrigated and rainfed conditions.* Kalyani Publishers, New Delhi. pp. 1- 574.

Reference Books

1. Crop Production Guide. (2020). Directorate of Agriculture, Chennai and Tamil Nadu Agricultural University, Coimbatore. pp. 1-460.
2. Shouichi Yoshida. (1981). *Fundamentals of Rice.* IRRI. Philippines. pp. 1- 268.
3. Srinivasan Jeyaraman. (2018). *Field crops production and management (Volume I).* Oxford and IBH Publishers. India. 21- 91.
4. Yellamanda Reddy, T. and Sankara Reddy, G.H. (2017). *Principles of Agronomy.* Kalyani publishers, Ludhiana. pp. 1- 685

Web References

1. www. irri. org.
2. www.tawn.tnau.ac.in
3. www. crri. nic. in.
4. www. drrindia. org.

Journals

1. Research on crops
2. Rice science
3. Rice research
4. Advances in Agronomy
5. Agronomy Journal

Course Nature: Only Practical							
Total Marks (100)							
S. No.	**Category**	**Assessment Tools**					
		In- Semester Examination	Assignment	Record	Attendance	End-Semester Examination	Marks
1.	Practical-External	-	-	-	-	*40*	*40*
2.	Practical-Internal	*40*	*05*	*10*	*05*	-	*60*
						Grand Total	*100*

Course Code	AGS19501	Course Name	ENTREPRENEURSHIP DEVELOPMENT AND BUSINESS COMMUNICATION	Course Category	S	Supportive Course	L	T	P	C
							1	0	1	2

Pre-requisite Courses	Nil	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department		*Agricultural Economics*	Data Book / Codes/Standards	*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1 :	*Expose to the functional areas of agribusiness management and its applications*
CLR-2 :	*Understand the concept of entrepreneurship, entrepreneurial competencies*
CLR-3 :	*Learn about entrepreneurial opportunities*
CLR-4 :	*Gain Knowledge on various management issues in establishing a business and to inculcate success.*
CLR-5 :	*Understand the Networking techniques*
CLR-6 :	*Explore various types of business strategies and entrepreneurship concepts that should help define the learning methods and goals.*

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Agriculture Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	Ability to solve scientific problems	Ability to implement knowledge gained in the applied field of Business Management	Ability to understand social and ethical responsibilities
CLO-1 :	*Explain principles relevant for agribusiness and their applications for decision making*	*3*	*90*	*80*	*M*	*M*	*M*	*M*	*H*	*M*	*M*	*H*	*M*	*H*	*H*	*H*	*H*	*H*	*H*
CLO-2 :	*Gain knowledge on Business environment*	*1*	*90*	*85*	*H*	*M*	*M*	*L*	*M*	*H*	*M*	*M*	*L*	*H*	*H*	*H*	*H*	*H*	*H*
CLO-3 :	*Establish Small and Medium Enterprises*	*2*	*75*	*70*	*M*	*H*	*M*	*M*	*M*	*H*	*M*	*M*	*H*	*H*	*H*	*H*	*H*	*H*	*H*
CLO-4 :	*Explain the scope for Agribusiness*	*3*	*80*	*75*	*M*	*H*	*M*	*M*	*L*	*M*	*L*	*M*	*M*	*H*	*H*	*H*	*H*	*H*	*H*
CLO-5 :	*Identify Consumer behaviour analysis*	*2*	*85*	*80*	*M*	*M*	*M*	*M*	*M*	*M*	*M*	*M*	*M*	*H*	*H*	*H*	*H*	*H*	*H*
CLO6 :	*Demonstrate the techniques in Capital Management and Financial management of Agribusiness*	*2*	*85*	*80*	*M*	*H*	*M*	*M*	*H*	*L*	*M*	*L*	*M*	*H*	*H*	*H*	*H*	*H*	*H*

Duration (hour)		Learning Unit / Module 1	Learning Unit / Module 2	Learning Unit / Module 3	Learning Unit / Module 4	Learning Unit / Module 5
		9	12	6	9	12
S-1	SLO-1	*Concept of Entrepreneurship*	*Principles of innovation*	*Management Functions*	*Staffing – Job Analysis,*	*Functional Areas of Management –*
	SLO-2	*Types of Entrepreneurship*	*Sources of innovative opportunities*	*Types of Plans and Steps in Planning*	*Human Resource Planning Process, Recruitment and Selection*	*Operations Management – Meaning and Scope*
S-2-3	SLO-1	***Lab 1:**Assessment of entrepreneurial traits*	***Lab 4:** Market survey for understanding customer needs*	***Lab 8:** Financing new agribusiness ventures - Visit to banks / discussion*	***Lab 10:** Preparation of Advertisement and Sales Promotion Measures for Agribusiness*	***Lab 13:** Calculation of Break Even Point and its Business Implication*
	SLO-2					
S-3	SLO-1	*Characteristics of Entrepreneurs and Entrepreneurial Skills,*	*Business environment – Micro and Macro environment, Agribusiness – Importance, Opportunities and Challenges.*	*Organizing – Principles*	*Directing – Principles,*	*Supply Chain Management – Importance.*
	SLO-2	*Entrepreneurial process –– Importance of Entrepreneurship*	*Impact of economic reforms on Agribusiness/Agrienterprises*	*Departmentation*	*Techniques of directing and Supervision*	*Drivers and flows of SCM*
S-4-5	SLO-1	***Lab 2:** Identification of new business opportunities*	***Lab 5:** Starting new business - Visit to firms / discussion with entrepreneurs*	***Lab 9:** Exercise on Demand Forecasting for Agricultural Inputs/Products*	***Lab 11:** Exercise on Inventory Management – EOQ Model and ABC Analysis*	***Lab 14:** Business Plan Preparation*
	SLO-2					
S-6	SLO-1	*SWOT Analysis & achievement motivation.*	*KVIC classification*	-	*Controlling – Process and Types. .*	*Total Quality Management – Meaning*
	SLO-2	*Government policy and programs and institutions for entrepreneurship development.*	*Startup and Business incubators*	-	*Business leadership skills, communication, direction and motivation skills.*	*Principles of Total quality management*
S-7-8	SLO-1	***Lab 3:** Exercise on SWOT Analysis of*	***Lab 6:** Documenting Procedure for*	-	***Lab 12:** Exercise on discounted*	***Lab 15:** Understanding balance sheet and*

	SLO-2	*Agribusiness sectorin India*	*Establishing Agribusiness Firms*	-	*measures of capital budgeting*	*income statement*
S-9	**SLO-1**	-	*Agribusiness – Importance, Opportunities and Challenges.*	-	-	*Marketing Management – Market Segmentation and*
	SLO-2	-	*Impact of economic reforms on Agribusiness/Agrienterprises*	-	-	*Marketing Mix. Financial Management – Meaning, Objectives and Scope*
S-10-11	**SLO-1**	-	***Lab 7:** Government programs and institutions for entrepreneurship development*	-	-	***Lab 16:** Financial Perfromance Analysis - Ratio Analysis*
	SLO-2	-		-	-	

Learning Resources	1. Ashwathappa, K., (2013). Human Resource and Personnel Management. New Delhi: Tata McGraw Hill Publishing Co. Ltd. pp: 1-686. 2. Dollinger, M, J., (1999). Entrepreneurship Strategies and Resources. Upper Saddle River, New Jersey: Prentice-Hall. pp.1-259.	3. Mohanty S K. ,(2007). Fundamentals of Entrepreneurship. New Delhi: Prentice Hall India Ltd. pp. 1-203. 4. Koontz, H., & Weihrich, H., (2015). Essentials of Management. India: Tata McGraw Hill Education. pp. 1-265

Level of Thinking		Continuous Learning Assessment (35% weightage)		University Practical Examination (15%)	End semester theory Examination (50%)
		In semester (20%)	Practical (15%)		
Level 1	**Remember**	40 %	30 %	35%	30 %
	Understand				
Level 2	**Apply**	40 %	40 %	35%	40 %
	Analyze				
Level 3	**Evaluate**	20 %	30 %	30%	30 %
	Create				
	Total	*100 %*	*100 %*	*100%*	*100 %*

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Mr. K.Arun, Business Manager, EDII Periyakulam Horti Business Incubation Forum,Periyakulam	Dr. Venkatesa Palanisamy, Professor and Head, Centre for Agricultural and Rural Development Studies Department of Agricultural Rural Management, TNAU, Coimbatore	Dr. Anbarassan A Dr. Periasami N

THEORY

Unit I – Entrepreneur and Entrepreneurial Process
Concept and Types of Entrepreneurship - Characteristics of Entrepreneurs and Entrepreneurial Skills - Entrepreneurial process – Importance of Entrepreneurship. SWOT Analysis & achievement motivation, Government policy and programs and institutions for entrepreneurship development.

Unit II – Entrepreneurship Opportunities
Innovation - principles of innovation - Sources of innovative opportunities - Business environment – Micro and Macro environment - MSME Classification and Opportunities for rural entrepreneurship - KVIC classification, Start up and Business incubators. Agribusiness – Importance, Opportunities and Challenges. Impact of economic reforms on Agribusiness/Agrienterprises

Unit III – Managerial Functions – Planning and Organizing
Entrepreneurial development process, business leadership skills – Developing organizational skill, controlling, supervising, problem solving, monitoring & evaluation - Management Functions – Planning – Types of Plans and Steps in Planning, Organizing – Principles and Departmentation.

Unit IV – Managerial Functions – Staffing, Directing and Control
Staffing – Job Analysis, Human Resource Planning Process, Recruitment and Selection, Directing-Principles, Techniques and Supervision, Controlling – Process and Types. Business leadership skills, communication, direction and motivation skills.

Unit V – Functional Areas of Management
Operations Management – Meaning and Scope, Supply Chain Management – Drivers and flows and Total Quality Management – Meaning and Principles, Marketing Management – Market Segmentation and Marketing Mix Financial Management – Meaning, Objectives and Scope.

Theory Lecture Schedule
1. Concept of Entrepreneurship and Types of Entrepreneurship
2. Characteristics of Entrepreneurs and Entrepreneurial Skills, Entrepreneurial process –– Importance of Entrepreneurship
3. SWOT Analysis & achievement motivation, Government policy and programs and institutions for entrepreneurship development.
4. Innovation - principles of innovation - Sources of innovative opportunities
5. Business environment – Micro and Macro environment, MSME Classification and Opportunities for rural entrepreneurship
6. KVIC classification, Startup and Business incubators
7. Agribusiness – Importance, Opportunities and Challenges. Impact of economic reforms on Agribusiness/Agrienterprises
8. Management Functions – Planning – Types of Plans and Steps in Planning
9. **In-Semester examination**
10. Organizing – Principles and Departmentation
11. Staffing – Job Analysis, Human Resource Planning Process, Recruitment and Selection
12. Directing – Principles, Techniques and Supervision
13. Controlling – Process and Types, . Business leadership skills, communication, direction and motivation skills.
14. Functional Areas of Management – Operations Management – Meaning and Scope
15. Supply Chain Management – Importance, Drivers and flows
16. Total Quality Management – Meaning and Principles
17. Marketing Management – Market Segmentation and Marketing Mix. Financial Management –Meaning, Objectives and Scope

Practical Schedule
1. Assessment of entrepreneurial traits
2. Identification of new business opportunities
3. Exercise on SWOT Analysis of Agribusiness sectorin India
4. Market survey for understanding customer needs
5. Starting new business - Visit to firms / discussion with entrepreneurs
6. Documenting Procedure for Establishing Agribusiness Firms

7. Government programs and institutions for entrepreneurship development
8. Financing new agribusiness ventures - Visit to banks / discussion
9. Exercise on Demand Forecasting for Agricultural Inputs/Products
10. Preparation of Advertisement and Sales Promotion Measures for Agribusiness
11. Exercise on Inventory Management – EOQ Model and ABC Analysis
12. Exercise on discounted measures of capital budgeting
13. Calculation of Break Even Point and its Business Implication
14. Business Plan Preparation
15. Understanding balance sheet and income statement
16. Financial Performance Analysis - Ratio Analysis
17. **University Practical Examination**

Text Books

1. Aswathappa, K., (2013). Human Resource and Personnel Management. New Delhi: Tata McGraw Hill Publishing Co. Ltd. pp: 1-686.
2. Mohanty, S, K., (2007). Fundamentals of Entrepreneurship. New Delhi: Prentice Hall India Ltd. pp. 1-203.

Reference Books

1. Dollinger, M, J., (1999). Entrepreneurship Strategies and Resources. Upper Saddle River, New Jersey: Prentice-Hall. pp.1-259.
2. Koontz, H., & Weihrich, H., (2015). Essentials of Management. India: Tata McGraw Hill Education. pp. 1-265

Web- References

1. www.ediindia.org
2. www.iie.nic.in
3. www.msme.gov.in
4. www.niesbudtraining.org
5. www.nimsme.org
6. www.nsic.co.in
7. www.nabard.org

Journals

1. Indian journal of agribusiness management
2. Indian Journal of management
3. Journal of management research
4. Indian Journal of Agriculture Business
5. International Journal of Research in Business Management

Course Nature: Theory based Practical							
Total Marks (100)							
S.No.	**Category**	**Assessment Tools**					
		In- Semester Examination	Assignment	Record	Attendance	End-Semester Examination	Marks
1	Theory-External	-	-		-	50	50
2	Theory-Internal	20	-			-	20
3	Practical-External	-	-		-	15	15
4	Practical-Internal	-	05	05	05	-	15
						Grand Total	100

Course Code	HOR19507	Course Name	PRODUCTION TECHNOLOGY FOR ORNAMENTAL CROPS, MAP AND LANDSCAPING	Course Category	S	Supportive Course	L	T	P	C
							1	0	1	2

Pre-requisite Courses	Nil	Co-requisite Courses	NIL	Progressive Courses	Nil
Course Offering Department	Horticulture	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1	Gain knowledge on the contributions of ornamental, MAP and Landscape design
CLR-2	Understand different landscape designing by CAD
CLR-3	Gain knowledge on postharvest technology in flower crops open and closed condition
CLR-4	Acquire technical knowledge on nursery management
CLR-5	Learn about the scope and importance of Medicinal and Aromatic plants
CLR-6	Gain information on seed production and oil extraction methods

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)													
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Identification of cut flowers	Identification loose flowers	Design & layout	Analysis, varietal Description	Protected structure	Culture practices	Environment problem	Propagation methods	Skill in medicinal plants	Skill in aromatic plants	Project Mgt. & Finance	Life Long Learning	Ability to solve scientific problems through Horticulture	Ability to implement knowledge gained in field of Horticulture	Ability to understand processing
CLO-1:	Exhibit skills on identify cut and loose flowers varieties	3	90	80	M								M	H		H	H	H	H
CLO-2:	Manage in solving field problems	1	95	85	H								L	H		H	H	H	H
CLO-3:	Appraise about protected structure for propagation	2	80	70	M		L	L					L	H		H	H	H	H
CLO-4	Integrate the knowledge on postharvest handling techniques of medicinal and aromatic crops produce for export.	3	75	65	M			L	L				M	H		H	H	H	H
CLO-5	Demonstarte on the quality control medicinal and aromatic crops	2	75	60	L	L							M	H		H	H	H	H
CLO-6	Identify and find solutions for field problems	2	75	65	L						H		M	H		H	H	H	H

Duration (hour)		Learning Unit / Module 1	Learning Unit / Module 2	Learning Unit / Module 3	Learning Unit / Module 4	Learning Unit / Module 5
		3	4	3	3	3
S-1	SLO-1	Scope of cultivation practices	Identifying cut flowers rose	Valve addition of loose flowers	Botanical classification of medicinal plants	Cultivation practices of Ocimum and minit
	SLO-2	Important Institutions	Protect technology in flowers crops	Cultivation practices in gladiolus tuberose	Medicinal proper of Ashwagandha and periwinkle	Medicinal and oil extraction of Ocimum, Mint and Economic importance
S 2-3	SLO-1	Practical:1 Identification of garden compounds and maintenance in garden	Practical5: Practices of nursery bed preparation, seed sowing flower crops	Practical9: identification of medicinal and aromatic plants and their economic parts	Practical12: Propagation techniques, planting, cultural operations in Ocimum, Mint, Geranium	Practical15: Extraction essential oils and distillation of medicinal & Aromatic crops
	SLO-2					
S-4	SLO-1	Export potential	Export technology of cut flowers Gerbera and carnation	Pinching practices maturity index in marigold	Skill in identifying cultivation practices in Glory lily and Isabgol	Cultivation practices of Geranium and Citronella
	SLO-2	Uses of ornamental and landscape	Perfume extraction methods	Knowledge on PGR in open cultivation of flowers chrysanthemum	Processing and marketing	Direct and transplanting technology
S 5-6	SLO-1	Practical2: Identification and selection of trees, shrubs climbers for landscape garden and their uses	Practical6: Training and pruning, intercultural operations in Ornamental flower crops	Practical10: Propagation techniques, planting, intercultural operations in Periwinkle and Aswagandha	Practical13: Propagation techniques, planting, cultural operations in lemon grass, Palmarosa, vetiver and citronella	Practical16: Visit to commercial flower /Medicinal and Aromatic Plants unit
	SLO-2					
S-7	SLO-1	Principles of landscape gardening	Cultivation practices on lilium, orchids	Cultivation practices in jasmine	Gel extraction technology of Alovera	Cultivation practices in Lemon grass and palmarosa
	SLO-2	Value of MAP	Processing technology of ornamental flower crops	Identifying the varietal description Jasmine and oil extraction method	Medicinal value of	Cultivation concept of vetiver and economic uses in trade
S 8-9	SLO-1	Practical3: Preparation and drawing of site plan, Learning the basics in computer aided design (CAD) for developing a garden landscape plan	Practical7: Protected structures – care and maintenance of major flower crops grown in India	Practical11: Propagation techniques, planting, cultural operations in Isabgol,Glory lily and Alovera	Practical14: Processing and value addition in medicinal and aromatic plants	University Practical Examination
	SLO-2					

S-10-11	SLO-1	*Practical4: Identification and varietal description of commercially important cut flower and ornamental flower crops*	*Cultivation practices in chrysanthemum and marigold*	-	-	-
	SLO-2		*Extraction of oil*	-	-	-
S 12-13		-	*Practical8: Harvesting and postharvest handling of cut and loose flowers*	-	-	-
					-	-

Learning Resources	1. N.Kumar (2014) Introduction to spices, plantation crops, Medicinal and Aromatic plants 2nd edition published by Oxford and IBH publishing CO.PVT.LTD 2. Singh Anil. Et All (2017) text book of floriculture and landscaping	3. Serdar Oztekin, Milan Martinov (2008) Medicinal and Aromatic crops: Harvesting, Drying and Processing 1st Ed pp:186 CRC Press

Level of Thinking		Continuous Learning Assessment (35% weightage)		University Practical Examination (15%)	End semester theory Examination **(50%)**
		In semester (20%)	Practical (15%)		
Level 1	**Remember**	40 %	30 %	35%	30 %
	Understand				
Level 2	**Apply**	40 %	40 %	35%	40 %
	Analyze				
Level 3	**Evaluate**	20 %	30 %	30%	30 %
	Create				
	Total	*100 %*	*100 %*	*100%*	*100 %*

Course Designers		
Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
Gorthi Nagarjuna Naidu General manager (Tanflora) naidugorthi@gmail.com	Dr. Arumugam Head of department TNAU Periyakulam	K.Nivetha **(**Horticulture) C.Kanimozghi **(**Horticulture)

THEORY

Unit I- Introduction to Flower, Medicinal, Aromatic Crops and Landscaping

Scope and Importance of ornamental flower crops, medicinal, Aromatic and landscaping - area, production, productivity and export potential of flower crops, Medicinal, Aromatic crops and Elements and Principles of landscaping – Landscape uses of trees, shrubs and climbers CAD- Garden Moghul, English, Italian, Persian and Japanese

Unit II- Production Technology of Cut Flower Crops Under Protected Conditions

Protected structures - controlled environmental conditions –Soil sterilization – factors influencing protected cultivation – cut flower production- flower forcing.

Soil and climate – Botany – species and varieties - propagation –principles and practices – planting systems and methods – pinching, training and pruning practices – nutrient and water management – role of growth regulators – inter cultivation – Harvest and yield

Crops: Roses, Carnation, Lilium, Gerbera and Orchids

Unit III- Production Technology of Flowers Under Open Conditions and Value Addition in Ornamental Crops

Soil and climate – Botany – species and varieties - propagation –principles and practices – planting systems and methods – pinching, training and pruning practices – nutrient and water management – role of growth regulators – inter cultivation – Harvest and yield

Crops: Gladiolus, Tuberose, Chrysanthemum, Marigold and Jasmine - Processing Value Addition - Ornamental Crops.

Unit IV- Production Technology of Medicinal Crops

Medicinal crops- importance and scope – current status - soil and climate – varieties – propagation– planting methods – nutrient, irrigation and organic practices – harvest and yield– post-harvest handling – storage and packaging

Crops: Periwinkle, Asparagus, Aloe, Isabgol, Glory Lily and Costus-Extraction and Value Addition of Medicinal Crops.

Unit V- Production Technology of Aromatic Crops

Aromatic crops - importance and scope – current status - soil and climate – varieties – propagation– planting methods – nutrient, irrigation and organic practices – harvest and yield – post-harvest handling – storage and packaging

Crops: Ocimum, Mint, Geranium, Citronella, Lemon Grass,Palmarosa And Vetiver – Distillation of Oil and Value Addition.

Theory Schedule

1. Scope and importance of Flower crops, Medicinal crops, Aromatic and landscaping
2. Area, production, productivity and export potential of Flower crops, Medicinal, Aromatic crops and Landscaping
3. Principles and concepts of landscape gardening
4. Components of garden, type of garden Moghul, English, Italian, Persian and Japanese
5. Production technology of Cut Rose under protected condition
6. Production technology of Gerbera and Carnation under protected condition
7. Production technology of lilium and orchids under protected conditions
8. Production technology of Gladiolus and Tuberose under open conditions
9. **In-semester examination**
10. Production technology of Chrysanthemum and Marigold under open conditions
11. Production technology of Jasmine under open conditions
12. Production technology of Aswagandha and Periwinkle
13. Production technology of Isabgol and Glory lily
14. Production technology of Aloevera, Costus
15. Production technology of Vetiver and Ocimum
16. Production technology of Mint and Lemon grass
17. Production technology of Geranium, Citronella and Palmarosa

Practical Schedule

1. Identification of garden compounds and maintenance in garden
2. Identification and selection of trees, shrubs climbers for landscape garden and their uses
3. Preparation and drawing of site plan, Learning the basics in computer aided design (CAD) for developing a garden landscape plan
4. Identification and varietal description of commercially important cut flower and ornamental flower crops
5. Practices of nursery bed preparation, seed sowing flower crops
6. Training and pruning, intercultural operations in Ornamental flower crops
7. Protected structures – care and maintenance of major flower crops grown in India
8. Harvesting and postharvest handling of cut and loose flowers
9. Identification of medicinal and aromatic plants and their economic parts
10. Propagation techniques, planting, intercultural operations in Periwinkle and Aswagandha,
11. Propagation techniques, planting, cultural operations in Isabgol, Glory lily and Alovera
12. Propagation techniques, planting, cultural operations in Ocimum, Mint and Geranium
13. Propagation techniques, planting, cultural operations in lemon grass, Palmarosa, vetiver and citronella
14. Processing and value addition in medicinal and aromatic plants
15. Extraction essential oils and distillation of medicinal & Aromatic crops
16. Visit to commercial flower /Medicinal and Aromatic Plants unit
17. **University Practical Examination**

Text Books

1. Anil Kumar Verma, Anil Gupta,Dharminder Kumar and Mast Ram Dhiman (2012) Post Harvest technologies for Commercial floriculture, New India Publishing Agency 2nd edition pp:1-230
2. Ankan Das, Amit Baran Sharangi (2018) Indian spices: The legacy, production and processing of India Treasured Export 1st ed pp:1- 203
3. Gupta R.K (2010) Medicinal and aromatic plants, CBS publication 2nd edition pp1-201
4. Kumar.N (2017) Introduction to spices, plantation crops, medicinal and Aromatic plants 2nd Edition Oxford and IBH publishing pp1-250
5. Singh Anil. Et All (2017) text book of floriculture and landscaping 2nd edition pp1-124
6. Singh.A.K (2006) Flower crops cultivation and management, New India publishing 1st edition pp1-245
7. Serdar Oztekin, Milan Martinov (2008) Medicinal and Aromatic crops: Harvesting, Drying and Processing 1st Ed pp:1-186 CRC Press

References Books

1. Arora, J.S. 2006. Introductory Ornamental Horticulture. Kalyani Publishers, Ludhiana pp:1-254
2. Bhattacharjee,S.K 2004. Landscape Gardening and Design with plants. Aavishkar Publishers and Distributers, Jaipur Vol2 1st edition pp1-310
3. Bhattacharjee, S.K and De L.C (2003) Advanced Commercial Floriculture Vol. (1) Aavishkar publishers, Distributors, Jaipur. 1st edition pp1-127
4. Bose, T.K., Yadav, L.P., Pal. P., Das. P. and Parthasarathy, V.A., (2002) Commercial Flowers. Vol.1, Naya Prakash, Calcutta.1st edition pp1-200
5. Farooqi, M., M. M. Khan and M. Vasundhara. 2004. Production technology of medicinal and aromatic crops. Natural Remedies Pvt. Ltd., Bangalore – 561229. pp1-175
6. Kumar, N. Introduction to Spices, Plantation, Medicinal and Aromatic crops. 1995. Oxford and IBH Publications, New Delhi.1st edition pp:315

Web- References

1. http://www.theflowerexport.com
2. http:// www.intuxford.tripod.com
3. http://www.webct.uark.edu
4. http://www.pubmed.com
5. http://www.bestgarden.net/
6. http://www.indiaagronet.com/
7. http://www.intuxford.tripod.com/
8. http://www.lawngrasses.com/
9. http://www.frlht.org
10. www.herbs.org

11. https://youtu.be/thaeC99H8FE
12. https://youtu.be/V5KODz92wLc

Journals

1. Ind. J. of Hort., The Horticultural Society of India, Indian Agricultural Research Institute, New Delhi.
2. Journal South Indian Hort., South Indian Horticultural Society, TNAU, Coimbatore.
3. Journal ornamental Hort.
4. Journal of medicinal and aromatic plants
5. Journal of Indian Perfumer
6. Journal of floriculture and landscaping

Course Nature: Theory based Practical							
Total Marks (100)							
S.No.	**Category**	**Assessment Tools**					
		In- Semester Examination	Assignment	Record	Attendance	End-Semester Examination	Marks
1	Theory-External	-	-		-	*50*	*50*
2	Theory-Internal	*20*	-			-	*20*
3	Practical-External	-	-		-	*15*	*15*
4	Practical-Internal	-	*05*	*05*	*05*	-	*15*
						Grand Total	*100*

Course Code	SUP19501	Course Name	RENEWABLE ENERGY AND GREEN TECHNOLOGY	Course Category	S	*Supplementary Course*	L	T	P	C
							1	0	1	2

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Agricultural Engineering*	Data Book / Codes/Standards		*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1 :	*Gain knowledge on the contributions of different scientists in the development of field of renewable energy*
CLR-2 :	*Understand different energy techniques and their role in agricultural operations*
CLR-3 :	*Gain information on the different energy conservation techniques and their uses*
CLR-4 :	*Acquire technical knowledge on the gasifiers biomass production used*
CLR-5 :	*Learn about technologies present on renewable energy side*
CLR-6 :	*Comprehend the technologies used in renewable engineering*

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Agriculture Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	Ability to solve scientific problems through Agricultural Engineering	Ability to implement knowledge gained in the applied field of Agricultural Engineering	Ability to understand social and ethical responsibilities of Agricultural Engineering
CLO-1 :	*Identify and differentiate the importance of renewable energy*	*3*	*90*	*80*	*M*								*M*	*H*		*H*	*H*	*H*	*H*
CLO-2 :	*Distinguish different components of renewable energy technologies*	*1*	*95*	*85*	*H*								*L*	*H*		*H*	*H*	*H*	*H*
CLO-3 :	*Compare different solar energy technologies*	*2*	*80*	*70*	*M*		*L*	*L*					*L*	*H*		*H*	*H*	*H*	*H*
CLO-4 :	*Classify various energy conservation techniques*	*3*	*75*	*65*	*M*			*L*	*L*				*M*	*H*		*H*	*H*	*H*	*H*
CLO-5 :	*Estimate the cost benefit economics of various renewable energy technologies*	*2*	*75*	*60*	*L*	*L*							*M*	*H*		*H*	*H*	*H*	*H*
CLO6 :	*Demonstrate different equipment used in renewable engineering side*	*2*	*75*	*65*	*L*						*H*		*M*	*H*		*H*	*H*	*H*	*H*

Duration (hour)		Learning Unit / Module 1	Learning Unit / Module 2	Learning Unit / Module 3	Learning Unit / Module 4	Learning Unit / Module 5
		(8)	11	8	11	10
S-1	SLO-1	*Energy - energy unit conversion*	*Biomass - methods of energy conversion*	*Biogas - science of production of biogas*	*. Introduction to solar energy - solar radiation*	*Wind energy - Energy available in wind*
	SLO-2	*classification of energy sources*	*biomass utilization for biofuel production*	*factors affecting biogas production*	*instruments for measuring solar radiation*	*components of WECS*
S-2-3	SLO-1	***Lab 1:** principles of working of renewable energy gadgets*	***Lab 4:** principle of KVIC biogas plant*	***Lab 7:** different types of agro residue gasifier*	***Lab 10:** solar cookers.*	***Lab 13:** solar street light and solar lantern*
	SLO-2					
S-4	SLO-1	*Contribution of energy sources in agricultural sector*	*Biochemical conversion methods*	*Biogas plant - types*	*solar collector - types*	*Wind mills – types of wind mill*
	SLO-2	*potential and achievements in India*	*Biochemical conversion methods Application in Agriculture*	*Application of biogas- Biodigested slurry*	*solar cooker and Heater*	*Advantages and disadvantages of wind mills*
S-5-6	SLO-1	***Lab: 2** production process of biodiesel*	***Lab 5:** principle of KVIC biogas plant*	***Lab 8:** different solar energy gadgets*	***Lab 11:** Study of distillation*	***Lab 14:** Study of solar fencing*
	SLO-2					
S-7	SLO-1	-	*Bio-fuels – importance*		*Drying - solar drying*	
	SLO-2	-	*Biodiesel production*		*classification of solar dryer*	
S 8-9		***Lab 3:** prodution process of bio fuel - bioethanol*	***Lab 6:** types of agro residue gasifier*	***Lab 9:** solar drying systems.*	-	***Lab 15:** solar water pumping*
S 10	SLO-1	-	*Thermochemical conversion methods*	-	*Solar PV systems*	
	SLO-2	-	*Chemistry of gasification*	-	*solar water pumping -working principle*	-
S11-12		-		-	***Lab 12:** Study of solar pond*	***Lab 16:** Study of different types of wind mills.*
S13	SLO-1	-	*Gasifier - types and principle*	-	*. Solar pond - types of solar pond*	-
	SLO-2	-	*Gasifier –Applications*	-	*solar distillation - working principles*	-

Learning Resources	1. Jagadishwar Sahay, 2010. Elements of Agricultural Engineering. Standard Publishers Distributors, Delhi. ISBN: 978-8180140440 2. Renewable Energy: Power for a Sustainable Future, Godfrey Boyle.

Level of Thinking		Continuous Learning Assessment (35% weightage)		University Practical Examination (15%)	End semester theory Examination **(50%)**
		In Semester (20%)	Practical (15%)		
Level 1	**Remember**	*40 %*	*30 %*	*35%*	*30 %*
	Understand				
Level 2	**Apply**	*40 %*	*40 %*	*35%*	*40 %*
	Analyze				
Level 3	**Evaluate**	*20 %*	*30 %*	*30%*	*30 %*
	Create				
	Total	*100 %*	*100 %*	*100%*	*100 %*

Course Designers		
Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
		Dr. Suresh Nivritti Khatawkar

THEORY:

Unit I: Energy Scenario
Energy - energy unit conversion - energy crisis - Indian energy scenario - classification of energy sources - contribution of these sources in agricultural sector - significance - potential and achievements in India.

Unit II: Biomass and Biofuels
Biomass - methods of energy conversion - Familiarization with biomass utilization for biofuel production and their application. Biochemical conversion methods- bioalcohol and bio ethanol production from wood and sugar subtracts - effect of different parameters on ethanolproduction - application in agriculture. Bio-fuels - importance - biodiesel - chemistry ofbiodiesel production - production methods - flowchart - byproducts and their utilization asbioenergy resource - advantages and applications. Thermochemical conversion methods –chemistry of gasification - gasifier - types of gasifier - working principle - operation -applications- biooil

Unit III: Biogas
Biogas - science of production of biogas - feed stocks used - properties of feed stock -factors affecting biogas production - capacity determination. Biogas plant - Familiarization withtypes of biogas plants - KVIC - Janata - Deenbandhu model biogas plant - construction andworking principles - application of biogas - Bio-digested slurry

Unit IV: Solar Energy
Introduction to Solar energy - solar radiation - types of solar radiation - instrument formeasuring solar radiation - collection and their application - solar constant - Familiarizationwith solar energy gadgets: solar cooker, solar water heater, application of solar energy: solarcollector - types of solar collector - solar drying, solar photovoltaic system and their application -advantages and limitations - solar water pumping - working principle - advantages andapplications - solar lantern. Solar pond - types of solar pond - solar distillation - workingprinciples and applications.

Unit V: Wind Energy
Introduction to wind energy and their application - Wind mills - types - components -working principles - applications, advantages and disadvantages of wind mill.

Theory- Lecture schedule:
1. Energy - energy unit conversion - energy crisis - Indian energy scenario - classification of energy sources
2. Contribution of energy sources in agricultural sector - significance - potential and achievements in India
3. Biomass - methods of energy conversion - Familiarization with biomass utilization for biofuel production and their application.
4. Biochemical conversion methods - fermentation and anaerobic digestion - bioalcohol -principle of production of bio ethanol from wood and sugar subtracts - effect of different parameters on ethanol production - application in agriculture
6. Bio-fuels – importance. Biodiesel - chemistry of biodiesel production -transesterification - production methods – flow chart - byproducts and their utilization as bioenergy resource - advantages and applications.
7. Thermochemical conversion methods - combustion - pyrolysis - gasification – chemistry of gasification - gasifier - types of gasifier - working principle - operation – applications– Biooil.
8. Biogas - science of production of biogas - anaerobic digestion - feed stocks used -properties of feed stock - factors affecting biogas production - capacity determination.
9. Biogas plant - types of biogas plant - KVIC - Janata - Deenbandhu model biogas plant -construction and working principles - application of biogas - Biodigesed slurry
10. **In- Semester Examination**
11. Introduction to solar energy - solar radiation - characteristics of solar radiation -typesof solar radiation - instruments for measuring solar radiation - collection and their application - solar constant - availability of solar adiation.
12. Familiarization with solar energy gadgets for collection and storage of solar radiation -solar collector - types of solar collector. Solar water heater - components - types of solar water heater - working principle applications - solar cooker - working principles and merits and demerits.
13. Drying - solar drying - solar air heater - solar dryer - classification of solar dryer – natural and forced convection type solar dryer.
14. Solar PV systems - applications, advantages and limitations - solar water pumping -working principle - advantages and applications - solar lantern.
15. Solar pond - types of solar pond - solar distillation - working principles and applications.
16. Wind energy - Energy available in wind - WECS - components of WECS - wind power transmission - controls - applications.
17. Wind mills – types of wind mill - working principle - applications - advantages and disadvantages of wind mill.

Practical Schedule

1. Study of basic principles of working of renewable energy gadgets
2. Study of production process of biodiesel.
3. Study of production process of bio fuel - bioethanol.
4. Study of working principle of KVIC biogas plant.
5. Study of working principle of deenbandhu biogas plant.
6. Study of different types of agro residue gasifier.
7. Study of different types of briquetting machines.
8. Study of different solar energy gadgets.
9. Study of solar drying systems.
10. Study of solar cookers.
11. Study of distillation.
12. Study of solar pond
13. Study of solar street light and solar lantern.
14. Study of solar fencing.
15. Study of solar PV system - solar water pumping
16. Study of different types of wind mills.
17. **University Practical Examination**

Text Books

1. Renewable Energy: Power for a Sustainable Future, Godfrey Boyle.
2. Jagadishwar Sahay, 2010. Elements of Agricultural Engineering. Standard Publishers Distributors, Delhi. ISBN: 978-8180140440

References

1. S. Pugalendhi, R. Shalini, J. Gitanjali and P. Subramanian. 2017. Introduction to Renewable Sources of Energy. TNAU, Coimbatore
2. G.D. Rai. 2012. Nonconventional Energy Sources. Khanna Publishers, New Delhi.
3. C.S. Solanki, 2009. Renewable Energy Technologies : A Practical Guide for Beginners. PHI Learning Pvt. Ltd., New Delhi.
4. S. Rao and B.B. Parulekar. 2007. Energy Technology: Non-Conventional, Renewable and Conventional. Khanna Publishers, Naisarak, Delhi.
5. G.D. Rai. 1993. Solar Energy Utilisation. Khanna Publishers, New Delhi.
6. J. F. Manwell, J. G. McGowan and A. L. Rogers. 2009. Wind Energy Explained: Theory, Design and Application. Wiley & Sons Ltd.,
7. N. S. Rathore. A.K. Kurchania, N.L. Panwar. (2007). Non Conventional Energy Sources, Himanshu Publications.
8. N.S. Rathore. A. K. Kurchania, N.L. Panwar. (2007). Renewable Energy, Theory and Practice, Himanshu Publications.
9. K.C. Khandelwal. & S.S. Mandi. (1990). Biogas Technology

Journals

1. Journal of fundamentals of Renewable Energy and Application
2. Energy and Environmental Science
3. IEEE Tractions on Sustainable Energy
4. Advanced Energy Materials
5. Journal of Nature Energy

e-References

1. https://www.academia.edu/10759886/Handbook_of_Renewable_Energy_Technology
2. https://www.researchgate.net/publication/46279878_Handbook_of_renewable_energy_technology
3. https://www.agrimoon.com/renewable-energy-pdf-book/
4. http://ecoursesonline.iasri.res.in/course/view.php?id=524
5. http://cohvka.kau.in/sites/default/files/documents/renewable_energy.pdf
6. https://nptel.ac.in/courses/108105058

Course Nature: Theory based Practical							
Total Marks (100)							
S.No.	Category	Assessment Tools					
		In- Semester Examination	Assignment	Record	Attendance	End-Semester Examination	Marks
1	Theory-External	-	-		-	50	50
2	Theory-Internal	20	-			-	20
3	Practical-External	-	-		-	15	15
4	Practical-Internal	-	05	05	05	-	15
						Grand Total	100

Course Code	SUP19502	Course Name	GEOINFORMATICS AND NANO-TECHNOLOGY AND PRECISION FARMING	Course Category	S	*Supplementary Course*	L	T	P	C
							1	0	1	2

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Natural Resource Management*	Data Book / Codes/Standards		*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1 :	*Learn about sensor and GIS technology and its role in agriculture*
CLR-2 :	*Gain knowledge on precision farming technology*
CLR-3 :	*To be familiar with data analysis techniques, Machine learning (ML), and IoT*
CLR-4 :	*Learn the advances of agricultural nanotechnology*
CLR-5 :	*Acquire managerial practices using variable rate technology*
CLR-6 :	*Infer about Crop simulation model*

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Agriculture Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	Ability to solve scientific problems through precision farming	Ability to implement knowledge gained in the applied field of Geo-informatics	Ability to understand social and ethical responsibilities
CLO-1 :	*Having computational thinking to manage huge geospatial data and retrieve information*	*2*	*85*	*75*	*H*		*H*												
CLO-2 :	*Develop geospatial database*	*2*	*85*	*70*												*H*	*H*	*H*	*M*
CLO-3 :	*Practice precision farming*	*3*	*80*	*70*		*M*		*M*	*H*							*M*		*H*	
CLO-4 :	*Elaborate recent advances in agriculture such as sensor and nanotechnology*	*3*	*85*	*75*	*M*			*L*									*M*		
CLO-5 :	*GIS software for agriculture*	*2*	*80*	*70*	*M*	*H*							*H*	*M*	*H*	*H*	*H*		
CLO-6 :	*Ability to use Geoinformatics for research purpose*	*2*	*85*	*75*	*H*		*H*			*M*	*H*	*H*	*H*				*M*	*H*	*M*

Duration (hour)		Learning Unit / Module 1	Learning Unit / Module 2	Learning Unit / Module 3	Learning Unit / Module 4	Learning Unit / Module 5
		6	12	12	12	6
S-1	SLO-1	*Geoinfromatics – Objectives, scope and importance; Environmental challenges*	*Platforms and sensors: types and characteristics; Interpretation of Image - interpretation keys*	*Precision farming Definition - Scope and importance; principles and concepts*	*Smart Water Management – sensor network based automatic irrigation management system for agricultural crops*	*Nanotechnology- Definition, concepts and techniques; Introduction of nano-scale effects, nano-particles, nano-pesticides, nano-fertilizers, nano-sensors*
	SLO-2	*Basic concept and different technologies of Geoinformatics - Remote sensing (RS) – Global Positioning System (GPS)- Geographic Information System (GIS)*	*Digital Image Processing - Image Classification; aerial photographs and interpretation; data processing; application of satellite images in agriculture*			
S-2-3	SLO-1	***LAB 1** - Use of Google Earth, Bhuvan programs*	***LAB 3 -** Digital image processing*	***LAB 7 –** Designing variable rate fertilizer map for site specific nutrient management*	***LAB 11 –** Smart irrigation system, Smart sprayers for agro based application, Intelligent advance harvesting machines Fruit picking machine; grading and packing system*	***LAB 15-** Application of nano-sensors for plant protection*
	SLO-2					
S-4	SLO-1	*Remote sensing (RS) – Basic principle – concept – types*	*Ground sensors - Spectroradiometer, Chlorophyll meter (SPAD), Green Seeker; Processing of ground sensor data*	*Recent precision farming equipments / sensors / devices*	*Use of drones in precision farming*	*Use of nanotechnology in seed, water, fertilizer, plant protection for scaling-up farm productivity*
	SLO-2	*Spectral reflectance of earth features, Environmental remote sensing*	*Application of ground sensors in agriculture*		*Application of robotics in agriculture*	
S-5-6	SLO-1	***LAB 2 -** Satellite product and MOSDAC portal*			***LAB 12** –Demonstration of drone and robot in agriculture*	

	SLO-2		***LAB 4-*** *Application of spectroradiometer for development of vegetation index*	***LAB 8 –*** *Use of precision farming equipment/sensors/devices*		***LAB 16 –****Use of nano- seeds, nano-particles, nano-pesticides, and nano-fertilizers*
S-7	**SLO-1**	-	*Global Positioning Systems (GPS) - definition - working principles, source of error – accuracy*	*Variable rate technology - principles and applications; spatial and temporal variability; Variable rate input techniques - data acquisition and analysis*	*Machine Learning (ML) – introduction – tasks of learning- tasks of analysis*	-
	SLO-2		*Applications of GPS in agriculture*	*Soil mapping and fertilizer recommendation; Site Specific Nutrient Management; Variable Spraying, Mobile mapping system and its application in precision farming, precision based inter and intra row weeders*	*ML models – Support Vector Machine (SVM) – Artificial Neural Network (ANN), concept; applications in agriculture*	
S-8-9	**SLO-1**	-	***LAB 5****- Application of GPS in soil sampling*	***LAB 9-*** *Crop yield monitoring and mapping of rice crop*	***LAB 13 :*** *Hands on machine learning (ML) software*	-
	SLO-2					
S-10	**SLO-1**	-	*Fundamentals of GIS - Definition, concepts and methods, components and functions*	*Crop simulation models and their uses for optimization of agricultural Inputs - crop discrimination and yield monitoring*	*Applications of IOT in agriculture / agro-hydrology – recent IoT systems*	-
	SLO-2		*Raster and vector data models; Non-spatial data type, DBMS - relational DBMS; Georeferencing, Geofencing and map design*	*Yield mapping, weed mapping, salinity mapping*	-	
S-11-12	**SLO-1**	-	***LAB 6-*** *Use of spatial data in Arc-GIS / Open source GIS / Web-GIS for environmental studies*	***LAB 10-*** *Advance application of crop simulation model*	***LAB 14:*** Practicing IoT system for Agriculture	-
	SLO-2					

Learning Resources	1. Reddy, S. R. (2017). Geoinformatics and Nanotechnology for Precision Farming. First edition. Kalyani Publishers, India 2. Thomas & Kiefer R.W. (2007). Remote Sensing and Image Interpretation. John Wiley & Sons, New York

Level of Thinking		Continuous Learning Assessment (35% weightage)		University Practical Examination (15%)	End semester theory Examination (50%)
		In semester (20%)	Practical (15%)		
Level 1	**Remember**	60 %	50 %	50 %	60 %
	Understand				
Level 2	**Apply**	25 %	30 %	30 %	30 %
	Analyze				
Level 3	**Evaluate**	15 %	20 %	20 %	10 %
	Create				
	Total	*100 %*	*100 %*	*100%*	*100 %*

Course Designers		
Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
S. Bharat Vedmaya Software Technologies Pvt. Ltd., Chennai	Dr. Sandipan Das Symbiosis International University (Deemed to be University), Pune, India	Dr. Kamlesh Golhani Dr. M. Sanjeeva Gandhi

THEORY

Unit I – Concept of Geoinformatics

Geoinfromatics – Objectives, scope and importance; environmental challenges; basic concept and different technologies of Geoinformatics – Remote sensing (RS), Global Positioning System (GPS), Geographic Information System (GIS)

Unit II – Remote Sensing and Geographic Information System

Platforms and sensors – types and characteristics; interpretation of image – interpretation keys, Digital Image Processing (DIP) – Image Classification; aerial photographs and interpretation; data processing; application of satellite images in agriculture – ground sensors – spectroradiometer, chlorophyll meter (SPAD), Green Seeker; Processing of ground sensor data, Application of ground sensors in agriculture; Global Positioning Systems (GPS) – definition, working principles, source of error – accuracy, Applications of GPS in agriculture; Fundamentals of GIS – Definition, components and functions; Raster and vector data models; Non-spatial data type – Database Management system (DBMS), advantage of DBMS, relational DBMS; Georeferencing, Geofencing and map design

Unit III – Precision Farming Technology

Precision farming – Definition, scope and importance, principles and concepts; Recent precision farming equipments / sensors / devices; Variable rate technology – principles and application; spatial and temporal variability, variable rate machinery, precision based inter and intra row weeders; Soil mapping and fertilizer recommendation – Site Specific Nutrient Management; variable Spraying; Mobile mapping system and its application in precision farming; Crop simulation models and their uses for optimization of agricultural Inputs; Crop discrimination and yield monitoring – yield mapping, weed mapping, salinity mapping, pest and disease incidence forecasting; Smart Water Management – sensor network based automatic irrigation management system for agricultural crops; Use of drones in precision farming; application of robotics in agriculture, Smart sprayers for agro based application- Intelligent advance harvesting machines, Fruit picking machine; Grading and packing system

Unit IV – Machine Learning (ML) and Internet of Things (IOT)

Machine Learning (ML) – Introduction, tasks of learning, tasks of analysis; ML models – Support Vector Machine (SVM), Artificial Neural Network (ANN), concept, applications in agriculture – disease detection, weed detection, species recognition; IoT – applications of IOT in agriculture / agro-hydrology, recent IoT systems;

Unit V – Nanotechnology

Definition – concepts and techniques; brief introduction about nano-scale effects, nano-particles, nano-pesticides, nano-fertilizers, nano-sensors; Use of nanotechnology in seed, water, fertilizer, plant protection for scaling-up farm productivity

Theory –Lecture Schedule

1. Geoinfromatics – Objectives, scope and importance; environmental challenges; basic concept and different technologies of Geoinformatics – Remote sensing (RS) – Global Positioning System (GPS)- Geographic Information System (GIS)
2. Remote sensing (RS) – Basic principle – concept – types – spectral reflectance of earth features, Environmental remote sensing
3. Platforms and sensors: types and characteristics; Interpretation of Image – Interpretation keys, Digital Image Processing – Image Classification; aerial photographs and interpretation; data processing; application of satellite images in agriculture
4. Ground sensors – Spectroradiometer, Chlorophyll meter (SPAD), Green Seeker; Processing of ground sensor data, Application of ground sensors in agriculture
5. Global Positioning Systems (GPS) – definition – working principles, source of error – accuracy; Applications of GPS in agriculture
6. Fundamentals of GIS – Definition, concepts and methods, components and functions; Raster and vector data models; Non-spatial data type, DBMS - relational DBMS; Georeferencing, Geofencing and map design
7. Precision farming Definition – Scope and importance; principles and concepts
8. Recent precision farming equipments / sensors / devices
9. **In-semester examination**
10. Variable rate technology – principles and applications; spatial and temporal variability; Variable rate input techniques – data acquisition and analysis; soil mapping and fertilizer recommendation; Site Specific Nutrient Management; Variable Spraying, Mobile mapping system and its application in precision farming, precision based inter and intra row weeders
11. Crop simulation models and their uses for optimization of agricultural Inputs – crop discrimination and yield monitoring – yield mapping, weed mapping, salinity mapping
12. Smart Water Management – sensor network based automatic irrigation management system for agricultural crops
13. Use of drones in precision farming; application of robotics in agriculture
14. Machine Learning (ML) – introduction – tasks of learning- tasks of analysis; ML models – Support Vector Machine (SVM) – Artificial Neural Network (ANN), concept; applications in agriculture
15. Applications of IOT in agriculture / agro-hydrology – recent IoT systems
16. Nanotechnology- Definition, concepts and techniques; Introduction of nano-scale effects, nano-particles, nano-pesticides, nano-fertilizers, nano-sensors
17. Use of nanotechnology in seed, water, fertilizer, plant protection for scaling-up farm productivity

Practical Schedule

1. Use of Google Earth and Bhuvan programs

2. Satellite product and MOSDAC portal
3. Digital image processing
4. Application of spectroradiometer for development of vegetation index
5. Application of GPS in soil sampling
6. Use of spatial data in Arc-GIS/Open source GIS/Web-GIS for environmental studies
7. Designing variable rate fertilizer map for site specific nutrient management
8. Use of precision farming equipment/sensors/devices
9. Crop yield monitoring and mapping of rice crop
10. Advance application of crop simulation model
11. Smart irrigation system, Smart sprayers for agro based application,- Intelligent advance harvesting machines Fruit picking machine; grading and packing system
12. Demonstration of drone and robot in agriculture
13. Hands on machine learning (ML) software
14. Practicing IoT system for Agriculture
15. Application of nano-sensors for plant protection
16. Use of nano- seeds, nano-particles, nano-pesticides, and nano-fertilizers
17. **Universityl Practical Examination**

Text Books

1. Anji Reddy, M. (2008). *Textbook of Remote Sensing and Geographic Information Systems*. Third Edition. BS Publication, Hyderabad
2. Reddy, S. R. (2017). G*eoinformatics and Nanotechnology for Precision Farming*. First edition. Kalyani Publishers, India

Reference Books

1. Kang-tsungchang (2006). *Introduction to Geographic Information Systems*. Tata McGraw – Hill Publishing Company Limited, New Delhi.
2. Thomas & Kiefer R.W. (2007). *Remote Sensing and Image Interpretation*. John Wiley & Sons, New York

Web-References

1. www.geospatialworld.net
2. https://www.indiawaterportal.org/articles/remote-sensing-applications-book-nrsc-2010
3. https://www.nrcan.gc.ca/maps-tools-publications/satellite-imagery-air-photos/tutorial-fundamentals-remote-sensing/9309
4. https://www.ucdavis.edu/minors/precision-agriculture

Journals

1. International Journal of Remote Sensing
2. Remote sensing Letters
3. Journal of Indian Society of Remote Sensing
4. Remote sensing
5. Journal of Geographic Information System

Course Nature: Theory based Practical							
Total Marks (100)							
S.No.	**Category**	**Assessment Tools**					
		In- Semester Examination	Assignment	Record	Attendance	End-Semester Examination	Marks
1	Theory-External	-	-		-	*50*	*50*
2	Theory-Internal	*20*	-			-	*20*
3	Practical-External	-	-		-	*15*	*15*
4	Practical Internal	-	*05*	*05*	*05*	-	*15*
						Grand Total	*100*

Course Code	ELC19501	Course Name	APPLIED MICROBIOLOGY	Course Category	E	*Elective course*	L	T	P	C
							1	0	1	2

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Agricultural Microbiology*	Data Book / Codes/Standards	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1 :	*Learn the importance of microbes in food industry*
CLR-2 :	*Introduce students to different concepts of preservation methods to be adopted in food industry*
CLR-3 :	*Know about the lactic acid bacteria and their role in food fermentations*
CLR-4 :	*Gain Information on the alcoholic beverages, metabolites and antibiotics*
CLR-5 :	*Acquire knowledge about food borne infection and intoxications*
CLR-6 :	*Infer about the microbial standards on food safety*

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Agriculture Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	Ability to solve scientific problems through Applied Microbiology	Ability to implement knowledge gained	Social and ethical responsibilities
CLO-1 :	*Gain knowledge on the importance of microbes in food industry*	*3*	*85*	*75*	*M*								*L*	*H*		*H*	*H*	*H*	*H*
CLO-2 :	*Apply different preservation methods for food products*	*2*	*90*	*85*	*M*		*L*					*L*	*L*	*H*		*H*	*H*	*H*	*H*
CLO-3 :	*Implement the use of microbes for fermentation of food products*	*3*	*80*	*70*	*M*			*L*				*L*	*L*	*H*		*H*	*H*	*H*	*H*
CLO-4 :	*Demonstrate different techniques on the use of microbes in food industry*	*3*	*80*	*70*	*M*		*L*	*L*	*L*				*M*	*H*		*H*	*H*	*H*	*H*
CLO-5 :	*Identify different food borne infections and intoxications*	*3*	*75*	*60*	*L*			*L*	*M*			*L*	*M*	*H*		*H*	*H*	*H*	*H*
CLO6 :	*Elaborate about different safety standards and guidelines to be adopted in the food industry*	*1*	*85*	*75*	*L*							*L*	*M*	*H*		*H*	*H*	*H*	*H*

Duration (hour)		Learning Unit / Module 1	Learning Unit / Module 2	Learning Unit / Module 3	Learning Unit / Module 4	Learning Unit / Module 5
		9 (3)	11 (3)	11(3)	10(4)	9(3)
S-1	SLO-1	*Importance of microorganisms in food*	*Principles of food preservation*	*Production of cultures for food fermentation*	*Fermented alcoholic beverages-beer*	*Food infections*
	SLO-2	*Food as substrate for microorganisms*	*Preservation of food by Physical methods*	*Bread making*	*Fermented alcoholic beverages-wine*	*Food intoxications*
S 2-3	SLO-1	***Lab 1:** Preparation of food for analysis*	***Lab 4:**Assessing of Food Preservation*	***Lab 8:**Probiotic microorganisms form curd*	***Lab 10:** Acetobacter acetii from fruit juice*	***Lab 14:** identification of Vibrio sp. from fish*
	SLO-2					
S-4	SLO-1	*Factors affecting microbial growth in food*	*Preservation of food by chemical & irradiation*	*Fermented Milk products-Cheese*	*Microbial metabolites-organic acids*	*Food sanitation*
	SLO-2	*Types of microorganisms in food like meat, egg, poultry*	*Bio preservation of foods*	*Fermented Milk products –Yoghurt and its types*	*Microbial metabolites-Antibiotics*	*Indicators of food safety*
S 5-6	SLO-1	***Lab 2:** Enumeration of microorganisms-aerobic plate count*	***Lab 5:**Wine Making*	***Lab 9:**Yeast from fruit juice*	***Lab 11:** identification of Coliforms and E.coli in food*	***Lab 15:** Antibiotic producing microorganism - crowded plate technique*
	SLO-2					
S-7	SLO-1	*Microorganisms in vegetables , Fruits & Milk*	-	*Fermented vegetables-sauerkraut*	-	*Microbiological standards*
	SLO-2	*Microorganisms in cereals and cereal products*	-	*Fermented vegetables-Pickles*	-	*Guidelines for food safety*
S 8-9	SLO-1	***Lab 3:** Microbial quality of milk -MBRT method*	***Lab 6:**Yoghurt Preparation*	*Oriental fermented foods*	***Lab 12:** Identification of Salmonella in egg and poultry*	***Lab 16:** Antibiotic producing microorganism - cross streak assay*
	SLO-2			*Microorganisms as food*		
S 10-11	SLO-1	-	***Lab 7:** Saurekraut*	*Probiotics-Mechanism of action*	***Lab 13:** identification of Staphylococcus aureus in meat*	*Food Safety*

	SLO-2	-		*Prebiotics*	-	*Regulatory bodies for food safety*

Learning Resources	1.	Adams, M.R. and Moss M.O. (2008). Food Microbiology, III edition, RCS publishing, UK. ISBN: 978-0-85404-284-5. Pp. 1-463.
	2.	Dubey, R. C. (2014). A textbook of Biotechnology. IV edition. S. Chand Publishing, India. ISBN:9788121926089. Pp 1-616.

Level of Thinking		Continuous Learning Assessment (35% weightage)		University Practical Examination (15%)	End semester theory Examination (50%)
		In Semester (20%)	Practical (15%)		
Level 1	**Remember**	40 %	30 %	35%	30 %
	Understand				
Level 2	**Apply**	40 %	40 %	35%	40 %
	Analyze				
Level 3	**Evaluate**	20 %	30 %	30%	30 %
	Create				
	Total	*100 %*	*100 %*	*100%*	*100 %*

Course Designers		
Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
Mrs. Udaya, Dairy Development Officer,MILMA-TRCMPU Ltd, Ksheera Bhavan, Pattom.P.O, Thiruvananthapuram - 04	Dr. A. Viaya Gupta, Professor and Head Agricultural Microbiology, Advance Post Graduate Center, ANGRAU, Guntur-522034	Dr. Anbukarasi K Dr. Melvin Joe M

THEORY

Unit I: Microorganisms in Food

Micro-organisms and their importance in food microbiology–molds, yeast, bacteria, Factors affecting microorganisms in food-Intrinsic factors and Extrinsic factors; types of microorganisms in food like meat, egg, poultry, sea foods, vegetables, fruits, milk and milk products, cereals and cereal products.

Unit II. Preservation of Foods

Food preservation- principles-factors affecting preservation- methods of preservation-physical, chemical and biopreservation

Unit III: Microorganisms in Food Fermentation

Lactic acid bacteria – Production of cultures for food fermentation - Fermented foods- dairy products, cereals, & vegetables - yoghurt, cheese, kefir, kumiss, bread, sauerkraut, pickles -Oriental fermented foods- Soysauce, miso, tempeh - Microorganisms as food-single cell protein- Probiotics- health benefit and mechanism of action, prebiotics and synbiotics

Unit IV: Industrial Microbiology

Production of alcoholic beverages-beer, wine,. Microbial production of vitamins(Riboflavin & Vitamin B12), antibiotics(Penicillin and Streptomycin);

Unit V: Food Borne Diseases and Safety

Food borne infections and intoxications- foodborne pathogens- *E. coli, Salmonella, Clostridium, Staphylococcus aureus, Campylobacter, Vibrio, Yersinia,* Microbiological criteria – Detection of spoilage in food products- microbiological standards and guidelines for food safety -GMP-HACCP-Regulatory bodies for food safety standards

Theory –Lecture Schedule

1. Introduction- Historical developments – importance and scope of microorganisms in food, Food as substrate for microorganisms - Sources of microorganisms in food,
2. Intrinsic and extrinsic factors of food affecting microbial growth, Types of micro-organisms in food like meat, egg, poultry and sea foods
3. Types of microorganisms in food like vegetables, fruits, milk and milk products, cereals and cereal products
4. Food preservation: principles -preservation by physical methods-temperature, drying and irradiation
5. Preservation of foods by chemical methods & Biopreservation
6. Lactic acid bacteria-Lactic acid fermentation-Homo and Heterofermentative, Production of cultures for food fermentation, Fermented foods – bread
7. Fermented milk products – Microbiology of cheese and its types, Yogurt, curd, kefir, kumiss, acidophilus milk, Bulgarian sour milk
8. Fermented vegetables-sauerkraut, pickles
9. **In-Semester Examination**
10. Oriental fermented foods-Soysauce, miso, tempeh, natto. Microorganisms as food-Single cell protein
11. Probiotics- health benefit and mechanism of action, prebiotics, and synbiotics
12. Fermented alcoholic beverages – Wine and beer, Microbial metabolites-, vitamins (Riboflavin and Vitamin B12), antibiotics(Penicillin and Streptomycin)
13. Food borne infections and intoxications-principles-routes of transmission, Food borne pathogens - Gram positive pathogens (*Clostridium perfringens, Cl. botulinum, S.aureus, B.cereus, L. monocytogenes*)-symptoms, prevention and treatment
14. Food borne pathogens – Gram negative pathogens (*E.coli* group, *Salmonella* spp, *Shigella* sp., *Vibrio* spp., *Campylobacter jejuni*, *Cronobacter sakazaki*)- symptoms, prevention and treatment
15. Food sanitation, Indicators of food safety, GMP and HACCP
16. Microbiological criteria - Microbiological standards and guidelines for food safety.
17. Regulatory bodies for food safety

Practical Schedule

1. Food sampling techniques and preparation of sample homogenate for microbial analysis
2. Enumeration of microorganisms in normal and spoiled foods by aerobic plate count method
3. Assessing the microbial quality of milk by MBRT method
4. Assessing the effect of food preservatives on microorganisms
5. Fermented products-Wine making
6. Fermented products –Yoghurt Preparation
7. Fermented products-Saurekraut preparation
8. Isolation of probiotic microorganism-LAB from curd/idly batter
9. Isolation of yeast from fruit juice

10. Isolation of *Acetobacter acetii* from fruit juice
11. Isolation and identification of Coliforms and *E. coli* in food
12. Isolation and identification of *Salmonella* in egg and poultry.
13. Isolation and identification of *Staphylococcus aureus* in meat.
14. Isolation and identification of *Vibrio* sp. from fish
15. Isolation of antibiotic producing microorganism by crowded plate technique
16. Identification of antibiotic activity by cross streak assay/agar well diffusion technique
17. **Universityl Practical Examination**

Text Books

1. Adams, M.R. and Moss M.O. (2008). Food Microbiology(3rd Edn,), United Kingdom: RCS publishing, (ISBN: 978-0-85404-284-5). pp.1-463
2. Dubey, R. C. (2014). A textbook of Biotechnology (4th Edn).India: S. Chand Publishing, (ISBN:9788121926089).pp.1-616
3. Frazier, W.C. and Westoff, D.C. (1995). Food Microbiology(4th Edn.).India: Tata McGraw-Hill Publishers, (ISBN: 9780070219175). pp.1-790.
4. Jay, J.M., Loessner, J.M and Golden, D.A. (2005). Modern Food Microbiology(7th Edn.), USA: Springer, (ISBN 978-0-387-23413-7). pp.1-565.
5. Matthews, K. R., Kniel, K. E., & Montville, T. J. (2017). Food microbiology: an introduction(3rd Edn.), United States: John Wiley & Sons, (ISBN-13: 978-1555816360). pp.1-201.
6. Saxena.S. (2015). Applied Microbiology(1st Edn). India: Springer Pvt.Ltd. (ISBN 978-81-322-2258-3).pp.1-190.
7. Ramanathan, N. (2017) Food Microbiology(1st Edn,). India: New India Publishing Agency, (ISBN: 9789386546661). pp.1-278.
8. Waiter. M.J., N.L.Morgan, J.S.Rocky and G.Higton.(2001). Industrial Microbiology – An Introduction(2nd Edn.),UK: Blackwell Scientific, (ISBN: 978-0-632-05307-0). pp.1-304.

Reference Books

1. Baltz, R. H., Demain, A. L., & Davies, J. E. (Eds.). (2010). Manual of industrial microbiology and biotechnology(3rd Edn.), United States: American Society for Microbiology Press, (ISBN-10: 155581512X).pp.1-784
2. Doyle, M. P., Diez-Gonzalez, F., & Hill, C. (Eds.). (2020). Food Microbiology: Fundamentals and Frontiers. United States: John Wiley & Sons, ISBN: 978-1-555-81996-5. pp.1-1100.
3. Mark W.(2008). Principles of Modern Microbiology(1st Edn.). Canada:, Jones & Bartlett Learning, (ISBN-13: 9780763710750). pp.1-528.
4. Pommerville J ,C. (2018). Microbes and Society(5th Edn,).Canada:. Jones & Bartlett Learning, (ISBN-13: 9781284172102).pp.1-476.
5. Robinson.R.K, (2002). Dairy Microbiology Handbook(3rd edition,),United States:Wiley Interscience, John Wiley & sons. Inc., Publications, (ISBN: 978-0-471-38596-7). pp.1-784.
6. Reed, G. (2004). Prescott and Dunn's Industrial Microbiology."(4th Edn.) , United States: CRC Press, :(ISBN-13: 978-8123910017).pp-1-350.

Web-References

1. https://www.agrimoon.com/wp-content/uploads/FOOD-AND-INDUSTRIAL-MICROBIOLOGY.pdf
2. https://www.youtube.com/watch?v=oFH56nvzYQk
3. https://www.youtube.com/watch?v=su6PfYeMrsI
4. https://www.youtube.com/watch?v=nfC689ElUVk
5. https://www.youtube.com/watch?v=jAhjPd4uNFY
6. https://www.youtube.com/watch?v=shWayTlt4hk
7. https://www.youtube.com/watch?v=el62Xpoyr_I
8. https://www.youtube.com/watch?v=lm76h4h1R6k
9. https://www.youtube.com/watch?v=PzUIR3SIfwY
10. https://www.youtube.com/watch?v=X37z3rOsXdA
11. www.fda.gov
12. www.food.gov.uk/safeeating
13. www.foodstandards.gov.uk

Journals

1. Journal of Food Quality
2. Journal of Food Science
3. Journal of Food Science and Technology
4. Biotechnology and Bioengineering

5. Food and Bioprocess Technology
6. Food Control

Course Nature: Theory based Practical							
Total Marks (100)							
S.No.	**Category**	**Assessment Tools**					
		In- Semester nExamination	Assignment	Record	Attendance	End-Semester Examination	Marks
1	Theory-External	-	-		-	*50*	*50*
2	Theory-Internal	*20*	-			-	*20*
3	Practical-External	-	-		-	*15*	*15*
4	Practical-Internal	-	*05*	*05*	*05*	-	*15*
						Grand Total	*100*

Course Code	ELC19502	Course Name	AGRIBUSINESS MANAGEMENT	Course Category	E	Elective Course	L	T	P	C
							1	0	1	2

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Agricultural Social Sciences	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1 :	Expose the students on functional areas of agribusiness management and its applications
CLR-2 :	Understand the concept of entrepreneurship, entrepreneurial competencies
CLR-3 :	Expose on the entrepreneurial opportunities
CLR-4 :	Expose the students on various management issues in establishing a business and to inculcate success.
CLR-5 :	Understand the Networking techniques
CLR-6 :	Explore various types of business strategies and entrepreneurship concepts that should help define the learning methods and goals.

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Agriculture Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	Ability to solve scientific problems	Ability to implement knowledge gained in the applied field of Business Management	Ability to understand social and ethical responsibilities
CLO-1 :	Elaborate about economic principles relevant for agribusiness and their applications for decision making	3	90	80	M	M			**H**	M		H	M	H	H	H	H	H	H
CLO-2 :	Appraise about Business environment	1	90	85	H	M	M		**M**	H		M	L	H	H	H	H	H	H
CLO-3 :	Establish Small and Medium Enterprises	2	75	70	M	H		M	**M**	H	**M**	M	H	H	H	H	H	H	H
CLO-4 :	Explain the scope of Agribusiness	3	80	75	M	H	M		L	M	L	M	M	H	H	H	H	H	H
CLO-5 :	IValidate consumer behaviour analysis	2	85	80	M	M		M	M	M	M	M	M	H	H	H	H	H	H
CLO6 :	Demonstrate the techniques in Capital Management and Financial management of Agribusiness	2	85	80	M	H	M		H	L		L	M	H	H	H	H	H	H

Duration (hour)		Learning Unit / Module 1	Learning Unit / Module 2	Learning Unit / Module 3	Learning Unit / Module 4	Learning Unit / Module 5
		12	9	6	12	6
S-1	SLO-1	Agribusiness – Definition	Distinctive features of Agribusiness Management	Business environment	Financial management of Agribusiness	Project Management
	SLO-2	Evolution of Agribusiness	Importance and needs of agro-based industries	PERT & SWOT analysis	Financial statements	Project cycle
S-2-3	SLO-1	**Lab: 1** Identification of new business opportunities	**Lab: 5** Starting new business	**Lab: 8** Visit to Financial institutions	**Lab: 10** Preparations of projects and Feasibility reports for agribusiness entrepreneur	**Lab: 14** Case study of agro-based industries.
	SLO-2					
S-4	SLO-1	Special features of Agribusiness	Classification of industries and types of agro based industries	Components of a business	Marketing Management	Project Appraisal
	SLO-2	characteristics of Enterprises	procedures to set up agro based industries	Steps in Business components	Marketing mix	Project Appraisal importance
S-5-6	SLO-1	**Lab: 2** Exercise on SWOT Analysis of Agribusiness sector in India	**Lab: 6** Documenting Procedure for Establishing Agribusiness Firms	**Lab: 9** Study of Agribusiness Finance Limited	**Lab: 11** Appraisal/evaluation techniques of identifying viable project	**Lab: 16** Net present worth technique for selection of viable project
	SLO-2					
S-7	SLO-1	Forms of Business Organisation	Constraints in establishing agro-based industries	-	Consumer behaviour analysis	-
	SLO-2	Sole Proprietorship	Agri-value chain:	-	Product Life Cycle	-
S-8-9	SLO-1	**Lab: 3** Study of agri-inputs markets	**Lab: 7** Government programs and institutions for entrepreneurship development	-	**Lab: 12** Non-discounting techniques	-
	SLO-2					
S-10	SLO-1	Transformation of agriculture into agribusiness	-	-	Sales & Distribution Management	-

	SLO-2	*Importance of agribusiness*	-	-	*Pricing policy*	-
S-11-12	**SLO-1**	***Lab:4** Study of agri-output markets*	-	-	***Lab: 13** Discounting techniques*	-
	SLO-2					

Level of Thinking		Continuous Learning Assessment (35% weightage)		University Practical Examination (15%)	End semester theory Examination (50%)
		In semester (20%)	Practical (15%)		
Level 1	**Remember**	40%	30%	35%	30 %
	Understand				
Level 2	**Apply**	40%	40%	35%	40 %
	Analyze				
Level 3	**Evaluate**	20%	30%	30%	30 %
	Create				
	Total	100%	100%	100%	100 %

Learning Resources	1. Aswathappa, K., (2013). Human Resource and Personnel Management. India, Tata McGraw Hill Publishing Co. Ltd, pp. 1-686. 2. Dollinger, M.J., (1999). Entrepreneurship Strategies and Resources. Upper Saddle River: New Jersey Prentice-Hall. pp. 1-259.	3. Koontz, H., & Weihrich, H., (2015). Essentials of Management. New Delhi: Tata McGraw Hill Education. pp: 1-265 4. Mohanty, S, K., (2007). Fundamentals of Entrepreneurship. New Delhi: Prentice Hall India Ltd., pp. 1-203.

Course Designers		
Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
Mr. K.Arun, Business Manager, EDII Periyakulam Horti Business Incubation Forum,Periyakulam	Dr. Venkatesa Palanisamy, Professor and Head, Centre for Agricultural and Rural Development Studies,Department of Agricultural Rural Management, TNAU, Coimbatore	Dr. Anbarassan A Dr. Periasami N

THEORY

UNIT I – Introduction to Agribusiness

Agribusiness – Definition – Evolution of Agribusiness - Agribusiness status in developed and developing nations. Special features of Agribusiness – Scope for Agribusiness in India. Government Promotional Programmes in Agribusiness. Classification of Enterprises- Micro, Small, Medium and Large. Forms of Business Organisation – Sole Proprietorship – Partnership –Private and Public Limited. Transformation of agriculture into agribusiness, various stakeholders and components of agribusiness systems. Importance of agribusiness in the Indian economy and New Agricultural Policy.

Unit II – Importance of Agribusiness Management

Distinctive features of Agribusiness Management: Importance and needs of agro-based industries, Classification of industries and types of agro based industries. Institutional arrangement, procedures to set up agro based industries. Constraints in establishing agro-based industries. Agri-value chain: Understanding primary and support activities and their linkages.

Unit III – Business Environment

Business environment: PERT & SWOT analysis. Management functions: Roles & activities, Organization culture. Planning, meaning, definition, types of plans. Purpose or mission, goals or objectives, Strategies, polices procedures, rules, programs and budget. Components of a business plan, Steps in planning and implementation. Organization staffing, directing and motivation.

Unit IV – Managerial Functions – Planning and Organizing

Ordering, leading, supervision, communications, control. Capital Management and Financial management of Agribusiness. Financial statements and their importance. Marketing Management: Segmentation, targeting & positioning. Marketing mix and marketing strategies. Consumer behaviour analysis, Product Life Cycle (PLC). Sales & Distribution Management. Pricing policy, various pricing methods.

UNIT V – Project Management

Project Management definition, project cycle, identification, formulation, appraisal, implementation, monitoring and evaluation. Project Appraisal and evaluation techniques.

Theory- Lecture Schedule

1. Agribusiness – Definition – Evolution of Agribusiness, Agribusiness status in developed and developing nations
2. Special features of Agribusiness – Scope for Agribusiness Classification and characteristics of Enterprises-Micro, Small, Medium and Large. in India
3. Forms of Business Organisation – Sole Proprietorship – Partnership –Private and Public Limited.
4. Transformation of agriculture into agribusiness, various stakeholders and components of agribusiness systems. Importance of agribusiness in the Indian economy and New Agricultural Policy.
5. Distinctive features of Agribusiness Management: Importance and needs of agro-based industries
6. Classification of industries and types of agro based industries. Institutional arrangement, procedures to set up agro based industries.
7. Constraints in establishing agro-based industries. Agri-value chain: Understanding primary and support activities and their linkages.
8. Business environment: PERT & SWOT analysis. Management functions: Roles & activities, Organization culture. Planning, meaning, definition, types of plans.
9. **In-Semester examination**
10. Purpose or mission, goals or objectives, Strategies, polices procedures, rules, programs and budget. Components of a business plan, Steps in planning and implementation. Organization staffing, directing and motivation.
11. Ordering, leading, supervision, communications, control. Capital Management and Financial management of Agribusiness. Financial statements and their importance.
12. Marketing Management: Segmentation, targeting & positioning. Marketing mix and marketing strategies.
13. Consumer behaviour analysis, Product Life Cycle (PLC).
14. Sales & Distribution Management. Pricing policy, various pricing methods.
15. Project Management definition, project cycle, identification, formulation, appraisal, implementation, monitoring and evaluation.
16. Project Appraisal and its importance
17. Project evaluation techniques

Practical Schedule

1. Identification of new business opportunities
2. Exercise on SWOT Analysis of Agribusiness sector in India
3. Study of agri-inputs markets
4. Study of agri-output markets
5. Starting new business - Visit to firms / discussion with entrepreneurs

6. Documenting Procedure for Establishing Agribusiness Firms
7. Government programs and institutions for entrepreneurship development
8. Visit to Financial institutions, Study of Cooperatives, Commercial banks, RRBs,
9. Study of Agribusiness Finance Limited, NABARD.
10. Preparations of projects and Feasibility reports for agribusiness entrepreneur.
11. Appraisal/evaluation techniques of identifying viable project
12. Non-discounting techniques.
13. Discounting techniques.
14. Case study of agro-based industries.
15. Trend and growth rate of prices of agricultural commodities.
16. Net present worth technique for selection of viable project. Internal rate of return.
17. **University Practical Examination**

Text Books

1. Aswathappa, K., (2013). Human Resource and Personnel Management. India, Tata McGraw Hill Publishing Co. Ltd, pp. 1-686.
2. Mohanty, S, K., (2007). Fundamentals of Entrepreneurship. New Delhi: Prentice Hall India Ltd., pp. 1-203.

Reference Books

1. Dollinger, M.J., (1999). Entrepreneurship Strategies and Resources. Upper Saddle River: New Jersey Prentice-Hall. pp. 1-259.
2. Koontz, H., & Weihrich, H., (2015). Essentials of Management. New Delhi: Tata McGraw Hill Education. pp: 1-265

Web-References

1. www.ediindia.org
2. www.iie.nic.in
3. www.msme.gov.in
4. www.niesbudtraining.org
5. www.nimsme.org
6. www.nsic.co.in
7. www.nabard.org

Course Nature: Theory based Practical							
Total Marks (100)							
S.No.	Category	Assessment Tools					
		In- Semester Examination	Assignment	Record	Attendance	End-Semester Examination	Marks
1	Theory-External	-	-		-	50	50
2	Theory-Internal	20	-			-	20
3	Practical-External	-	-		-	15	15
4	Practical-Internal	-	05	05	05	-	15
						Grand Total	100

Course Code	ELC19503	Course Name	SYSTEM SIMULATION AND AGRO ADVISORY	Course Category	E	Elective Course	L	T	P	C
							1	0	1	2

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Agronomy	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
CLR-1:	Gain understanding of basic concepts of modeling crops and soils	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-2:	Learn how to use the models for applications in water and nutrient management and climate change issues			
CLR-3:	Learn how to make use of models to evaluate long term field experiment			
CLR-4:	Efficient crop production technology is based on a right decision at right time in a right way			
CLR-5:				

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Agriculture Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	Ability to solve scientific problems	Ability to implement knowledge gained	Ability to understand social and ethical responsibilities
CLO-1:	Gaining quantitative and mechanistic understanding of crop-weather-soil-management relationship and interactions	1	90	85	H			H			H		M	H		H	H	H	H
CLO-2:	Using weather data and other data about the crop environment, these models can simulate crop development, growth, yield, water, and nutrient uptake.	2	95	85	H			H					L	H		H	H	H	H
CLO-3:	Understanding and use of crop simulation models and the ability to build crop models	2	80	70	M		M	M			H		L	H		H	H	H	H
CLO-4:	Analysethe models in yield forecasting systems	3	85	75	M			H					M	H		H	H	H	H
CLO-5:	Provide an analysis of the risks involed in adopting a particular strategy	3	85	90	M								M	H		H	H	H	H

Duration (hour)		Learning Unit / Module 1	Learning Unit / Module 2	Learning Unit / Module 3	Learning Unit / Module 4	Learning Unit / Module 5
		3	4	3	3	2
S-1	SLO-1	System approach for representing soil-plant-atmosphere continuum	Evaluation of crop responses to weather elements	Potential and achievable crop production	Weather forecasting	Preparation of agro-advisory bulletin based on weather forecast
	SLO-2	System boundaries				
S-2,3	SLO-1	**Field/Lab.1.** Visit to Agro meteorological Observatory	**Field/Lab.5.** Working with statistical and simulation models for crop growth	**Field/Lab.9.** Sensitivity analysis of varying weather and crop management practices.	**Field/Lab.12.** Feedback from farmers about the agro advisory.	**Field/Lab.15.**Visit to RMC, Chennai
	SLO-2					
S-4	SLO-1	Crop Models	Elementary crop growth models	Concept and modelling techniques for their estimation	Types of weather forecasting	Use of crop simulation model for preparation.
	SLO-2	Crop modeling – Concept and techniques				
S-5,6	SLO-1	**Field/Lab. 2.** Preparation of crop weather calendars.	**Field/Lab.6**.Potential & achievable production, Yield forecasting	**Field/Lab.10.** Use of statistical approaches in data analysis and	**Field/Lab.13.** Visit to GKMS centre / AIR, Karaikal	**Field/Lab.16.** Field visits.
	SLO-2					
S-7	SLO-1	Types of models	Calibration and validation	Crop production in moisture and nutrients limited conditions	Methods, tools and techniques of weather forecasting	
	SLO-2	Data requirements				
S-8,9	SLO-1	**Field/Lab.3.**Preparation of agro-advisories	**Field/Lab. 7**. Insect & disease forecasting models.	**Field/Lab.11.** Preparation of historical, past and present meteorological data for medium range weather forecast	**Field/Lab.14.** Visit to IMD, DWRS, Karaikal	--
	SLO-2					
S-10	SLO-1		Verification and sensitivity analysis.	Components of soil water and nutrients balance	Forecast verification and ITK for weather forecast and its validity	
	SLO-2					--
S-11	SLO-1	**Field/Lab.4.** Synoptic charts	**Field/Lab.8**. Simulation with limitations of water and nutrient management options	--	--	--
	SLO-2					--

Learning Resources	1. Bishnoi, O.P. (2010). Applied Agroclimatology. Oxford Book Company, Jaipur, India. pp. 1-540. 2. Mavi, H.S. (2019). Introduction to Agro meteorology, oxford and IBH Publishing Co., New Delhi. pp. 1-296.	3. Mavi, H.S. and Tupper, G.J. (2004). Agrometeorology: Principles and Application of Climate Studies in Agriculture, Haworth Press. pp. 1-351. 4. Prasada Rao, G.S.L.H.V. (2008). Agricultural meteorology. PHI Learning Private Limited, Delhi. pp. 1-364

	Level of Thinking	Continuous Learning Assessment (35% weightage)		University Practical Examination (15%)	End semester theory Examination **(50%)**
		In semester (20%)	Practical (15%)		
Level 1	**Remember**	40 %	30 %	35%	30 %
	Understand				
Level 2	**Apply**	40 %	40 %	35%	40 %
	Analyze				
Level 3	**Evaluate**	20 %	30 %	30%	30 %
	Create				
	Total	*100 %*	*100 %*	*100%*	*100 %*

Course Designers		
Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
Nil	Dr. V. Geethalakshmi, Director, Centre of Crop Management, Tamil Nadu Agricultural University, Coimbatore - 3	Dr. D. Selvakumar Dr. N. Krishnaprabu Dr. S. Marimuthu

THEORY

Unit I: System & Models
System Approach for representing soil-plant-atmosphere continuum, system boundaries, Crop models, concepts & techniques, types of crop models, data requirements, relational diagrams.

Unit II: Validation of Models
Evaluation of crop responses to weather elements; Elementary crop growth models; calibration, validation, verification and sensitivity analysis.

Unit III: Modelling Techniques
Potential and achievable crop production- concept and modelling techniques for their estimation. Crop production in moisture and nutrients limited conditions; components of soil water and nutrients balance.

Unit IV: Weather Forecasting and Verification
Weather forecasting, types, methods, tools and techniques, forecast verification; ITK for weather forecast and its validity;

Unit V: Simulation and Agromet Advisory Bulletins
Preparation of agro-advisory bulletin based on weather forecast. Use of crop simulation model for preparation.

Theory-Lecture Schedule:
1. System – definition – concepts - Models- definition - scope.
2. Soil-plant-atmosphere continuum
3. Model- limitations- Constraints - System boundaries – inputs
4. Crop models, Types – concepts – techniques - Abstract models and simulation Models.
5. Input and output data requirements, relational diagrams.
6. Evaluation of crop responses to weather elements.
7. Elementary crop growth models - Calibration, validation, verification and sensitivity analysis of models.
8. Potential and achievable crop production - Concept and modelling techniques for estimation of yields
9. **In-Semester examiantion**
10. Crop production in moisture and nutrients limited conditions.
11. Components of soil water and nutrients balance.
12. Weather forecasting- definitions- scope- types and methods of weather forecasting and tools.
13. Techniques of weather forecasting, forecast verification - value-added weather forecast - now casting and its application.
14. National Centre for Medium Range Weather Forecasting (NCMRWF) and Agro Meteorological Field Units (AMFU) and forecasting and Long-Range Weather Forecasting (LRF).
15. ITK for weather forecast and its validity and preparation of agro-advisory bulletin based on weather forecast.
16. Use of crop simulation model for preparation of Agro-advisory- IMD and its role in weather forecasting.
17. Websites and information on weather forecasting.

Practical Schedule
1. Visit to Agro meteorological Observatory.
2. Preparation of crop weather calendars.
3. Preparation of agro-advisories based on weather forecast using various approaches
4. Synoptic charts
5. Working with statistical and simulation models for crop growth
6. Potential & achievable production, Yield forecasting
7. Insect & disease forecasting models.
8. Simulation with limitations of water and nutrient management options.
9. Sensitivity analysis of varying weather and crop management practices.
10. Use of statistical approaches in data analysis and

11. Preparation of historical, past and present meteorological data for medium range weather forecast.
12. Feedback from farmers about the agro advisory.
13. Visit to GKMS centre / AIR, Karaikal
14. Visit to IMD, DWRS, Karaikal
15. Visit to RMC, Chennai
16. Field visits.
17. **University Practical Examination**

Text Books

1. Bishnoi, O.P. (2010). *Applied Agroclimatology.* Oxford Book Company, Jaipur, India. pp. 1-540.
2. Mavi, H.S. (2019). *Introduction to Agrometeorology.* oxford and IBH Publishing Co., New Delhi. pp. 1-295.
3. Mavi, H.S. and Tupper, G.J. (2004). *Agrometeorology: Principles and Application of Climate Studies in Agriculture.* Haworth Press. pp. 1-351.
4. Prasada Rao, G.S.L.H.V. (2008). *Agricultural meteorology.* PHI Learning Private Limited, Delhi. pp. 1-364
5. Ramkrishnan, R., Johannes Gehrke and Grawhill, M.C. (2014). *Database Management Systems.* Education (India) Pvt.Ltd, New Delhi. pp. 1- 1100.
6. Rao, G.S.L.H.V. (2005). *Agricultural Meteorology.* Kerala Agricultural University Press, Thrissur. pp. 1-326.
7. Sahoo, D.D. and Solanki, R. M. (2008). *Remote Sensing Techniques in Agriculture.* Agrobios (India), Jodhpur. pp. 1-240.

Reference Books

1. Patra, A.K. (2016). *Principles and applications of Agricultural Meteorology.* New India Publishing Agency, New Delhi. pp. 1-424.
2. Reddy, S.R. (2016). *Introduction to Agriculture and Agrometeorology.* Kalyani Publishers, New Delhi. pp.1-425.
3. Radhakrishna, V. and Murthy, B. S. (2002). *Basic Principles of Agricultural Meteorology.* BS Publications, Hyderabad. pp. 1-261.
4. Varshneya, M.C. and Balakrishna Pillai, P. (2003). *Text book of Agricultural Meteorology.* ICAR. New Delhi. pp. 1-217.
5. Wallach, D., Makowshi, D and Jones, J. W. (2006). *Working with Dynamic crop models, Evaluation, Analysis, Parametrization and Applications.* Elsevier Oxford U.K. pp. 1-441.

Web References:

1. www.pajancoa.ac.in
2. www.tawn.tnau.ac.in
3. www.usbr.gov/pn/agri.met
4. www.imd.gov.in.
5. http://agropedia.iitk.ac.in/content/crop-model

Course Nature: Theory based Practical							
Total Marks (100)							
S.No.	**Category**	**Assessment Tools**					
		In- Semester Examination	Assignment	Record	Attendance	End-Semester Examination	Marks
1	Theory-External	-	-		-	*50*	*50*
2	Theory-Internal	*20*	-			-	*20*
3	Practical-External	-	-		-	*15*	*15*
4	Practical-Internal	-	*05*	*05*	*05*	-	*15*
						Grand Total	*100*

Course Code	CRH19601	Course Name	DISEASES OF FIELD AND HORTICULTURAL CROPS AND THEIR MANAGEMENT -II	Course Category	C	Compulsory Course	L	T	P	C
							2	0	1	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Plant Pathology	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1 :	Knowledge on symptoms of diseases
CLR-2 :	Understand host pathogen interaction
CLR-3 :	Relate the role of environmental factors in disease development
CLR-4 :	Understand the survival and mode of spread of the pathogen
CLR-5 :	Knowledge about Integrated disease management
CLR-6 :	-

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Agriculture Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	Ability to solve scientific problems through plant pathology	Ability to implement knowledge gained in the applied field	Ability to understand social and ethical responsibilities
CLO-1 :	Distinguish and interpret different crop related issues	2	90	75	M	M		M					M	H		H	H	H	H
CLO-2 :	Correlate host parasite relationship for different crops	2	85	70	M	L	M	L					H	H		H	H	H	H
CLO-3 :	Exhibit skill in identifying the causal organisms of the disease	1	95	70	M	M							M	H		H	H	H	H
CLO-4 :	Relate the abiotic factor for disease development	2	80	65	L			L					L	H		H	H	H	H
CLO-5 :	Apply different approaches for management	1	85	70	M	L					M		M	H		H	H	H	H
CLO6 :	Apply knowledge as a potential entrepreneur	3	75	65	L								L	H		H	H	H	H

Duration (hour)		Learning Unit / Module 1	Learning Unit / Module 2	Learning Unit / Module 3	Learning Unit / Module 4	Learning Unit / Module 5
		8	16	22	10	9
S-1	SLO-1	Disease symptoms – Wheat I	Disease symptoms – Cotton	Disease symptoms – Cucurbits	Disease symptoms – Black pepper & betel vine	Post-harvest diseases
	SLO-2	Epidemiology and IDM in wheat I	Epidemiology and IDM in cotton	Epidemiology and IDM in cucurbits	Epidemiology and IDM in black pepper & betel vine	Fruits and vegetables
S-2	SLO-1	Disease symptoms in Wheat I	Disease symptoms – Sugarcane	Disease symptoms – Potato I	Disease symptoms – Rose & jasmine	Mushroom - Introduction
	SLO-2	Epidemiology and IDM in wheat II	Epidemiology and IDM in sugarcane	Epidemiology and IDM in Potato I	Epidemiology and IDM in rose & jasmine	Importance & scope
S 3-4	SLO-1	***Lab1:*** *Symptomology, host parasite relationship and IDM - Wheat*	***Lab3:*** *Symptomology, host parasite relationship and IDM – Cotton & sugarcane*	***Lab7:*** *Symptomology, host parasite relationship and IDM – Cucurbits*	***Lab13:*** *Symptomology, host parasite relationship and IDM – Black pepper & betelvine*	***Lab15:*** *Cultivation of button & paddy straw mushroom*
	SLO-2					
S-5	SLO-1	Disease symptoms – Chickpea & lentil	Disease symptoms – Mango	Disease symptoms – Potato II	Disease symptoms – Marigold & crossandra	Button mushroom - Introduction
	SLO-2	Epidemiology and IDM in chickpea & lentil	Epidemiology and IDM in mango	Epidemiology and IDM in potato II	Epidemiology and IDM in marigold & crossandra	Cultivation
S-6	SLO-1	Disease symptoms – Sunflower & mustard	Disease symptoms – Citrus	Disease symptoms – Peas	Disease symptoms – Chrysanthemum	Paddy straw mushroom - Introduction
	SLO-2	Epidemiology and IDM in sunflower & mustard	Epidemiology and IDM in citrus	Epidemiology and IDM in peas	Epidemiology and IDM in chrysanthemum	Cultivation
S 7-8	SLO-1	***Lab2:*** *Symptomology, host parasite relationship and IDM - chickpea, lentil, sunflower and mustard*	***Lab4:*** *Symptomology, host parasite relationship and IDM – Mango*	***Lab8:*** *Symptomology, host parasite relationship and IDM – Potato & peas*	***Lab14:*** *Symptomology, host parasite relationship and IDM – Flower crops*	***Lab16:*** *Cultivation of oyster & milky mushroom*
	SLO-2					
S-9	SLO-1	-	Disease symptoms – Grapevine	Disease symptoms – Cassava, colocasia & yam	Disease symptoms – Tuberose & carnation	Oyster & milky mushroom - Introduction

	SLO-2	-	*Epidemiology and IDM in grapevine*	*Epidemiology and IDM in cassava, colocasia & yam*	*Epidemiology and IDM in tuberose & carnation*	*Cultivation*
S-10	**SLO-1**	-	*Disease symptoms – Apple & peach*	*Disease symptoms – Chilli*	*Disease symptoms – Lilium & orchids*	-
	SLO-2	-	*Epidemiology and IDM in apple & peach*	*Epidemiology and IDM in chilli*	*Epidemiology and IDM in lilium & orchids*	-
S 11-12	**SLO-1**	-	***Lab5:** Symptomology, host parasite relationship and IDM – Citrus & grapevine*	***Lab9:** Symptomology, host parasite relationship and IDM – Cassava, colocasia & yam*	-	-
	SLO-2	-			-	-
S-13	**SLO-1**	-	*Disease symptoms – Plum & pear*	*Disease symptoms – Turmeric & ginger*	-	-
	SLO-2	-	*Epidemiology and IDM in plum & pear*	*Epidemiology and IDM in turmeric & ginger*	-	-
S-14	**SLO-1**	-	*Disease symptoms – Strawberry*	*Disease symptoms – Onion*	-	-
	SLO-2	-	*Epidemiology and IDM in strawberry*	*Epidemiology and IDM in onion*	-	-
S 15-16	**SLO-1**	-	***Lab6:** Symptomology, host parasite relationship and IDM – apple, peach, plum, pear and strawberry*	***Lab10:** Symptomology, host parasite relationship and IDM – Chilli, turmeric & ginger*	-	-
	SLO-2	-			-	-
S-17	**SLO-1**	-	-	*Disease symptoms – Garlic*	-	-
	SLO-2	-	-	*Epidemiology and IDM in garlic*	-	-
S-18	**SLO-1**	-	-	*Disease symptoms – Coriander & cardamom*	-	-
	SLO-2	-	-	*Epidemiology and IDM in coriander & cardamom*	-	-
S 19-20	**SLO-1**	-	-	***Lab11:** Symptomology, host parasite relationship and IDM – Onion & garlic*	-	-
	SLO-2		-			
S-21	**SLO-1**	-	-		-	-
	SLO-2	-	-		-	-
S-22	**SLO-1**	-	-		-	-
	SLO-2	-	-		-	-
S 23-24	**SLO-1**	-	-	***Lab12:** Symptomology, host parasite relationship and IDM – Coriander & cardamom*	-	-
	SLO-2					

Learning Resources	1. Girish Chand and Santhosh Kumar. (2016). *Crop Diseases and Their Management*. Florida: CRC press. pp. 1-285 2. Sanjeev Kumar. (2016). *Diseases of Field Crops and Their Integrated Management*. India: New India publishing agency. pp. 1-296	3. Sonia Ahuja. (2005). *Plant Diseases*. New Delhi: Vishvabharti. pp. 1-268

Level of Thinking		Continuous Learning Assessment (35% weightage)		University Practical Examination (15%)	End semester theory Examination **(50%)**
		In Semester (20%)	Practical (15%)		
Level 1	**Remember**	40 %	45%	40%	45 %
	Understand				
Level 2	**Apply**	40 %	30%	30%	30 %
	Analyze				
Level 3	**Evaluate**	20 %	25%	20%	25 %
	Create				
	Total	*100 %*	*100%*	*100%*	*100 %*

Course Designers		
Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
Dr. A. Bharani deppan, Ph.D. E.I. DuPont India Pvt Ltd. The V-Ascendas, Atria Block, 12th Floor, Plot.17 SoftwareUnits Layout, Madhapur,Hyderabad, Telangana Ph: 936666899, Mail: bharani-deepan.a@corteva.com	Dr. A. Kamalakannan, Professor Department of Plant Pathology Tamil Nadu Agricultural University Coimbatore- 641003 Ph: 9790620313, E-Mail: kamals2k@yahoo.co.in	Dr. Rageshwari S Dr. VinodKumar S

THEORY

Symptoms, etiology, mode of spread, survival, epidemiology and integrated management of diseases and nematode disease complex. Mushroom cultivation.

Unit I – Diseases of Cereals, Pulses and Oil Seed Crops

Cereals: Wheat - Rust, loose smut, bunt, powdery mildew, foot rot, leaf blight, yellow ear rot. Pulses: Chickpea - Wilt, blight, rust, powdery mildew, root rot, lentil – Rust and wilt. Oil seeds: Sunflower and mustard - leaf spot, rust, root rot, stem rot, powdery mildew, downy mildew, white rust, mosaic

Unit II – Diseases of Cash Crops and Fruit Crops

Cash crops: Cotton - wilt, root rot, anthracnose, grey mildew, rust, leaf spot, bacterial leaf blight, Sugarcane - Red rot, smut, wilt, sett rot, red stripe, rust, leaf spot, mosaic, ratoon stunting, grassy shoot, pokkah boeng. **Fruit crops:** Mango - mango malformation, powdery mildew, anthracnose, black tip of mango, algal leaf spot, gray blight, sooty mold, die back, gummosis, root rot, Citrus - citrus canker, citrus tristeza disease, citrus greening, citrus stubborn, citrus die back, citrus wilt, exocortis, root rot, citrus nematode, Grapevine - anthracnose, rust, powdery mildew, downy mildew, pierce disease, grape fan leaf virus, Apple - fire blight of apple, apple canker, anthracnose, apple scab, root rot, Peach - leaf curl, powdery mildew, Strawberry - leaf spot, rust, fruit blight, powdery mildew, Plum and pear – Leaf spot, powdery mildew, brown rot, black knot, crown gall

UNIT III–DISEASES OF VEGETABLE AND SPICE CROPS (10 hours)

Vegetable crops: Potato - late blight, early blight, ring rot, leaf roll, mosaic, leaf spot, black scurf, silvery scurf, powdery scab, black leg, bacterial soft rot, golden cyst nematode, Cucurbits - powdery mildew, leaf spot, downy mildew, root rot, wilt, bacteria leaf spot, mosaic disease, Peas – powdery mildew, fusarium wilt, rust, Cassava - leaf spot, mosaic disease, root rot, Colocasia and yam – Leaf spot, root rot, Chilli - damping off, leaf spot, anthracnose, powdery mildew, wilt, root rot, Turmeric - rhizome rot, leaf blotch, leaf spot, root rot, blast, bacterial wilt, Ginger – soft rot, bacterial wilt, leaf spot, storage rot, yellows, dry rot, Onion - blight, smut, smudge, rust, root rot, Garlic – basal rot, white rot, downy mildew, botrytis rot, penicillium rot, Coriander - stem gall, powdery mildew, Cardamom - Katte/marble mosaic disease, azhukal disease, rhizome rot, leaf spot.

Unit IV – Diseases of Plantation and Flower Crops

Plantation crops: Black pepper - quick wilt, slow wilt, pollu disease, charcoal rot, root rot, Betelvine – foot rot, wilt, powdery mildew, anthracnose, leaf spot. Flower crops: Rose - black spot, powdery mildew, flower blight, rust, gray blight, die back, crown gall, Jasmine - leaf spot, collar rot, phyllody, root rot, Marigold - leaf spot, wilt, root rot, Crossandra – wilt, root rot, leaf blight, , Chrysanthemum - leaf spot, white rust, wilt, root rot, stunt viroid, Tube rose - stem rot, flower bud rot, botrytis spot and blight, sclerotial wilt, leaf spot, Carnation - wilt, root rot, wilt, rust, fairy ring spot, stem rot, Lillium - wilt, root rot, leaf spot, Orchids – Leaf spot.

Unit V – Post Harvest Diseases of Fruits and Vegetables, Mushroom Cultivation Post-harvest diseases of fruits and vegetable. Mushroom cultivation: Importance of mushroom - Cultivation of oyster mushroom, milky mushroom, paddy straw mushroom and button mushroom – Constraints in mushroom cultivation - Post harvest technology

Theory –Lecture Schedule

Symptoms, etiology, mode of spread, survival, epidemiology and integrated management of (Lec 1 to 30)

1. Diseases of wheat I
2. Diseases of wheat II
3. Diseases of chickpea and lentil
4. Diseases of sunflower and mustard
5. Diseases of cotton
6. Diseases of sugarcane
7. Diseases of mango
8. Diseases of citrus
9. Diseases of grapevine
10. Diseases of apple and peach
11. Diseases of plum and pear
12. Diseases of strawberry
13. Diseases of cucurbits
14. Diseases of potato I
15. Diseases of potato II
16. Diseases of peas
17. **In-semester examination**
18. Diseases of cassava, colocasia and yam

19. Diseases of chilli
20. Diseases of turmeric and ginger
21. Diseases of onion
22. Diseases of garlic
23. Diseases of coriander and cardamom
24. Diseases of black pepper and betel vine
25. Diseases of rose and jasmine
26. Diseases of marigold and crossandra
27. Diseases of chrysanthemum
28. Diseases of tuberose and carnation
29. Diseases of lilium and orchids
30. Post-harvest diseases of fruits and vegetables
31. Importance and scope of mushroom
32. Cultivation for button mushroom
33. Cultivation of paddy straw mushroom
34. Cultivation of oyster mushroom and milky mushroom

Practical Schedule

Symptomatology, host parasite relationship and management of (1 to 14)

1. Diseases of wheat
2. Diseases of chickpea, lentil, sunflower and mustard
3. Diseases of cotton and sugarcane
4. Diseases of mango
5. Diseases of citrus and grapevine
6. Diseases of apple, peach, plum, pear and strawberry
7. Diseases of cucurbits
8. Diseases of potato and peas
9. Diseases of cassava, colacasia and yam
10. Diseases of chilli, turmeric and ginger
11. Diseases of onion and garlic
12. Diseases of coriander, cardamom
13. Diseases of black pepper and betelvine
14. Diseases of flower crops
15. Cultivation of button and paddy straw mushroom
16. Cultivation of oyster, and milky mushroom
17. **University Practical Examination**

Note: Students should submit 50 well preserved disease specimens.

Text Books

1. Agrios, G.N. (2005). *Plant Pathology* (5th Ed.). New York: Academic Press. pp. 1-922.
2. Girish Chand and Santhosh Kumar. (2016). *Crop Diseases and Their Management*. Florida: CRC press. pp. 1-295.
3. Gupta, V. K. (2008). *Diseases of Fruit Crops*. Kalyani Publishers. pp. 1-344
4. Gupta, V.K. & Paul, Y S. (2005). *Diseases of Plantation Crops*. Kalyani Publishers. pp. 1-197.
5. Rangasawmi, G and Mahadevan, A. (2004). *Diseases of Crop Plants in India*. New Delhi: Prentice Hall of India Pvt. Ltd. pp. 1-548.
6. Roland N Perry & Maurice Moens. (2013). *Plant Nematology*. UK: CABI. pp. 1-568.
7. Sanjeev Kumar. (2015). *Diseases of Horticultural crops, Identification and Management*. India: New India Publishing Agency. Pai & Sons. pp. 1-296.

Reference Books

1. Alfred Steferud. (2005). *Diseases of Plantation Crops*. Delhi: Biotech Books. pp. 1-317.
2. Alfred Steferud. (2005). *Diseases of Vegetable Crops*. Delhi: Biotech Books. pp. 1-210.
3. Dasgupta, M.K. and Mandal, W.C. (1989). *Post-harvest pathology of perishables*. New Delhi: Oxford IBH publishing Co. pp. 1-638.
4. Madhu Meeta. (2005). *Diseases of Ornamental Plants in India: Reference Book Cum Bibliography*. South Asia Books. pp. 1-327.
5. Sonia Ahuja. (2005). *Plant Diseases*. New Delhi: Vishvabharti. pp. 1-268.
6. Trivedi, P.C. (2016). *Diseases of vegetables and their management*. Jaipur: Pointer publisher. pp. 1-270.

Web-References

1. http://www.biologydiscussion.com
2. https://www.microscopemaster.com/fungi
3. www.apsnet.org/edcenter
4. Tolweb.org
5. http://www.hillagric.ac.in/edu/coa/ppath/lectures.htm
6. http://ecoursesonline.iasri.res.in/course/view.php?id=143
7. www.ucmp.berkeley.edu/fungi
8. www.ictv.org
9. www.vivo.library.cornell.edu
10. https://www.youtube.com/c/MTutorEdu/search?query=plant+pathology
11. https://www.youtube.com/channel/UCsqovy3LIp-dB8pMxU2VZ7A
12. https://www.youtube.com/user/uwipm/search?query=diseases

Journals

1. Phytopathology
2. Plant Pathology
3. Australasian Plant Pathology
4. Indian Phytopathology
5. Studies in Mycology
6. Journal of Plant Pathology

Course Nature: Theory based Practical							
Total Marks (100)							
S.No.	**Category**	**Assessment Tools**					
		In- Semester Examination	Assignment	Record	Attendance	End-Semester Examination	Marks
1	Theory-External	-	-		-	*50*	*50*
2	Theory-Internal	*20*	-			-	*20*
3	Practical-External	-	-		-	*15*	*15*
4	Practical-Internal	-	*05*	*05*	*05*	-	*15*
						Grand Total	*100*

Course Code	CRH19602	Course Name	MANAGEMENT OF BENEFICIAL INSECTS	Course Category	C	*Compulsory Core*	L	T	P	C
							1	0	1	2

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	Agricultural Entomology	Data Book / Codes/Standards	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	*Obtain Knowledge on importance of beneficial insects*			
CLR-2 :	*Learn about the equipments & seasonal management of honey bee*			
CLR-3 :	*Gain knowledge on bee pasturage, Insect pests and diseases of honey bee. Role of pollinators in cross pollinated plants.*			
CLR-4 :	*Acquire knowledge on types of silkworm, Chawki rearing and late age silk worm raring*			
CLR-5 :	*Obtain basic information on Pest and diseases of silkworm and their management*			
CLR-6 :	*Comprehend the lac cultivation and their product, Know the parasitoids and predator, weed killers and pollinators*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Agriculture Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	Ability to solve scientific problems through Agricultural Entoology	Ability to implement knowledge gained in the applied field of Agricultural Entomology	Ability to understand social and ethical responsibilities of Agricultural Entomology
CLO-1 :	*Imparting skills on beneficial insects*	*2*	*90*	*80*	*M*								*M*	*H*		*H*	*H*	*H*	*H*
CLO-2 :	*Gain knowledge on honey bee species , equipments & seasonal management of honey bee*	*3*	*80*	*85*	*H*								*L*	*H*		*H*	*H*	*H*	*H*
CLO-3 :	*Understand the bee pasturage, Insect pests and diseases of honey bee. Role of pollinators in cross pollinated plants*	*1*	*75*	*70*	*M*			*L*					*M*	*H*		*H*	*H*	*H*	*H*
CLO-4 :	*Obtain basic knowledge on types of silkworm, Chawki rearing and late age silk worm raring*	*2*	*80*	*60*	*M*		*L*		*L*				*L*	*H*		*H*	*H*	*H*	*H*
CLO-5 :	*Gain knowledge on the Pest and diseases of silkworm and their management*	*3*	*75*	*60*	*L*	*L*		*L*					*M*	*H*		*H*	*H*	*H*	*H*
CLO6 :	*Understand the lac cultivation and their product, know the parasitoids and predator, weed killers and pollinators*	*2*	*75*	*65*	*L*						*H*		*M*	*H*		*H*	*H*	*H*	*H*

Duration (hour)		Learning Unit / Module 1	Learning Unit / Module 2	Learning Unit / Module 3	Learning Unit / Module 4	Learning Unit / Module 5
		16	18	5	5	2
S-1	**SLO-1**	*Economic classification of insects and importance of beneficial insects*	***Lab:6** Mulberry nursery bed preparation – methods of planting - Pruning methods – leaf / shoot harvest– preservation of leaves.*	***Lab: 12** Identification and mass culturing of different types of parasitoids*	***Lab: 14.** Mass production techniques of predators and parasitoids. Identification of weeds, and weed killers, pollinators, scavengers and soil builders*	*Scavengers and soil builders and their importance*
	SLO-2	***Lab: 1** Identification, morphology and structural adaptations in honey bees*	*Ecological requirements for mulberry cultivation – soil type – mulberry varieties -Different methods of propagation -merits and demerits – selection of semi hard wood cuttings -methods of mulberry leaf harvest and preservation*	*Lac insect- biology-strains-Natural enemies of lac insect and lac products*	*Biological weed control, pollinators*	***Lab:16** Visit to research and training institutions for bee keeping, sericulture, lac insect and natural enemies*
S-2	**SLO-1**	*Bee species – comparison – castes of bees – bee behaviour and bee dance*	***Lab:7** Pests and diseases of mulberry*	***Lab13.** Identification and mass culturing of different types of predators*	***Lab:15** Biological control – definition, parasitoids and predators and their role in pest management and mass production*	-
	SLO-2	***Lab:2**. Different species of honey bees*	*Pests and diseases of mulberry*	-	-	-

S-3	**SLO-1**	*Apiary management practices – bee pasturage – foraging – bee communications seasonal Variations-Seasonal management of honey beesDifferent types hives -Bee products- Bee enemies- predators and parasites*	*Lab:8 Different species of silkworms- Chawki and late age silkworm rearing*	-	-	-
	SLO-2	*Lab:3 Bee keeping appliances and seasonal management*	*Types of silkworm - Mulberry silkworm – origin – classification based on voltinism, moultinism, geographical distribution and genetic nature*	-	-	-
		Bee diseases – bacteria, virus, fungi and protozoan	*Lab: 9. Appliances and disinfection in silkworm rearing*	-	-	-
		Lab: 4. Rearing of queen, worker and drone cell and colony organization	*Characters of multivoltine races, bivoltine races, cross breeds and bivoltine hybrids - double hybrids– suitability for rearing in different seasons*	-	-	-
S-4	**SLO-1**	*Equipments used in bee keeping*	*Lab:10 Pests and diseases of mulberry silkworm*	-	-	-
	SLO-2	*Lab: 5. Bee enemies and diseases/ bee products*	*Morphology and biology of silkworm – sexual dimorphism in immature and adult stages – silkworm genetics – chromosome number – sex limited characters in egg, larva and cocoon for grainage use*	-	-	-
S-5	**SLO-1**	*Role of pollinators in cross pollinated plants*	*Lab: 11 Lac insect-life history, hosts and culturing of lac, natural enemies and lac products*	-	-	-
	SLO-2		*Methods of chawki and late age silkworm rearing- disinfections-pests and diseases of silkworms*	-	-	-

Learning Resources	1. Dandin, S.B., Jayaswal, J and Giridhar, K.(2003). *Hand book of Sericulture Technologies*.Central Silk Board, Bangalore, pp1-287. 2. David, B.V. and Ramamurthy,V.V. (2011). *Elements of Economic Entomology*, Namrutha Publications, Chennai, pp1-386.

Level of Thinking		Continuous Learning Assessment (35% weightage)		University Practical Examination (15%)	End semester theory Examination **(50%)**
		In Semester (20%)	Practical (15%)		
Level 1	**Remember**	40 %	40 %	35%	30 %
	Understand				
Level 2	**Apply**	40 %	30 %	40%	40 %
	Analyze				
Level 3	**Evaluate**	20 %	30 %	25%	30 %
	Create				
	Total	*100 %*	*100 %1*	*1 100%*	*100 %*

Course Designers		
Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
Dr. K. Ramesh Ph.D Principal Biologist –Rice Insecticide and Nematicide, South Asia Co-chair for insecticide resistance action committee(IRAC), India Corteva agrisciences (Dow Dupont), Madhapur, Hyderabad, India e- mail :ramesh.kaliaperumal@corteva.com ,mobile : 9952885708	Dr. K. Kumar, Professor and Head, Department of Agricultural Entomology, PAJANCOA&RI, Karaikal-609603	Dr. L.Ramazeame Assistant Professor, Entomology Dr. Murugan , Assistant Professor, Sericulture

THEORY

Unit I:
Importance of beneficial Insects, Beekeeping and pollinators, bee biology, commercial methods of rearing, equipment used, seasonal management, Bee pasturage, bee foraging and communication. Insect pests and diseases of honey bee. Role of pollinators in cross pollinated plants.

Unit II:
Types of silkworm, voltinism and biology of silkworm. Mulberry cultivation, mulberry varieties and methods of harvesting and preservation of leaves. Rearing, mounting and harvesting of cocoons.

Unit- III:
Pest and diseases of silkworm, management, rearing appliances of mulberry silkworm and methods of disinfection Species of lac insect, morphology, biology, host plant.

Unit - IV:
Lac production – seed lac, button lac, shellac, lac- products. Identification of major parasitoids and predators commonly being used in biological control.

Unit –V:
Insect orders bearing predators and parasitoids used in pest control and their mass multiplication techniques. Important species of pollinator, weed killers and scavengers with their importance

Theory- lecture schedule
1. Economic classification of insects and importance of beneficial insects
2. Bee species – comparison – castes of bees – bee behaviour and bee dance
3. Apiary management practices – bee pasturage – foraging – bee communications seasonal Variations- Seasonal management of honey bees
4. Different types hives -Bee products- Bee enemies- predators and parasites
5. Bee diseases – bacteria, virus, fungi and protozoan
6. Equipments used in bee keeping
7. Ecological requirements for mulberry cultivation – soil type – mulberry varieties -Different methods of propagation -merits and demerits – selection of semi hard wood cuttings -methods of mulberry leaf harvest and preservation
8. Pests and diseases of mulberry
9. **In- semester examination**
10. Types of silkworm - Mulberry silkworm – origin – classification based on voltinism, moultinism, geographical distribution and genetic nature
11. Characters of multivoltine races, bivoltine races, cross breeds and bivoltine hybrids – double hybrids– suitability for rearing in different seasons
12. Morphology and biology of silkworm – sexual dimorphism in immature and adult stages – silkworm genetics – chromosome number – sex limited characters in egg, larva and cocoon for grainage use
13. Methods of chawki and late age silkworm rearing- disinfections- pests and diseases of silkworms
14. Lac insect- biology-strains-Natural enemies of lac insect and lac products
15. Biological control – definition, parasitoids and predators and their role in pest management and mass production.
16. Biological weed control and pollinators
17. Scavengers and soil builders and their importance

Practical schedule
1. Identification, morphology and structural adaptations in honey bees
2. Different species of honey bees
3. Bee keeping appliances and seasonal management
4. Rearing of queen, worker and drone cell and colony organization
5. Bee enemies and diseases/ bee products
6. Mulberry nursery bed preparation – methods of planting - Pruning methods – leaf /shoot harvest– preservation of leaves.
7. Pests and diseases of mulberry
8. Different species of silkworms- Chawki and late age silkworm rearing
9. Appliances and disinfection in silkworm rearing

10. Pests and diseases of mulberry silkworm
11. Lac insect-life history, hosts and culturing of lac, natural enemies and lac products
12. Identification and mass culturing of different types of parasitoids
13. Identification and mass culturing of different types of predators
14. Mass production techniques of predators and parasitoids
15. Identification of weeds, and weed killers, pollinators, scavengers and soil builders
16. Visit to research and training institutions for bee keeping, sericulture, lac insect and natural enemies
17. **University Practical examination**

Text Books

1. David, B.V. and Ramamurthy, V.V.(2011). *Elements of Economic Entomology*, Namrutha Publications, Chennai,. {ISBN: 978-81-921477-0-3} pp1-386.
2. Dhaliwal, G.S. and R.Arora. (2001). *Integrated Pest Management – Concepts and approaches*. Kalyani publishers, New Delhi. {ISBN: 81-7663-904-4} pp1-427.
3. Pedigo, L.P. and Rice, M.E. (1996). *Entomology and Pest Management.* Prentice-Hall of India Pvt Ltd, New Delhi.. {ISBN-978-8120338869} pp1-812.

Reference books

1. Alford David, V. (2019). Beneficial Insects, Apple Academic Press Inc, pp1-384.
2. Dandin, S.B., Jayaswal, J and Giridhar, K.(2003). *Hand book of Sericulture Technologies*. Central Silk Board, Bangalore, pp1- 287.
3. Singh,T and Saratchandra, B.(2004).*Principles and techniques of silkworm seed production.* Discovery publishing house, New Delhi.pp1-376.

Web References

1. http://www.sristi.org/hbnew
2. http://www.ncipm.org.in/recent-publications.htm
3. http://www.ipmnet.org
4. www.silkbase.org
5. www.papilo.ab.a.u.tokyo.ac.in

Journals

1. Indian Journal sericulture
2. Journal of Apicultural Research
3. The Journal Sericulture science of Japan
4. The Journal of Apicultural Science

Course Nature: Theory based Practical							
Total Marks (100)							
S.No.	**Category**	Assessment Tools					
		In- Semester Examination	Assignment	Record	Attendance	End-Semester Examination	Marks
1	Theory-External	-	-		-	*50*	*50*
2	Theory-Internal	*20*	-			-	*20*
3	Practical-External	-	-		-	*15*	*15*
4	Practical-Internal	-	*05*	*05*	*05*	-	*15*
						Grand Total	*100*

Course Code	GPB19601	Course Name	CROP IMPROVEMENT-II (*RABI CROPS*)	Course Category	C	*Compulsory Core*	L	T	P	C
							1	0	1	2

Pre-requisite Courses	*Nil*	**Co-requisite Courses**	*Nil*	**Progressive Courses**	*Nil*
Course Offering Department		*Genetics and Plant Breeding*	**Data Book / Codes/Standards**	*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1 :	*Learn about he importance of breeding for crop improvement*
CLR-2 :	*Inculcate the understanding of breeding methodologies for crops*
CLR-3 :	*Gain information about the different strategies for crop improvement*
CLR-4 :	*Infer hybridization techniques*
CLR-5 :	*Simulate about the population maintenance*

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	**Learning**			**Program Learning Outcomes (PLO)**														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Agriculture Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	Ability to solve scientific problems through Crop improvement	implement knowledge gained in the applied field of Crop	Ability to understand social and ethical responsibilities of Crop improvement
CLO-1 :	*Explain the emasculation and artificial pollination in crops*	*3*	*90*	*80*	*M*								*M*	*H*		*H*	*H*	*H*	*H*
CLO-2 :	*Produce hybrids in different crops*	*1*	*95*	*85*	*H*								*L*	*H*		*H*	*H*	*H*	*H*
CLO-3 :	*Discuss about the difficulties on crop improvement and rectifications*	*2*	*80*	*70*	*M*		*L*	*L*					*L*	*H*		*H*	*H*	*H*	*H*
CLO-4 :	*Develop the varieties in crops*	*3*	*75*	*65*	*M*			*L*	*L*				*M*	*H*		*H*	*H*	*H*	*H*
CLO-5 :	*Perform stress breeding*	*2*	*75*	*60*	*L*	*L*							*M*	*H*		*H*	*H*	*H*	*H*
CLO 6 :	*Demonstarte ideotype breeding*	*2*	*75*	*65*	*L*						*H*		*M*	*H*		*H*	*H*	*H*	*H*

Duration (hour)		**Learning Unit / Module 1**	**Learning Unit / Module 2**	**Learning Unit / Module 3**	**Learning Unit / Module 4**	**Learning Unit / Module 5**
		6	**6**	**9**	**15**	**11**
S-1	**SLO-1**	*Origin and distribution of wheat*	*Origin and distribution of chickpea*	*Origin and distribution of rapeseed mustard and sunflower*	*Origin and distribution of sugarcane and potato*	*Breeding for biotic stress*
	SLO-2	*Breeding of wheat*	*Breeding of chickpea*	*Breeding of rapeseed mustard and sunflower*	*Breeding of sugarcane and potato*	*Breeding for Abiotic stress*
S-2, 3	**SLO-1**	***Lab 1.*** *Emasculation and hybridization techniques in wheat*	***Lab 3****. Emasculation and hybridization techniques in chickpea, lentil and field pea*	***Lab 5.*** *Emasculation and hybridization techniques in sunflower and potato*	***Lab 8.*** *Maintenance breeding of different kharif crops*	***Lab 13.*** *Study of quality characters*
	SLO-2					
S-4	**SLO-1**	*Origin and distribution of barley and oat*	*lentil and field pea lentil and field pea*	*Origin and distribution of fodder berseem*	*Origin and distribution of cumin*	*Breeding for quality*
	SLO-2	*Breeding of barley and oat*	*Breeding of lentil and field pea*	*Breeding of fodder berseem*	*Breeding of cumin*	*Ideotype breeding*
S-5, 6	**SLO-1**	***Lab 2.*** *Emasculation and hybridization techniques in oats and barley*	***Lab 4****. Emasculation and hybridization techniques in rapeseed mustard*	***Lab 6.*** *Emasculation and hybridization techniques in berseem*	***Lab 9****. Handling of germplasm and segregating populations by different methods like pedigree, bulk and single seed decent methods*	***Lab 14.*** *Donor parents for different characters*
	SLO-2					
S-7	**SLO-1**			*Origin and distribution of fodder oats*	*Origin and distribution of coriander*	*Plant genetic resources for crop improvement*
	SLO-2	-	-	*Breeding of fodder oats*	*Breeding of coriander*	*Climate resilient crop varieties for future*
S-8, 9	**SLO-1**	-	-	***Lab 7****. Emasculation and hybridization techniques in sugarcane*	***Lab 10.*** *Study of field techniques for seed production and hybrid seeds production in Kharif crops*	***Lab 15.*** *Visit to seed production plots*
	SLO-2	-	-			
S-10	**SLO-1**	-	-	-	*Origin and distribution of fenugreek and fennel*	-
	SLO-2	-	-	-	*Breeding of fenugreek and fennel*	-
S- 11, 12	**SLO-1**	-	-	-	***Lab 11.*** *Estimation of heterosis, inbreeding depression and heritability*	***Lab 16.*** *Visit to AICRP plots of different field crops*
	SLO-2	-	-	-		

S-13	**SLO-1**	-	-	-	*Origin and distribution of isabgol*	-
	SLO-2	-	-	-	*Breeding of isabgol*	-
S-14, 15	**SLO-1**	-	-	-	***Lab 12.*** *Layout of field experiments*	-
	SLO-2	-	-	-		-

Learning Resources	1. Bharadwaj, D.N. (2012). *Breeding Field Crops.* Jodhpur: Agrobios (India), pp. 1- 934. 2. Hari Har Ram. (2011). *Vegetable Breeding– Principles and Practice.* New Delhi: Kalyani Publishers. pp. 1- 421.	3. Harihar Ram & Hari Govind Singh. (1994). *Crop Breeding and Genetics.* New Delhi: Kalyani Publishers. pp. 1- 510.

Level of Thinking		Continuous Learning Assessment (35% weightage)		University Practical Examination (15%)	End semester theory Examination **(50%)**
		In semester (20%)	Practical (15%)		
Level 1	**Remember**	40 %	30 %	35%	30 %
	Understand				
Level 2	**Apply**	40 %	40 %	35%	40 %
	Analyze				
Level 3	**Evaluate**	20 %	30 %	30%	30 %
	Create				
	Total	*100 %*	*100 %*	*1 100%*	*100 %*

Course Designers		
Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
Dr. S M .Prabhu, Ph. D. Senior Breeder (Paddy Breeding and Transgenic) R&D centre,Rasi Seeds (P) Ltd., Attur, Salem – 636141.	Dr. T. Sabesan Associate rofessor Department of Genetics and Plant Breeding Faculty of Agriculture, Annamalai University,Annamalai nagar , Chidambaram - 608 002, sabavani@gmail.com	Dr. G. Selvakumar , Assistant Professor(GPB) Dr. R. Mahendran, Assistant Professor(GPB) Dr. J. Vanitha, Tutor (GPB)

THEORY

Unit I - Cereals

Place of origin – putative parents – related wild species – classification – objectives of breeding – methods of breeding – quantity – quality – stress – conventional – innovative – heterosis breeding – distant hybridization and important varieties in cereals: wheat, oats and barley.

Unit II - Pulses

Place of origin – putative parents – related wild species – classification – objectives of breeding – methods of breeding – quantity – Quality – stress – conventional – innovative – heterosis breeding – distant hybridization and important varieties in following pulses crops: chickpea, lentil and field pea.

Unit III - Oilseeds and Fodders

Place of origin – putative parents – related wild species – classification – objectives of breeding – methods of breeding – quantity – Quality – stress – conventional – innovative – heterosis breeding – distant hybridization and important varieties in Oilseeds: rapeseed mustard and sunflower. Fodders; berseem, oats and lucerne

Unit IV – Horticultural Crops and Cash Crops

Objectives of breeding – methods of breeding – quantity – quality – stress – conventional – innovative – heterosis breeding – cash crops; sugarcane. vegetable crops – potato, seed spices and medicinal plants: Cumin, coriander, fenugreek, fennel and isabgol.

Unit V - Breeding for Biotic and Abiotic Stresses and Quality

Breeding for pest and disease resistance - mechanisms of resistance; Breeding for Abiotic stress – drought and cold – salinity and alkalinity- mechanisms of resistance; Breeding for Abiotic stress –mechanisms of resistance; Breeding for quality produce; Ideotype breeding. Plant genetic resources, their utilization and conservation.Ideotype concept and climate resilient crop varieties for future.

Theory –Lecture Schedule

1. Centers of origin, distribution of species, floral biology, breeding objectives and hybrid seed production in wheat
2. Centers of origin, distribution of species, floral biology, breeding objectives and hybrid seed production in oats and barley
3. Centers of origin, distribution of species, floral biology, breeding objectives and hybrid seed production in in chickpea
4. Centers of origin, distribution of species, floral biology, breeding objectives and hybrid seed production in lentil and field pea
5. Centers of origin, distribution of species, floral biology, breeding objectives and hybrid seed production in rapeseed mustard and sunflower
6. Centers of origin, distribution of species, floral biology, breeding objectives and hybrid seed production in fodder berseem
7. Centers of origin, distribution of species, floral biology, breeding objectives and hybrid seed production in fodder oats In Semester examination
8. Centers of origin, distribution of species, floral biology, breeding objectives and hybrid seed production in fodder Lucerne
9. **In-semester Examination**
10. Centers of origin, distribution of species, floral biology, breeding objectives and hybrid seed production in sugarcane and potato
11. Centers of origin, distribution of species, floral biology, breeding objectives and hybrid seed production in cumin
12. Centers of origin, distribution of species, floral biology, breeding objectives and hybrid seed production in coriander
13. Centers of origin, distribution of species, floral biology, breeding objectives and hybrid seed production in fenugreek and fennel
14. Centers of origin, distribution of species, floral biology, breeding objectives and hybrid seed production in isabgol
15. Breeding for pest and disease resistance - mechanisms of resistance; Breeding for Abiotic stress – drought and cold – salinity and alkalinity- mechanisms of resistance
16. Breeding for Abiotic stress –mechanisms of resistance; Breeding for quality produce; Ideotype breeding
17. Plant genetic resources, their utilization and conservation. Ideotype concept and climate resilient crop varieties for future

Practical Schedule

1. Emasculation and hybridization techniques in wheat
2. Emasculation and hybridization techniques in oats and barley
3. Emasculation and hybridization techniques in chickpea, lentil and field pea
4. Emasculation and hybridization techniques in rapeseed mustard
5. Emasculation and hybridization techniques in sunflower and potato
6. Emasculation and hybridization techniques in berseem
7. Emasculation and hybridization techniques in sugarcane
8. Maintenance breeding of different kharif crops
9. Handling of germplasm and segregating populations by different methods like pedigree, bulk and single seed decent methods

10. Study of field techniques for seed production and hybrid seeds production in Kharif crops
11. Estimation of heterosis, inbreeding depression and heritability
12. Layout of field experiments
13. Study of quality characters
14. Donor parents for different characters
15. Visit to seed production plots
16. Visit to AICRP plots of different field crops
17. Final Practical Examination

Text Books

1. Bharadwaj, D.N. (2012). *Breeding Field Crops.* Jodhpur: Agrobios (India), pp. 1- 934.
2. Hari Har Ram. (2011). *Vegetable Breeding– Principles and Practice.* New Delhi: Kalyani Publishers. pp. 1- 421.
3. Harihar Ram & Hari Govind Singh. (1994). *Crop Breeding and Genetics.* New Delhi: Kalyani Publishers. pp. 1- 510.
4. Kumar, N. (2006). *Breeding of horticultural crops - Principles and Practices.* New Delhi: New India Publishing Agency. pp. 1- 220.
5. Phoelman, J.N. & Borthakur. (1969). *Breeding Asian field crops.* New Delhi: Oxford & IBH Publishing Co. pp. 1- 385.
6. Ram, H.H. (2011). *Crop Breeding and Biotechnology.* New Delhi: Kalyani Publishers. pp. 1-735.
7. Sleper, D. A. & Poehlman, J. M. (2007). *Breeding Field Crops.* USA: Blackwell Publishing Professional. pp. 1- 424.

Reference Books

1. Annaliese S. Mason. (2017). *Polyploidy and hybridizaton for crop improvement.* USA: CRC Press. pp. 1- 490.
2. Chopra, V.L. (1990). *Plant Breeding. Theory and Practice.* New Delhi: Oxford and IBH Publishing Co. pp. 1- 490.
3. David A. Sleper & Poehlman, J. M. (2006). *Breeding Field Crops* (5th ed.). USA: Blackwell. pp. 1- 432.
4. Sharma, J.R. (1994). *Principles and practice of Plant Breeding.* New Delhi: Tata McGraw - Hill Publishing Co. Ltd. pp. 1- 599.

Web-References

1. http://agritech.tnau.ac.in/crop_improvement/crop_imprv_breed.html
2. https://www.cropscience.bayer.com/innovations/seeds-traits/plant-breeding
3. https://research.wur.nl/en/publications/some-remarks-on-the-breeding-of-field-crops-in-the-netherlands/fingerprints/
4. https://www.cwrdiversity.org/project/pre-breeding/
5. https://qaafi.uq.edu.au/speed-breeding

Journals

1. Turkish Journal of Field Crops
2. Field Crops Research - Journal - Elsevier
3. Journal of Plant Breeding and Crop Science
4. Journal of Crop Improvement
5. Crop Breeding, Genetics and Genomics

Course Nature: Theory based Practical							
Total Marks (100)							
S.No.	**Category**	**Assessment Tools**					
		In- Semester Examination	Assignment	Record	Attendance	End-Semester Examination	Marks
1	Theory-External	-	-		-	*50*	*50*
2	Theory-Internal	*20*	-			-	*20*
3	Practical-External	-	-		-	*15*	*15*
4	Practical-Internal	-	*05*	*05*	*05*	-	*15*
						Grand Total	*100*

Course Code	AGE19601	Course Name	RAINFED AGRICULTURE AND WATERSHED MANAGEMENT	Course Category	C	*Compulsory Core*	L	T	P	C
							1	0	1	2

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*AGRONOMY*	Data Book / Codes/Standards		*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1:	*Create awareness on importance of rainfed farming in future agriculture*
CLR-2:	*Develop skills on soil and moisture conservation measures*
CLR-3:	*Learn about Watershed harvesting technique and watershed management in rainfed areas*
CLR-4:	*Gain skill and ability to perform in watershed areas*
CLR-5:	*Create the awareness on impact on drought in future agriculture*
CLR-6:	-

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Agriculture Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	Ability to solve scientific problems	Ability to implement knowledge gained	Ability to understand social and ethical responsibilities
CLO-1:	*Distinguish between rainfed agriculture and dryland agriculture and gaining knowledge on several drought management strategies*	*2*	*90*	*90*	*H*						*H*		*M*	*H*		*H*	*L*	*M*	*M*
CLO-2:	*Demonstrate on soil and moisture conservation practices and analysis of rainfall climatology and crop planning in rainfed areas*	*2*	*90*	*95*	*H*					*L*	*H*					*H*	*H*	*H*	*H*
CLO-3:	*Perusade the importance of watershed in rainfed farming*	*3*	*85*	*80*	*H*					*H*	*H*		*M*	*H*		*H*	*H*	*H*	*H*

Duration (hour)		Learning Unit / Module 1	Learning Unit / Module 2	Learning Unit / Module 3	Learning Unit / Module 4	Learning Unit / Module 5
		2	4	3	4	3
S-1	SLO-1	*Introduction of rainfed farming*	*Drought and their types*	*Soil erosion and losses due to erosion and types of erosion*	*Water harvesting, importance and techniques*	*Watershed: concept, objectives, principles and components*
	SLO-2	*Characteristics and scope of DF in India*	*Physiological characteristics of plants*	*Factors affecting erosion*	*Water harvesting structures*	*Watershed development programme*
S-2,3	SLO-1 SLO-2	***Lab/Field 1.** classification of Climate*	***Lab/Field 4.** Mapping of rainfed areas in India.*	***Lab/Field 8.** Calculation of effective rainfall.*	***Lab/Field 11.** Practicing Soil & moisture conservation measures*	***Lab/Field 15.** Mechanization in dryland farming.*
S-4	SLO-1	*Rainfed agriculture history*	*Morphological characteristics of plants*	*Measures to reduce moisture lose*	*Water Storage and recycling*	*Factors affecting watershed management*
	SLO-2	*Watersheds in India, problem and prospects of rainfed agriculture*	*Mechanism of crop adaptation under drought*	*Agronomic measures to conserve water and soil*	*Efficient utilization of water through soil and crop management practices*	*Alternate land use system*
S-5,6	SLO-1 SLO-2	***Lab/Field 2.** Rainfall pattern in rainfed areas of India and pattern of onset and withdrawal of monsoons.*	***Lab/Field 5**. Interpretation of meteorological data for rainfall variability.*	***Lab/Field 9.** Drought management technologies in dryland agriculture*	***Lab/Field 12.** Water harvesting structures*	***Lab/Field 16.** Visit to watershed / rainfed research station.*
S-7	SLO-1	*Rainfall pattern and distributions and Soil conditions prevalent in rainfed areas*	*Drought management*	*Mechanical measures of soil and water conservation*	*Contingent crop planning for aberrant weather conditions*	*Non-monetary inputs in rainfed Agriculture*
	SLO-2	*Climatic conditions prevalent in rainfed areas*	*Measures to reduce evapotranspiration*	*In-situ moisture conservation measures*	*Management of crops in rainfed areas and mid-season correction*	*Low cost technologies in rainfed agriculture*
S-8,9	SLO-1 SLO-2	***Lab/Field 3.** Cropping pattern of different rainfed areas of India and TN*	***Lab/Field 6.** Scheduling of supplemental irrigation based on crop ET demand.*	***Lab/Field 10.** Methods to reduce evaporation and transpiration*	***Lab/Field 13.** Characterization and delineation of model watershed.*	-
S-10	SLO-1	-	*Weeding, use of mulches,*	-		-
	SLO-2	-	Anti-transparent, windbreaks and shelterbelts	-		-

S-11,12	**SLO-1**	-	***Lab/Field 7**. Critical analysis of rainfall and calculation of wet spells, dry spells and LGP*	-	***Lab/Field 14.** Cropping and farming systems in drylands.*	-
	SLO-2	-		-		-

Learning Resources	1. Govindan K. and Thirumurugan, V. (2012). *Principles and practice of Dryland Agriculture.* Kalyani Publishers, Chennai. pp. 1-279. 2. Nagar, S. (2015). *Integrated Watershed Management in Rainfed Agriculture*. Scitus Academic publishing, USA. pp. 1-298.	3. Oswal. M.C. (2016). *Watershed Management (for Dryland Agriculture)*. Associated Publishing Company. India. pp. 1-201. 4. Rayees Ahamad Shah. (2017). *Rainfed Agriculture and Watershed management*. Kushal publications, Varanasi. pp. 1-290.

Level of Thinking		Continuous Learning Assessment (35% weightage)		University Practical Examination (15%)	End semester theory Examination (50%)
		In semester (20%)	Practical (15%)		
Level 1	**Remember**	40 %	35 %	35%	30 %
	Understand				
Level 2	**Apply**	35 %	35 %	40%	40 %
	Analyze				
Level 3	**Evaluate**	25 %	30 %	25%	30 %
	Create				
	Total	100 %	100 %	**100%**	100 %

Course Designers		
Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
Dr. S. Karthikeyan Assistant Agricultural Engineering Agricultural Engineering Department, Virudhunagar.	Dr. M. Mohammad Amanullah, Professor, Maize Research Institute, Tamil Nadu Agricultural University, Dindigul.	Dr. S. Marimuthu Dr. N. Krishnaprabu Dr. D. Selvakumar

THEORY

Unit I: Rain Fed Agriculture

Rainfed agriculture - introduction and definition -Dry farming and rainfed farming: Characteristics. Significance and scope of dry farming in India -History of rainfed agriculture and Watersheds in India. Problems and prospects of rainfed agriculture in India - Soil and climatic conditions prevalent in rainfed areas.

Unit II: Drought

Drought - types, effect of water deficit on physio- morphological characteristics of the plants, Mechanism of crop adaptation under moisture deficit condition; Management strategies for drought.

Unit III: Soil and Water Conservation

Soil erosion - definition - losses due to erosion - types of water and wind erosion - factors affecting erosion - Agronomic measures, mechanical measures and *In-situ* moisture conservation measures of soil and water conservation

Unit IV: Water Harvesting

Water harvesting - importance and its techniques - Water harvesting structures – Storage and recycling - Efficient utilization of water through soil and crop management practices -Management of crops in rainfed areas - Contingent crop planning for aberrant weather conditions - mid season correction.

Unit V: Watershed Management

Watershed - concept - objectives - principles and components of watershed development programme - factors affecting watershed management. Alternate land use system- Non-monetary inputs and low-cost technologies for crop production.

Theory - Lecture Schedules

1. Rainfed agriculture - introduction and definition -Dry farming and rainfed farming: Characteristics. Significance and scope of dry farming in India
2. History of rainfed agriculture and watersheds in India.
3. Problems and prospects of rainfed agriculture in India - climate - rainfall pattern -distribution - variabilities of rainfall
4. Soil and climatic conditions prevalent in rainfed areas.
5. Drought – definition - types of drought - effect of water deficits on physio-morphological characteristics of the plants- mechanism of crop adaptation under drought
6. Management strategies for drought - measures to reduce evapotranspiration – weeding, use of mulches, anti transpirants, windbreaks and shelterbelts
7. Soil erosion - definition - losses due to erosion - types of water and wind erosion – nature and extent of wind and water erosion - factors affecting erosion – universal soil loss equation
8. Agronomic measures of soil and water conservation - choice of crop - crop geometry -tillage - contour cultivation - strip cropping - cover cropping - mulching – cropping systems and weed control
9. **In- Semester examination**
10. Mechanical measures of soil and water conservation - gully control - bench terraces – contour bunds - graded bunds
11. In-situ moisture conservation measures - bund forming - bunding, ridge and furrow system - conservation furrows - inter plot water harvesting, mulching - Broad Bed and Furrow (BBF) and leveling.
12. Water harvesting - importance and its techniques - Water harvesting structures – Storage and recycling
13. Efficient utilization of water through soil and crop management practices – Management of crops in rainfed areas
14. Contingent crop planning for aberrant weather conditions - mid season correction.
15. Watershed: concept - objectives - principles and components of watershed development programme - factors affecting watershed management.
16. Alternate land use system: Definition- Principles- Various models and benefits.
17. Non-monetary inputs and low-cost technologies for crop production.

Practical Schedule

1. Studies on classification of Climate.
2. Rainfall pattern in rainfed areas of India and pattern of onset and withdrawal of monsoons.
3. Studies on Cropping pattern of different rainfed areas of India and Tamil Nadu
4. Mapping of rainfed areas in India.
5. Interpretation of meteorological data for rainfall variability.
6. Scheduling of supplemental irrigation based on crop ET demand.
7. Critical analysis of rainfall and calculation of wet spells, dry spells and length of growing period.
8. Calculation of effective rainfall.
9. Drought management technologies in dryland agriculture

10. Study of methods to reduce evaporation and transpiration
11. Practicing Soil & moisture conservation measures.
12. Water harvesting structures
13. Characterization and delineation of model watershed.
14. Cropping and farming systems in drylands.
15. Mechanization in dryland farming.
16. Visit to watershed / rainfed research station.
17. **University Practical examination**

Text Books

1. Govindan K. and Thirumurugan, V. (2012). *Principles and practice of Dryland Agriculture.* Kalyani Publishers, Chennai. pp. 1-279.
2. Nagar, S. (2015). *Integrated Watershed Management in Rainfed Agriculture.* Scitus Academic publishing, USA. pp. 1-298.
3. Oswal. M.C. (2016). *Watershed Management (for Dryland Agriculture).* Associated Publishing Company. India. pp. 1-201.
4. Rayees Ahamad Shah. (2017). *Rainfed Agriculture and Watershed management.* Kushal publications, Varanasi. pp. 1-290.
5. Reddy S.R and Prabhakara Reddy, G. (2018). *Rainfed Agriculture and Watershed management.* Kalyani Publications, New Delhi. pp. 1-290.

REFERENCE BOOKS:

1. Jat, M. L., S. R., Bhakar, S. K., Sharma and Kothari, A. K. (2016). *Dryland Technology*. 2nd Edition, Scientific Publishers, India. pp. 1-703.
2. Pradeep, S. (2014). *Dryland Agriculture.* Discovery Publishing House Pvt. Ltd, New Delhi. pp. 1-278.
3. Rengasamy, P. (1990). *Dry farming Technology in India*. Agri publishing Academy, New Delhi. pp. 1- 203.
4. Robert J. Naiman. (1992). *Watershed management, Balancing sustainability and environmental change.* Springer publications. pp. 1-521.
5. Widtsoe, J. A. (2012). *Dry Farming for Sustainable Agriculture.* Agrobios (India), Jodhpur. pp. 1-467.

Web References

1. www. tnau. ac. in
2. www. crida. org
3. www. icrisat. Org
4. www.iwmi.cgiar.org
5. https://www.icarda.org/

Journals

1. Journal of Dryland Agriculture
2. Indian Journal of Dryland Agricultural Research and Development
3. Journal of sustainable agriculture
4. Journal of watershed management research

Course Nature: Theory based Practical							
Total Marks (100)							
S. No.	**Category**	**Assessment Tools**					
		In- Semester Examination	Assignment	Record	Attendance	End-Semester Examination	Marks
1	Theory-External	-	-		-	*50*	*50*
2	Theory-Internal	*20*	-			-	*20*
3	Practical-External	-	-		-	*15*	*15*
4	Practical-Internal	-	*05*	*05*	*05*	-	*15*
						Grand Total	*100*

Course Code	AGE19602	Course Name	PRINCIPLES OF ORGANIC FARMING	Course Category	C	*Compulsory Core*	L	T	P	C
							1	0	1	2

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Agronomy*	Data Book / Codes/Standards	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1 :	*Learn the basis of historical, biological and ecological concepts in organic farming.*
CLR-2:	*Gain knowledge on soil organic carbon and their improvement.*
CLR-3:	*Understand the Importance of organic sources of nutrients on soil fertility management.*
CLR-4:	*Gain information on non-chemical approaches and ITK's practices.*
CLR-5:	*Comprehend the steps in organic certification*

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Agriculture Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	Ability to solve scientific problems through Soil science	Ability to implement knowledge gained	Ability to understand social and ethical responsibilities
CLO-1:	*Explain about the organic farming*	*1*	90	85	*H*			*H*			*H*		*M*	*H*		*H*	*H*	*H*	*H*
CLO-2:	*Demonstrate on the preparation of organic sources.*	*2*	95	85	*H*			*H*					*L*	*H*		*H*	*H*	*H*	*H*
CLO-3:	*Support the different stakeholders to get organic certification*	*2*	80	70	*M*		*M*	*M*			*H*		*L*	*H*		*H*	*H*	*H*	*H*
CLO-4:	*Appraise organic approaches in different agro-climatic zones*	*3*	85	75	*M*			*H*					*M*	*H*		*H*	*H*	*H*	*H*
CLO-5:	*Exhibit the skills and knowledge about ITK practices*	*3*	85	90	*M*								*M*	*H*		*H*	*H*	*H*	*H*

Duration (hour)		Learning Unit / Module 1	Learning Unit / Module 2	Learning Unit / Module 3	Learning Unit / Module 4	Learning Unit / Module 5
		4	4	3	2	3
S-1	SLO-1	*Organic farming definition, concepts and scope*	*Sources of organic manures- plant, animal and microbial origin*	*Weeds - Ecology - habitat management of weeds*	*Indigenous Technical Knowledge (ITK) in organic agriculture - scientific rationale.*	*Organic certification - NPOP guidelines*
	SLO-2	*OF history and status in India and World*	*On - farm resources; FYM, green manures, crop residues, poultry manure, sheep and goat manures, biogas slurry and vermicompost.*	*Non - chemical weed management methods; preventive and physical, methods*	*ITK- soil and nutrient management*	*Organic Certification agencies in India*
S-2,3	SLO-1	***Field/Lab.1.** Resource inventory of organic farm*	***Field/Lab.5.**Hands on experience on recycling techniques; bio-composting and vermicomposting*	***Field/Lab.9.** Skill development in composting farm residues.*	***Field/Lab.12.** Organic crop production and diseases management.*	***Field/Lab.15.** Exposure visit to organic market out lets.*
	SLO-2					
S-4	SLO-1	*Introduction to bio - diversity; importance*	*Off-farm resources- coir pith, press mud, oilcakes, fly ash*	*Cultural, use of tools and implements*	*ITK- weed, water, management*	*Crop production standards in Organic farming*
	SLO-2	*Measures to preserve bio - diversity*	*bio compost, minerals, bone meal, bio fertilizers, traditional preparations.*	*Biological measures - good crop husbandry practices*	*Prospects and problems in organic farming.*	*Quality considerations in organic agricultural products*
S-5,6	SLO-1	***Field/Lab2.** Raising of green manures*	*Field/Lab.6.Quantification of nutrients from organic sources and application of manures and bio- fertilizers*	***Field/Lab.10**. Organic crop production and pest management.*	***Field/Lab.13. Skill** development in vermicompost preparation.*	***Field/Lab.16**.Exposure visit to organic certification agencies / Directorate of Organic Certification, Tamil Nadu.*
	SLO-2					
S-7	SLO-1	*Pre-requisites and basic steps for organic farming*	*Organic waste recycling methods and techniques*	*Integrated pest and diseases management*	--	*Labeling and accreditation process in organic products*
	SLO-2	*Conversation to organic farming - planning and processes in practices -. IFS approach in Integration of animal components*	*Composting, vermicomposting, in situ composting - system approach.*	*Bio control agents in organic farming*	--	*Marketing and export opportunities of organic products*
S-8,9	SLO-1	***Field/Lab.3.** Incorporation of green manure*	***Field/Lab. 7.** Exposure visit to an*	***Field/Lab.11.** Exposure visit to bio-control*	***Field/Lab.14.**Hands on training on*	--

	SLO-2	*- seed treatment*	*organic farm to learn ITK based preparations*	*agent*	*grading, packaging and post-harvest management.*	
S-10	**SLO-1**	*Organic carbon status and improvement strategies*	*Soil and crop management in organic farming*	*Bio rational pesticides; minerals, botanicals, soaps, trap crops, bird perches, and traditional preparations - sanitation*	--	--
	SLO-2	*Conservative tillage systems.*	*Inter cropping and companion planting, crop rotation green manures and cover crops, mulching*		--	--
S-11	**SLO-1**	***Field/Lab.4.*** *Hands on practice on preparatory cultivation; soil and water conservation methods.*	***Field/Lab.8.****Organic crop production and weed management.*	--	--	--
	SLO-2					--

Learning Resources	1. Arun. K. Sharma. (2011). *Handbook of Organic farming*. Agrobios (India), Jodhpur. pp. 1-627. 2. Bansal, M. (2020). *Basics of organic farming.* CBS publishers and distributors pvt. Ltd., New Delhi. pp. 1-143.	3. Lampkin, N., Measures, M. and Padel, S. (2014). *Organic Farm Management Handbook.* University of Wales, Aberystwyth. pp. 1-207 4. Maliwal, P.L. (2020). *Principles of organic farming.* Scientific Publishers (India). pp. 1-180.

Level of Thinking		Continuous Learning Assessment (35% weightage)		University Practical Examination (15%)	End semester theory Examination (50%)
		In semester (20%)	Practical (15%)		
Level 1	**Remember**	40 %	30 %	35%	30 %
	Understand				
Level 2	**Apply**	40 %	40 %	35%	40 %
	Analyze				
Level 3	**Evaluate**	20 %	30 %	30%30	30 %
	Create				
	Total	**100 %**	**100 %**	**100%**	**100 %**

Course Designers		
Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
Mr. Sivakumar *Madras iyer thottam organic farm,* ***Kondappa naicken palayam, Sathyamangalam, Tamil Nadu 638503.***	*Dr. E. Somasundharam* *Professor and Head* *Department of Sustainable Organic Agriculture, Tamil Nadu Agricultural University, Coimbatore – 3.*	*Dr. D. Selvakumar* *Dr. N. Krishnaprabu* *Dr. S. Marimuthu*

THEORY

Unit - I Components and Principles of Organic Farming

Organic farming: Definition - Scope - principles and concepts - history of organic farming – global scenario - biodiversity: importance and measure to preserve biodiversity - prerequisites for Organic farming: - Soil organic carbon: status and improvement strategies.

Unit – II - Organic Sources of Nutrients

Organic sources of nutrients - manures and other inputs - on farm and off farm sources - organic waste recycling - methods - Soil and crop management - inter cropping, crop rotation, green manures, cover crops, mulching - bio fertilizers.

Unit - III Non - Chemical Weed and Pest Disease Management

Non-chemical weed management methods: preventive, physical, cultural, mechanical and biological measures - Bio-intensive pest and disease management.

Unit – IV Indigenous Technical Knowledge (ITK)

Indigenous Technical Knowledge (ITK) in organic agriculture - scientific rationale - soil, nutrient, weed, water, management - prospects and problems in organic farming.

Unit - V Certification and Marketing

Organic certification - NPOP guidelines - Certification agencies in India - crop production standards - Quality considerations - labeling and accreditation process - marketing and export opportunities.

Theory- Lecture Schedules

1. Organic farming; definition - prospects - principles and concepts - History and genesis of organic farming in World and India: Present status in World, India and Tamil Nadu.
2. Introduction to bio - diversity; importance and measures to preserve bio - diversity.
3. Pre-requisites and basic steps for organic farming; conversation to organic farming - planning and processes in practices - IFS approach - Integration of animal components.
4. Organic carbon; status and improvement strategies - conservative tillage systems.
5. Sources of organic manures - plant, animal and microbial origin - on - farm resources; FYM, green manures, crop residues, poultry manure, sheep and goat manures, biogas slurry and vermicompost.
6. Off-farm resources; coir pith, press mud, oilcakes, fly ash, bio compost, minerals, bone meal, bio fertilizers, traditional preparations.
7. Organic waste recycling methods and techniques - composting, vermicomposting, *in situ* composting - system approach.
8. Soil and crop management in organic farming; Inter cropping and companion planting, crop rotation green manures and cover crops, mulching.
9. **In semester examination**
10. Weeds - Ecology - habitat management of weeds - Non - chemical weed management methods; preventive, physical, cultural, use of tools and implements and biological measures - good crop husbandry practices.
11. Integrated pest and diseases management - bio control agents, bio rational pesticides; minerals, botanicals, soaps, trap crops, bird perches, and traditional preparations - sanitation.
12. Indigenous technical knowledge (ITK) in organic agriculture - rationale and principles - general, indigenous practices for soil, nutrient, weed, water pest and disease management in farming - ITK's in farmers practice.
13. Benefits and problems in organic farming.
14. Organic farming; Promotional activities; role of government and NGO's - action plan - policy considerations.
15. Economic evaluation of organic production systems - cost - benefit analysis and comparison with conventional systems.
16. Organic certification - procedures - certification agencies in India - labeling, marketing and export opportunities.
17. Crop production standards - NPOP guidelines - principles, recommendations and standards - Quality considerations - assessment methods - premium and export opportunities.

Practical Schedule

1. Resource inventory of organic farm- Soil sampling and analysis for organic carbon and pesticide residues / contaminants.
2. Raising of green manures (Sunnhemp / Daincha / Fodder cowpea).
3. Incorporation of green manure - seed treatment and rising of field crop (Rice / Maize / Cowpea / Cotton / Gingelly).
4. Hands on practice on preparatory cultivation; soil and water conservation methods.
5. Hands on experience on recycling techniques; bio-composting and vermicomposting.
6. Quantification of nutrients from organic sources and application of manures and bio- fertilizers.
7. Exposure visit to an organic farm to learn ITK based preparations.
8. Organic crop production and weed management.
9. Skill development in composting farm residues.
10. Organic crop production and pest management.
11. Exposure visit to bio-control agent (*Pseudomonas, Trichoderma* etc.,) production units.
12. Organic crop production and diseases management.

13. Skill development in vermicompost preparation.
14. Hands on training on grading, packaging and post-harvest management.
15. Exposure visit to organic market outlets.
16. Exposure visit to organic certification agencies / Directorate of Organic Certification, Tamil Nadu.
17. **University Practical examination**

Text Books

1. Arun. K. Sharma. (2011). *Handbook of Organic farming.* Agrobios (India), Jodhpur. pp. 1-627.
2. Bansal, M. (2020). *Basics of organic farming.* CBS publishers and distributors pvt. Ltd., New Delhi. pp. 1-143.
3. Lampkin, N., Measures, M and Padel, S. (2014). *Organic Farm Management Handbook.* University of Wales, Aberystwyth. pp. 1-207
4. Maliwal, P.L. (2020). *Principles of organic farming.* Scientific Publishers (India). pp. 1-180.
5. Palaniappan, S. P and Annadurai, K. (2018). *Organic Farming: Theory and Practice.* (7th Edition), Scientific Publishers. pp. 1-257.
6. Reddy, S.R. (2017). *Principles of organic farming.* Kalyani publishers, India. pp. 1-117.

Reference Books

1. Barker, A.V. (2010). *Science and Technology of Organic Farming.* CRC Press. pp.1-240.
2. Dushyant Gehlot. (2010). *Organic farming: Components and management.* Agrobios (India), Jodhpur. pp. 1-376.
3. Masanobu Fukuoka, Larry Korn, Wendell Berry and Frances Moore Lappe. (2009). *The One-Straw Revolution: An Introduction to Natural Farming.* NYRB Classics, New York. pp. 1-200.
4. Panda, S.C. (2012). *Principles and Practices of Organic Farming.* Agrobios (India), Jodhpur. pp. 1-594.
5. Peter Fossel. (2014). *Organic Farming: How to Raise, Certify, and Market Organic Crops and Livestock.* Reprint edition, Voyageur Press, USA. pp. 1-176.

Web References

1. www.ifoam.org
2. www.apeda.org
3. www.cowindia.org
4. www.ncof.org
5. www.earthfooda.co.uk,
6. www.newfarm.org/training
7. https://www.youtube.com/watch?v=JlWsxo5nNgg

Journals

1. Organic Agriculture
2. Journal of Organic Agriculture and Environment
3. Organic Farming
4. International Journal of Sustainable Agricultural Management and Informatics
5. Journal of Sustainable Agriculture
6. Advances in Agronomy

Course Nature: Theory based Practical							
Total Marks (100)							
S. No.	**Category**	**Assessment Tools**					
		In- Semester Examination	Assignment	Record	Attendance	End-Semester Examination	Marks
1	Theory-External	-	-		-	*50*	*50*
2	Theory-Internal	*20*	-			-	*20*
3	Practical-External	-	-		-	*15*	*15*
4	Practical-Internal	-	*05*	*05*	*05*	-	*15*
						Grand Total	*100*

Course Code	AGE19603	Course Name	PRACTICAL CROP PRODUCTION-II (*RABI* CROPS)	Course Category	C	Compulsory Core	L	T	P	C
							0	0	1	1

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*AGRONOMY*	Data Book / Codes/Standards	*Nil*		

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1:	Acquire knowledge and skills of various crop production in *rabi* season
CLR-2:	Learn about soil fertility and weed management besides plant protection and crop harvesting.
CLR-3:	Infer package of practices for *rabi* season crops
CLR-4:	Learn the application of the principles of the scientific basis of crop and plant production sciences.
CLR-5:	Gain Knowledge in the preparation of cost estimates for production of *rabi* crops.
CLR-6:	-

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Agriculture Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	Ability to solve scientific problems	Ability to implement knowledge gained	Ability to understand social and ethical responsibilities
CLO-1:	Demonstrate a conceptual understanding of key aspects of cultivation practices required to grow the major *rabi* crops successfully.	2	85	80	H						H		M	H		H	L	M	M
CLO-2:	Evaluate the critical management factors involved in profitable crop production	2	75	75	H					L	H					H	H	H	H
CLO-3:	Demonstrate a thorough and deep understanding of the agronomic factors involved in producing crops in integrated, sustainable crop production system	3	90	85	H		H	M		L			H	H		H	M	H	M
CLO-4:	To impart in-depth practical knowledge in crop production	3	85	75	H					L						H	M	M	M
CLO-5:	Perusade on practical knowledge of major crop production	2	85	80	H	M				L	H		H			H	H	H	
CLO6:	-																		

Theory		Learning Unit / Module 1	Learning Unit / Module 2	Learning Unit / Module 3	Learning Unit / Module 4	Learning Unit / Module 5
Practical (2 hrs.)		8	8	8	8	
S-5	SLO-1	*Study of importance, origin, distribution of sunflower*	*Acquiring skill in seed treatment of sunflower*	*Acquiring skill in gap filling and thinning*	*Estimation of yield and yield parameters*	-
	SLO-2	*Study of botany of Sunflower*	*Sowing practices of sunflower*	*Observation on nutritional deficiency*		-
S-7	SLO-1	*Study of ecosystems and climate of sunflower*	*Practicing of application of manures and fertilizers*	*Recording growth parameters and assessing dry matter production*	*Harvesting, threshing and cleaning of sunflower*	-
	SLO-2	*Study the soils of Tamil Nadu and India for sunflower cultivation*				-
S-8	SLO-1	*Study of cropping systems and seasons*	*Water management practices for sunflower*	*Artificial pollination in sunflower*	*Seed storage, seed dormancy and utilization of sunflower*	-
	SLO-2	*Study of varieties of sunflower in India and Tamil Nadu*				-
S-9	SLO-1	*Main field preparation for sunflower*	*Estimation of plant population*	*Observation of insect pests and diseases*	*Working out cost of cultivation and economics*	-
	SLO-2					-

Learning Resources	
1.	Chidda Singh, Prem Singh and Rajbir Singh. (2020). *Modern Techniques of Raising Field Crops*. Oxford and IBH Publishing Co Pvt.Ltd, New Delhi. pp. 1- 596.
2.	Crop Production Guide. (2020). Directorate of Agriculture, Chennai and Tamil Nadu Agricultural University, Coimbatore. pp. 1-460.
3.	Mukund Joshi., (2015). *Text Book of Field Crops.* PHI Learning Private limited. New Delhi. pp. 1-537.
4.	Srinivasan Jeyaraman. (2018). *Field crops production and management (Volume I & 2).* Oxford and IBH Publishers. India. pp. 1- 1068.

Level of Thinking		Continuous Learning Assessment (60% weightage)		University Practical Examination (40%)
		In semester (40%)	Practical (20%)	
Level 1	**Remember**	35%	35%	35%
	Understand			
Level 2	**Apply**	40%	40%	40%
	Analyze			
Level 3	**Evaluate**	25%	25%	25%
	Create			
	Total	100%	100%	100%

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, and Conf. Paper etc.

Course Designers		
Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
Mr. Sivakumar Madras Iyer Thottam Organic farm, Kondappa naicken palayam, Sathyamangalam, Tamil Nadu 638503.	Dr. S. Sanbagavalli, Associate Professor (Agronomy), Department of Agronomy, Tamil Nadu Agricultural University, Coimbatore - 3	Dr. N. Krishnaprabu Dr. D. Selvakumar Dr. S. Marimuthu

Practical Schedule
Any irrigated dry crop (sunflower / Peas / Chickpea)

Practical Schedule for Irrigated dry crop (Eg. Sunflower):
Ecosystem - Climate and weather – Seasons, soil and varieties of Tamil Nadu and India - Selection of field - Main field preparation - seed treatment - Application of manures and fertilizers - Sowing - Weed management and practicing pre-emergence application of herbicides - Thinning and gap filling - Estimation of plant population - Top dressing - Weed management - Water management - Pest management - Observation on nutrient and weeds - Recording growth, yield attributes and yield - Harvesting, threshing and cleaning the produce - Cost of cultivation and economics

Practical Schedule
1. Study of importance, origin, distribution and botany of Sunflower.
2. Study of ecosystems, climate and soils of Tamil Nadu and India
3. Study of cropping systems, seasons and varieties of sunflower in Tamil Nadu and India
4. Selection of field and main field preparation for sunflower
5. Acquiring skill in seed treatment and sowing practices of sunflower
6. Practicing of application of manures and fertilizers for sunflower
7. Study of water management practices for sunflower
8. Study of weeds and weed management in sunflower
9. Estimation of plant population and acquiring skill in gap filling and thinning
10. Observation on nutritional deficiency symptoms and corrective measures
11. Recording growth parameters and assessing dry matter production
12. Acquiring skill in artificial pollination in sunflower
13. Observation of insect pests and diseases and their management
14. Estimation of yield and yield parameters in sunflower
15. Harvesting, threshing and cleaning, seed storage, seed dormancy and utilization of sunflower
16. Working out cost of cultivation and economics
17. **University Practical Examination**

Text Books

1. Ahlawat, I.P.S., Om Prakash and Saini, G.S. (2010). *Scientific Crop Production in India*. Rama publishing House, Meerut. pp. 1- 680.
2. Chidda Singh, Prem Singh and Rajbir Singh. (2020). *Modern Techniques of Raising Field Crops*. Oxford and IBH Publishing Co Pvt.Ltd, New Delhi. pp. 1- 596.
3. Mukund Joshi., (2015). *Text Book of Field Crops.* PHI Learning Private limited. New Delhi. pp. 1- 537.
4. Rajendra Prasad. (2017). *Textbook of Field Crops Production (Volume 1 & 2).* Indian Council of Agricultural Research (ICAR), New Delhi. pp. 1-1008.
5. Reddy. S.R. (2014). *Principles of Crop Production*. Kalyani Publishers, Ludhiana. pp. 1- 794.

Reference Books

1. Alabaster Jenkins. (2016). *Agronomy and crop production.* Syrawood publishing house, UK. pp. 1- 205.
2. Crop Production Guide. (2020). Directorate of Agriculture, Chennai and Tamil Nadu Agricultural University, Coimbatore. pp. 1-460.
3. Reddy, S.R. (2012). *Agronomy of field crops.* Kalyani publishers, New Delhi. pp. 1- 443.
4. Singh. S.S. (2015). *Crop management under irrigated and rainfed conditions.* Kalyani Publishers, New Delhi. pp. 1- 574.
5. Srinivasan Jeyaraman. (2018). *Field crops production and management (Volume I & 2).* Oxford and IBH Publishers. India. pp. 1- 1068.
6. Yellamanda Reddy, T. and Sankara Reddy, G.H. (2017). *Principles of Agronomy.* Kalyani publishers, Ludhiana. pp. 1- 685.

Web References
1. www.tnau.ac.in/agriportal
2. www.fao.org/ag/ca
3. https://www.agrimoon.com/wp-content/uploads/Introduction-to-major-field- crops.pdf
4. http://www.icar-iior.org.in/

Journals

1. Research on crops
2. Indian journal of crops
3. Journal of crop and weed
4. Advances in Agronomy
5. Agronomy Journal

Course Nature: Only Practical							
Total Marks (100)							
S. No.	Category	Assessment Tools					
		In- Semester Examination	Assignment	Record	Attendance	End-Semester Examination	Marks
1.	Practical-External	-	-	-	-	40	40
2.	Practical-Internal	40	5	10	5	-	60
						Grand Total	100

Course Code	AGE19604	Course Name	AGRICULTURAL MICROBIOLOGY	Course Category	C	Compulsory Core	L	T	P	C
							1	0	1	2

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Agricultural Microbiology	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1:	Gain Knowledge on contributions of different scientists in the development of soil Microbiology
CLR-2:	Understand soil microbial diversity and their role in biogeochemical cycling and soil fertility
CLR-3:	Gain information on the different groups of microorganism capable of plant growth promotion
CLR-4:	Acquire technical knowledge on the bioinoculant production setup
CLR-5:	Learn about pilot scale study, mass production and quality control strategies
CLR-6:	Comprehend the production process of biodegradation and bioremediation in soil

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Agriculture Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environ. Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	Ability to solve scientific problems through Agricultural Microbiology	Ability to implement knowledge gained in the applied field of Agricultural Microbiology	social and ethical responsibilities of Agricultural
CLO-1:	Isolate microorgnisms responsible for plant growth promotion	3	90	80	M								M	H		H	H	H	H
CLO-2:	Discuss on the different plant growth promoting traits of the microorganisms	1	95	85	H								L	H		H	H	H	H
CLO-3:	Demonstrate about biofertilizer industrial setup and its requirements	2	80	70	M		L	L					L	H		H	H	H	H
CLO-4:	Perform mass production of bio inoculants	3	75	65	M			L	L				M	H		H	H	H	H
CLO-5:	Appraise on the quality control and production ecconomics of bioinoculants	2	75	60	L	L							M	H		H	H	H	H
CLO6:	Elaborate on utilization of microbes for biodegration and bioremediation of polluted soils	2	75	65	L						H		M	H		H	H	H	H

Duration (hour)		Learning Unit / Module 1	Learning Unit / Module 2	Learning Unit / Module 3	Learning Unit / Module 4	Learning Unit / Module 5
		11 (3)	11 (3)	11(3)	10 (4)	7(3)
S-1	SLO-1	Definition of Microbiology	Organic matter decomposition	Rhizosphere microrganisms	Nitrogen fixation	Microbes in soil reclamation
	SLO-2	Scope of Soil Microbiology	Carbon cycle	Phyllosphere microorganisms	Phosphate solubilization and mobilization	Microbes on soil waste management
S 2-3	SLO-1	**Lab1:** Determination of R: S ratio	**Lab 5:** Associative symbiotic - Azospirillum	**Lab 9:** PGPR-Pseudomonas sp.	**Lab13 :** Spot indole test	**Lab16:** Industrial visit-biopesticide unit
	SLO-2					
S-4	SLO-1	History of Soil Microbiology	Nitrogen Cycle	Spermosphere microorganisms	Blue green algae	Bioremediation of agricultural residues
	SLO-2	Developments in soil microbiology	Biological nitrogen fixation	Endophytic microorganisms	Azolla	Chemicals – Biodegradation
S 5-6	SLO-1	**Lab 2:** Biological Indicators of soil Health	**Lab 6:** Free Living-Azotobacter	**Lab10:** Phyllosphere microorganisms - PPFM	**Lab 14 :** Methods of application of bioinoculants	**Lab17:** Final Practical Examination
	SLO-2					
S-7	SLO-1	Soil Microbial Diversity and factors affecting	Phosphorous Cycle and mineral transformations in soil	Plant growth promoting rhizobacteria	Biological Nitrogen Fixation	Microbes involved in bioremediation
	SLO-2	Soil fertility index	Rhizosphere, phyllosphere, spermosphere and endophytic microbes	Bacterial Interactions	Mass production and quality control	Bioremediation mechanisms
S 8-9	SLO-1	**Lab 3:** Crowded Plate technique	**Lab 7:**Endophyte- Gluconacetobacter diazotrophicus	**Lab11:**Mycorrhiza infection from roots	**Lab15:** Pesticide degrading bacteria	–
	SLO-2					
S 10-11	SLO-1	**Lab 4 :** Symbiotic –Rhizobium sp.	**Lab 8-** Phosphate solubilizing - Phosphobacteria	**Lab 12 :** Mass production of bacterial bio inoculants	Fungal bioinoculants	-
	SLO-2				Application of bioinoculants	-

Learning Resources	
1.	Subba Rao N.S. (2001) Soil Microorganisms and plant growth. IV edition, Oxford and IBH Publishing Co. Pvt. Ltd, New Delhi (ISBN: 9788120413832). Pp: 1-406.
2.	Van Elsas J.D., Trevors J.T., Rosado A.S. and Nannipieri P. (Ed) (2019) Modern Soil Microbiology, III edition, CRC Press, United States (ISBN: 978-1498763530). Pp. 1-501.

Level of Thinking		Continuous Learning Assessment (35% weightage)		University Practical Examination (15%)	End semester theory Examination **(50%)**
		In semester (20%)	Practical (15%)		
Level 1	**Remember**	40 %	30 %	35%	30 %
	Understand				
Level 2	**Apply**	40 %	40 %	35%	40 %
	Analyze				
Level 3	**Evaluate**	20 %	30 %	30%	30 %
	Create				
	Total	100 %	100 %	100%	100 %

Course Designers		
Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
Mr. C. Vaithilingam Romvijay Biotech PVT LTD NH32, Mullodai, Kanniyakoil, Puducherry 607402	Dr. Reetha D, Professor, Department of Microbiology, Faculty of Agriculture, Annamalai University, Annamalainagar-608002	Dr. Anbukarasi K Dr. Melvin Joe M

THEORY

Unit I - Introduction to Soil Microbiology

Soil Microbiology-Definition and scope. Historical developments in soil microbiology. Soil microorganisms-Major groups, characteristics, and their diversity; Factors influencing microbial diversity in soil. Biological indicators of soil fertility and soil fertility index(SFI)

Unit II - Microbes In Soil Fertility and Crop Production

Carbon cycle: Organic matter decomposition in oxygenic and anoxygenic environment; humus formation. Nitrogen cycle- ammonification, nitrification, and denitrification . Biological Nitrogen Fixation (BNF); Free living, associative, symbiotic, endophytic and epiphytic diazotrophs; Nodulation - leguminous and non-leguminous plants; biochemistry of BNF. Phosphorus cycle- phosphorus solubilization and mobilization. Microbial transformation of sulphur , potassium, zinc and silica in soil.

Unit III- Plant-Microbe Interaction

Rhizosphere, phyllosphere, spermosphere, endophytic microorganisms and their significance. Plant growth promoting rhizobacteria (PGPR). Soil microorganisms and their interactions

Unit IV – Microbes in Human Welfare

Microbes in silage production. Bioinoculants: Types of bioinoculants-nitrogen fixers, phosphate, zinc and silicate solubilizers , potassium releasers , phosphate mobilizers , Pink Pigmented Facultative Methylotrophs (PPFM), - ACC (1-aminocyclopropane-1-carboxylate) deaminase and their role in stress agriculture. BGA and *Azolla*. Mass production and quality control of bioinoculants. Methods of application of bioinoculants. Biopesticides and microbial biofuels

Unit IV - Microbial Degradation and Bioremediation

Microbial reclamation of problematic soils. Role of microorganisms in soil waste management. Biodegradation of pesticides and xenobiotic pollutants– mechanisms involved in degradation

Theory –Lecture Schedule

1. Soil Microbiology-Definition and scope, Historical developments in soil microbiology, Contribution of Hermaan Hellriegel, Wolfarth, Martinus Beijerinck and Sergei Winogradsky, Alexander Fleming, Selman Waksman, Albert Bernhard Frank, Dobereiner
2. Soil microorganisms-Major groups, characteristics, abundance and their diversity, factors influencing microbial diversity, Biological indicators of soil health-microbial biomass, soil enzymes, Soil respiration & metabolic quotient (qCO_2)
3. Carbon cycle- C:N ratio, Organic matter decomposition- oxygenic and anoxygenic environments ; humus formation, Nitrogen cycle- ammonification, nitrification, and denitrification.
4. Biological Nitrogen Fixation (BNF)-Free living, associative, symbiotic , endophytic and epiphytic diazotrophs
5. Nodulation : Legume-Rhizobium and Frankia-Actinorhizal symbiosis, Biochemistry of BNF
6. Phosphorus cycle: Microbial transformation of Phosphorus, Phosphorus solubilizers and Phosphorus Mobilizers
7. Microbial transformation of S, K, Zn and Si
8. Plant-microbe interactions- Rhizosphere and root exudates, Spermosphere, phyllosphere, endophytic microorganisms and their significance.
9. **In-semester Examination**
10. Plant growth promoting microbes-types and mechanism of action.
11. Soil microorganisms and their interactions-positive and negative interaction
12. Microbes in silage production. Bioinoculants- Types- nitrogen fixers, phosphate mobilizers, PPFM, BGA and *Azolla*
13. Mass production and quality control of bacterial, fungi and algal bioinoculants
14. Methods of application of bioinoculants. Biopesticides – types and mechanism of action
15. Biofuel production – methane, hydrogen, alcohol and biodiesel production
16. Microbial reclamation of problematic soils. Microbes in solid waste management
17. Biodegradation of pesticides and xenobiotic , mechanism involved in degradation

Practical Schedule

1. Enumeration of rhizospheric microorganisms and determination of R: S ratio
2. Determination of biological indicators of soil Health : Soil respiration and Soil Enzyme activity
3. Antibiosis in soil by Crowded plate Technique
4. Isolation of symbiotic microorganism from root nodules
5. Isolation of *Azospirillum* from roots.
6. Isolation of *Azotobacter* from soil
7. Isolation of *Gluconacetobacter* from sugarcane phyllosphere/rhizosphere
8. Isolation of *Phosphobacteria* , potassium releasing and zinc solubilizing bacteria from soil
9. Isolation of PGPR(*Pseudomonas* sp.) from soil

10. Isolation of Phyllosphere microorganisms (PPFM) from different vegetables crops
11. Examination of AM infection in roots
12. Mass production of bacterial bio inoculants, BGA and Azolla
13. Spot indole test and quantitative determination of IAA production
14. Methods of application of different bioinoculants
15. Isolation of pesticide degrading bacteria from agricultural soils
16. Visit to biofertilizer production unit and compost yard
17. **University practical Examination**

Text Books

1. Adhya, T. K., Mohapatra,Lal. B., Paul,B. D., & Das, S. (Eds.). (2018). Advances in soil microbiology: recent trends and future prospects (1st Edn,) . Singapore: Springer Nature, Switzerland AG (ISBN 978-981-10-6178-3). pp.1-204.
2. Alexander, M. (1977). Introduction to Soil Microbiology(2nd Edn.) . New York:John Wiley & Sons, (ISBN-10: 0471030570).pp. 1-467.
3. Edwards. A. (2017) Introduction to Soil Microbiology(1st Edn.). UK: Koros Press,(ISBN-1978178163104).pp 1-524.
4. Paul E.A. (ed.) (2015). Soil microbiology, Ecology and Biochemistry(4th Edn,), United States:Elsevier Academic Press, (ISBN: 978-0-12-546807-7). pp-1-603.
5. Rangaswami, G. and Bagyaraj, D.J. (1998). Agricultural Microbiology (2nd Edn,).India : Prentice Hall of India Pvt. Ltd. (ISBN: 9781842652763).pp 1-422
6. Subba Rao N.S. (2001) Soil Microorganisms and plant growth(4th Edn,). New Delhi, Oxford and IBH Publishing Co. Pvt. Ltd, (ISBN: 9788120413832). pp-1-406

Reference Books

1. Glick B.R. (2020) Beneficial Plant Bacterial Interactions(2nd Edn,). Switzerland:,Springer Nature,.(ISBN 978-3-319-13921-0).pp.1-382.
2. Mark, W. (2008). Principles of Modern Microbiology (1st Edn,).Canada: Jones & Bartlett Learning, (ISBN-13: 9780763710750).pp-1-445.
3. Pepper, I. L., Gerba, C. P., & Gentry, T. J. (2019). Environmental microbiology (3rd Edn,), United States: Academic Press, (ISBN: 9780123946263). pp.1-728.
4. Pommerville J C. (2018). Microbes and Society(5th Edn.), Canada: Jones & Bartlett Learning, (ISBN-13: 9781284172102). pp.1-476.
5. Sylvia, D. M., Fuhrmann, J. J., Hartel, P. G., and Zuberer, D. A. (2005). Principles and applications of soil microbiology (2nd Edn,), United States: Prentice Hall, (ISBN 978-0130941176). pp 1-672.
6. USDA NRCS Soil Quality Institute. (2001**).** Soil Quality Test Kit Guide. United States Department of Agriculture. Retrieved from: http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_050956.pdf
7. Van Elsas J.D., Trevors J.T., Rosado A.S. and Nannipieri P. (Ed) (2019) Modern Soil Microbiology (3rd Edn.), United States: CRC Press, (ISBN: 978-1498763530). pp. 1-501.

Journals

1. Soil Biology and Biochemistry
2. Applied and Environmental Microbiology
3. European Journal of soil Biology
4. Applied Microbiology and Biotechnology
5. Journal of Bioremediation and biodegradation
6. Beneficial Microbes

Course Nature: Theory based Practical							
Total Marks (100)							
S.No.	**Category**	**Assessment Tools**					
		In- Semester Examination	Assignment	Record	Attendance	End-Semester Examination	Marks
1	Theory-External	-	-		-	*50*	*50*
2	Theory-Internal	*20*	-			-	*20*
3	Practical-External	-	-		-	*15*	*15*
4	Practical-Internal	-	*05*	*05*	*05*	-	*15*
						Grand Total	*100*

Course Code	AGS19601	Course Name	FARM MANAGEMENT, PRODUCTION AND RESOURCE ECONOMICS	Course Category	S	Supportive Course	L	T	P	C
							1	0	1	2

Pre-requisite Courses	Nil	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	***Agricultural Economics***	Data Book / Codes/Standards	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1 :	*Expose the students to functional areas of farm management*
CLR-2 :	*Understand the concept of production theories*
CLR-3 :	*Infer the combinations of inputs and outputs*
CLR-4 :	*Expose the students on various records maintain in farms*
CLR-5 :	*Understand about the resource utilization*
CLR-6 :	*Expose the students to functional areas of farm management*

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	*Explain about farm input combinations*	*3*	90	80
CLO-2 :	*Discuss on factors of production*	*1*	90	85
CLO-3 :	*Decide on rational production*	*2*	75	70
CLO-4 :	*Appraise the scope of farm management*	*3*	80	75
CLO-5 :	*Identify profitable enterprises*	*2*	85	80
CLO-6 :	*Demonstrate the techniques in optimization of resource utilization*	*2*	85	80

Program Learning Outcomes (PLO)															
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Agriculture Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	Ability to solve scientific problems	Ability to implement knowledge gained in the applied field of Business Management	Ability to understand social and ethical responsibilities
M	M	M	M	H	M	H	H	M	H	H	H	H	H	H
H	M	M	M	M	H	H	M	L	H	H	H	H	H	H
M	H	H	M	M	H	M	M	H	H	H	H	H	H	H
M	H	M	L	L	M	L	M	M	H	H	H	H	H	H
M	M	M	M	M	M	M	M	M	H	H	H	H	H	H
M	H	M	M	H	L	M	L	M	H	H	H	H	H	H

		Learning Unit / Module 1	Learning Unit / Module 2	Learning Unit / Module 3	Learning Unit / Module 4	Learning Unit / Module 5
Duration (hour)		9	12	9	9	**9**
S-1	SLO-1	*Meaning and concept of farm management*	*Principles of farm management*	*Product – Product relationship*	*Farm planning*	*Scarcity of resources*
	SLO-2	*Factors determining types and size of farms*	*Production function in decision-making on a farm*	*Optimum Combination of Products*	*Linear programming*	*Property Rights*
S-2-3	SLO-1	***Lab:1** Preparation of farm layout*	***Lab:3** Application of equi - marginal returns*	***Lab:7** Application of cost principles including CACP concepts*	***Lab:11**Risk Analysis*	***Lab:15** Graphical solution to Linear Programming problem*
	SLO-2					
S-4	SLO-1	*Types of farming*	*Factor - Product relationship*	*Principle of Opportunity Cost*	*Concept of risk and uncertainty*	*Inefficiency and welfare loss*
	SLO-2	*Systems of farming*	*Laws of Returns*	*Minimum Loss Principle*	*Crop / livestock / machinery insurance*	*Common property resources*
S-5-6	SLO-1	***Lab:2** Valuation of assets by different methods.*	***Lab:4** Determination of most profitable level of inputs*	***Lab:8** Estimation of cost of cultivation*	***Lab:12** Preparation and Analysis of Net worth Statement*	***Lab:16** Collection and analysis of data on various resources in India*
	SLO-2					
S-7	SLO-1	-	*Meaning and concept of cost*	*Farm business analysis*	*Farm budgeting*	-
	SLO-2	-	*Cost curves*	*Concept of farm income*	*Net work*	-
S-8-9	SLO-1	-	***Lab:5** Determination of least cost combination of inputs*	***Lab:9** Estimation of cost of returns of livestock products.*	***Lab:13** Preparation and Analysis of Net worth Statement*	-
	SLO-2					
S-10	SLO-1	-	*Economies of Scale*	*Importance of farm records*	*Resource Economics*	-
	SLO-2	-	*Economies of Size*	*Farm inventory*	*Natural Resource Economics (NRE) and agricultural economics*	-
S-11-12	SLO-1	-	***Lab:6** Selection of most profitable enterprise combination*	***Lab:10** Preparation of farm plan and budget*	***Lab:14** Estimation of Break – even analysis*	-
	SLO-2					

Learning Resources	1. *Debertin, D, L., (2012). Agricultural Production Economics. New York: Create Space Independent Publishing Platform. pp. 1-98.* 2. *Johl, S,S., & Kapoor, T, R.,(2009). Fundamentals of Farm Business Management. New Delhi, Kalyani Publishers. pp.1-255.* 3. *Mohanty, S, K., (2007). Fundamentals of Entrepreneurship. New Delhi: Prentice. Hall India Ltd. pp.1-272*	4. *Panda, S, C., (2007). Farm Management and Agricultural Marketing. India, Ludhiana: Kalyani Publishers. pp. 10-150.* 5. *Raju, V, T., (2017). Economics of Farm Production and Management. New Delhi: Oxford & IBH Publishing. pp.1-207* 6. *Sankayan, P, L., (1983). Introduction to Farm Management. New Delhi: Tata McGraw Hill Publishing Company Ltd. pp. 1-86.*

	Level of Thinking	Continuous Learning Assessment (35% weightage)		University Practical Examination (15%)	End semester theory Examination (50%)
		In semester (20%)	Practical (15%)		
Level 1	Remember Understand	40 %	30 %	35%	30 %
Level 2	Apply Analyze	40 %	40 %	35%	40 %
Level 3	Evaluate Create	20 %	30 %	30%	30 %
	Total	100 %	100 %	100%	100 %

Course Designers		
Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
Mr. K. Arun, Business Manager, *EDII Periyakulam Horti Business Incubation Forum, Periyakulam*	*Dr. D. Sureshkumar, Professor and Head,* *Department of Agricultural Economics,* *Centre for Agricultural and Rural Development Studies, Tamil Nadu Agricultural University, Coimbatore – 3*	*Dr. Anbarassan A* *Dr. Periasami N*

THEORY

Unit I – Production Economics and Farm Management - Nature and Scope

Meaning and concept of farm management, objectives and relationship with other sciences. Meaning and definition of farms, its types and characteristics, factors determining types and size of farms. Types of farming: Specialized, Diversified, and Mixed farming – Systems of farming: Peasant Farming, State Farming, Capitalistic, Collective and Co – operative Farming.

Unit II – Factor – Product, Factor–Factor and Product – Product Relationships

Principles of farm management: concept of production function and its characteristics and its type, use of production function in decision-making on a farm. Factor-Product relationship. Meaning, Definition – Laws of Returns. Meaning and concept of cost, types of costs, cost curves - and their inter-relationship - shut down and break-even points, importance of cost in managing farm business and estimation of gross farm income, net farm income, family labor income and farm business income. Economies of Scale – Economies of Size - Determination of Optimum Input and Output – Physical and Economic Optimum. Factor – Factor relationship: Least Cost Combination of inputs; Product – Product relationship: Optimum Combination of Products – Principle of Equi – Marginal Returns – Principle of Opportunity Cost and Minimum Loss Principle. Law of Comparative Advantage.

Unit III – Farm Planning and Budgeting

Farm business analysis: meaning and concept of farm income and profitability, technical and economic efficiency measures in crop and livestock enterprises. Importance of farm records and accounts in managing a farm, various types of farm records needed to maintain on farm, farm inventory, balance sheet, profit and loss accounts. Meaning and importance of farm planning and budgeting, partial and complete budgeting, steps in farm planning and budgeting - linear programming, appraisal of farm resources, selection of crops and livestock's enterprises.

Unit IV – Risk and Uncertainty in Agriculture Production

Concept of risk and uncertainty occurrences in agriculture production, nature and sources of risks and their management strategies, Crop / livestock / machinery insurance. Weather based crop insurance - Features and determinants of compensations.

Unit V – Resource Economics

Resource Economics: Concepts, Classification, differences between Natural Resource Economics (NRE) and agricultural economics, unique properties of natural resources. Natural Resources - Issues – Scarcity of resources – Factors mitigating scarcity – Property Rights: Common Property Resources (CPRs): meaning and characteristics of CPRs – Externalities: meaning and types - positive and negative externalities in agriculture, Inefficiency and welfare loss, solutions; Important issues in economics and management of common property resources of land, water, pasture and forest resources.

Theory Lecture Schedule

1. Meaning and concept of farm management, objectives and relationship with other sciences. Meaning and definition of farms, its types and characteristics, factors determining types and size of farms.
2. Types of farming: Specialized, Diversified, and Mixed farming – Systems of farming: Peasant Farming, State Farming, Capitalistic, Collective and Co – operative Farming.
3. Principles of farm management: concept of production function and its characteristics and its type, use of production function in decision-making on a farm.
4. Factor - Product relationship: Meaning, Definition – Laws of Returns: Classical production function and its characteristics.
5. Meaning and concept of cost, types of costs, cost curves - and their inter-relationship -shut down and break even points, importance of cost in managing farm business and estimation of gross farm income, net farm income, family labor income and farm business income.
6. Economies of Scale – Economies of Size - Determination of Optimum Input and Output – Physical and Economic Optimum.
7. Factor – Factor relationship: Least Cost Combination of inputs.
8. Product – Product relationship: Optimum Combination of Products – Principle of Equi –Marginal Returns –
9. **In-Semester examination**
10. Principle of Opportunity Cost and Minimum Loss Principle. Law of Comparative Advantage.
11. Farm business analysis: meaning and concept of farm income and profitability, technical and economic efficiency measures in crop and livestock enterprises.
12. Importance of farm records and accounts in managing a farm, various types of farm records needed to maintain on farm, farm inventory, balance sheet, profit and loss accounts.
13. Meaning and importance of farm planning and budgeting, partial and complete budgeting, steps in farm planning and budgeting - linear programming, appraisal of farm resources, selection of crops, assessment of crop water requirements and livestock's enterprises.
14. Concept of risk and uncertainty occurs in agriculture production, nature and sources of risks and its management strategies. Crop / livestock / machinery insurance. Weather based crop insurance - Features and determinants of compensations.
15. Resource Economics: Concepts, Classification, differences between Natural Resource Economics (NRE) and agricultural economics, unique properties of natural resources.
16. Natural Resources Issues – Scarcity of resources – Factors mitigating scarcity – Property Rights – Common Property Resources (CPRs): meaning and characteristics of CPRs – Externalities: meaning and types - positive and negative externalities in agriculture,

17. Inefficiency and welfare loss, solutions, Important issues in economics and management of common property resources of land, water, pasture and forest resources.

Practical Schedule

1. Preparation of farm layout. Determination of cost of fencing of a farm.
2. Computation of depreciation and cost of farm assets: Valuation of assets by different methods.
3. Application of equi - marginal returns / opportunity cost principle in allocation of farm resources.
4. Determination of most profitable level of inputs use in a farm production process.
5. Determination of least cost combination of inputs.
6. Selection of most profitable enterprise combination.
7. Application of cost principles including CACP concepts in the estimation of cost of cultivation and cost of production of agricultural crops.
8. Estimation of cost of cultivation and cost of production of perennial crops / horticultural crops.
9. Estimation of cost of returns of livestock products.
10. Preparation of farm plan and budget.
11. Farm records and accounts: Usefulness, types of farm records: farm production records and farm financial records.
12. Preparation of Cash flow statement
13. Preparation and Analysis of Net worth Statement and Profit and Loss statement
14. Estimation of Break – even analysis.
15. Graphical solution to Linear Programming problem.
16. Collection and analysis of data on various resources in India.
17. **University Practical Examination**.

Text Books

1. Johl, S,S., & Kapoor, T, R.,(2009). Fundamentals of Farm Business Management. New Delhi, Kalyani Publishers. pp.1-255.
2. Mohanty, S, K., (2007). Fundamentals of Entrepreneurship. New Delhi: Prentice Hall India Ltd. pp.1-272
3. Panda, S, C., (2007). Farm Management and Agricultural Marketing. India, Ludhiana: Kalyani Publishers. pp. 10-150.
4. Raju, V, T., (2017). Economics of Farm Production and Management. New Delhi: Oxford & IBH Publishing. pp.1-207

Reference Books

1. Debertin, D, L., (2012). Agricultural Production Economics. New York: Create Space Independent Publishing Platform. pp. 1-98.
2. Sankayan, P, L., (1983). Introduction to Farm Management. New Delhi: Tata McGraw Hill Publishing Company Ltd. pp. 1-86.

Web – References

1. www.ediindia.org
2. www.iie.nic.in
3. www.msme.gov.in
4. www.niesbudtraining.org
5. www.nimsme.org
6. www.nsic.co.in
7. www.nabard.org
8. www.uky.edu/~deberti/agprod5.pdf
9. www.hillagric.ac.in/edu/coa/AgriEcoExtEduRSocio/lectures/AgEcon122FSM.pdf

Journals

1. Journal of Farm Management
2. International Journal of Agricultural Management.
3. The International Journal of Production Economics
4. American Journal of Environmental and Resource Economics

Course Nature: Theory based Practical							
Total Marks (100)							
S.No.	**Category**	**Assessment Tools**					
		In- Semester Examination	Assignment	Record	Attendance	End-Semester Examination	Marks
1	Theory-External	-	-		-	*50*	*50*
2	Theory-Internal	*20*	-			-	*20*
3	Practical-External	-	-		-	*15*	*15*
4	Practical-Internal	-	*05*	*05*	*05*	-	*15*
						Grand Total	*100*

Course Code	AGS19602	Course Name	INTELLECTUAL PROPERTY RIGHTS	Course Category	S	Supportive Course	L	T	P	C
							1	0	0	1

Pre-requisite Courses	Nil	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	***Agricultural Economics***	Data Book / Codes/Standards	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1 :	*Expose the students on intellectual properties*
CLR-2 :	*Gain knowledge on various property rights*
CLR-3 :	*Understand the process of patent filing*
CLR-4 :	*Learn about IPR Institutions*
CLR-5 :	*Acquire knowledge about PPV & FR*
CLR-6 :	*Expose the students on intellectual properties*

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	*Explain about IPR and importance*	*3*	*90*	*80*
CLO-2 :	*Appraise on IPR's*	*1*	*90*	*85*
CLO-3 :	*Explain the Ideology on filing IPR's*	*2*	*75*	*70*
CLO-4 :	*Persuade about the scope and importance for future generations*	*3*	*80*	*75*
CLO-5 :	*Speculate about conservation of traditional food crops and ITK*	*2*	*85*	*80*
CLO-6 :	*Elaborate on Bio-diversity conservation acts related to food crops*	*2*	*85*	*80*

Program Learning Outcomes (PLO)														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Agriculture Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	Ability to solve scientific problems	Ability to implement knowledge gained in the applied field of Business Management	Ability to understand social and ethical responsibilities
M	*M*	*L*	*M*	*H*	*M*	*M*	*H*	*M*	*H*	*H*	*H*	*H*	*H*	*H*
H	*M*	*M*	*M*	*M*	*H*	*L*	*M*	*L*	*H*	*H*	*H*	*H*	*H*	*H*
M	*H*	*L*	*M*	*M*	*H*	*M*	*M*	*H*	*H*	*H*	*H*	*H*	*H*	*H*
M	*H*	*M*	*L*	*L*	*M*	*L*	*M*	*M*	*H*	*H*	*H*	*H*	*H*	*H*
M	*M*	*M*	*M*	*M*	*M*	*M*	*M*	*M*	*H*	*H*	*H*	*H*	*H*	*H*
M	*H*	*M*	*L*	*H*	*L*	*M*	*L*	*M*	*H*	*H*	*H*	*H*	*H*	*H*

		Learning Unit / Module 1	Learning Unit / Module 2	Learning Unit / Module 3	Learning Unit / Module 4	Learning Unit / Module 5
Duration (hour)		**3**	**3**	**2**	**3**	**5**
S-1	SLO-1	*Historical perspectives of Intellectual properties*	*Copyrights, geographical indications, designs*	*Patents Act 1970 and Patent system in India*	*UPOV protection*	*Biodiversity protection*
	SLO-2	*Introduction of Intellectual Property Right*	*Traditional Knowledge and trademarks,*	*Fundamentals of patents*	*Protection of plant varieties*	*Protectable subject matters*
S-2	SLO-1	*Intellectual properties rights*	*Treaties for IPR protection*	*Patentability, process and product patent,*	*Plant breeders rights, Researcher and farmers rights*	*Convention on Biological Diversity*
	SLO-2	*Patent and trade mark*	*Madrid protocol*	*filing of patent, patent specification*	*Registration of plant varieties*	*National Biodiversity protection initiatives*
S-3	SLO-1	*GATT and WTO origin*	*Indian legislation in IPR protection*		*Protection of other biological materials*	*International Treaty on Plant Genetic Resources*
	SLO-2	*TRIPs and WIPO*	*Protection of various types of Intellectual Properties*	-	*Ownership and period of protection*	*Traditional knowledge*
S-4	SLO-1	-	-	-	-	*Licensing of technologies*
	SLO-2	-	-	-	-	*Research collaboration Agreement*

Learning Resources	
	1. *Ahuja, V, K., (2017). Law relating to Intellectual Property Rights. India: Lexis Nexis. Pp. 10-150*
	2. *Neeraj, P., & Khusdeep, ., (2014). Intellectual Property Rights. India: PHI learning Private Limited. pp1-268*
	3. *Nithyananda, K, V., (2019). Intellectual Property Rights: Protection and Management. India: Cengage Learning India Private Limited. Pp. 1-396*

	Level of Thinking	Continuous Learning Assessment (50% weightage)		End semester theory Examination **(50%)**
		In semester (40%)	Theory Internal (10%)	
Level 1	Remember	40 %	40 %	40 %
	Understand			
Level 2	Apply	40 %	40 %	30 %
	Analyze			
Level 3	Evaluate	20 %	20 %	30 %
	Create			
	Total	100 %	100 %	100 %

Course Designers		
Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
Mr. K.Arun, Business Manager, *EDII Periyakulam Horti Business Incubation Forum, Periyakulam*	*Dr.D. Sureshkumar, Professor and Head,* *Department of Agricultural Economics,* *Centre for Agricultural and Rural Development Studies,Tamil Nadu Agricultural University, Coimbatore – 3*	*Dr. Anbarassan A* *Dr. Periasami N*

THEORY

Unit I–Origin and Genesis Intellectual Property Rights
Introduction and meaning of intellectual property, brief introduction to GATT, WTO, TRIPs and WIPO

Unit II –Types of Intellectual Property and Legislations
Treaties for IPR protection: Madrid protocol, Berne Convention, Budapest treaty, etc. Types of Intellectual Property and legislations covering IPR in India:-Patents, Copyrights, Trademark, Industrial design, Geographical indications, Integrated circuits, Trade secrets.

Unit III – Procedures in Filing Patent
Patents Act 1970 and Patent system in India, patentability, process and product patent, filing of patent, patent specification, patent claims, Patent opposition and revocation, infringement, Compulsory licensing, Patent Cooperation Treaty, Patent search and patent database.

Unit IV–International Union for the Protection of New Varieties of Plants
Origin and history including a brief introduction to UPOV for protection of plant varieties, Protection of plant varieties under UPOV and PPV&FR Act of India, Plant breeders rights, Registration of plant varieties under PPV&FR Act 2001, breeders, researcher and farmers rights.

Unit V – International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA)
Convention on Biological Diversity, International treaty on plant genetic resources for food and agriculture (ITPGRFA). Indian Biological Diversity Act, 2002 and its salient features, access and benefit sharing. Traditional knowledge-meaning and rights of TK holders. Farmer's Rights, Tribal rights, Consumer rights, Indigenous people rights Food Security.

Theory lecture Schedule
1. Historical perspectives and need for the introduction of Intellectual Property Right regime; GATT, WTO;
2. Brief introduction to GATT and WTO
3. TRIPs and WIPO TRIPS Agreement Intellectual Property and Intellectual Property Rights (IPR), benefits of securing IPRs;
4. Copyrights, geographical indications, designs and layout, Trade secrets and traditional
5. Knowledge and trademarks, Treaties for IPR protection: Madrid protocol, Berne Convention, Budapest treaty, etc.
6. Indian Legislations for the protection of various types of Intellectual Properties;
7. Fundamentals of patents, patent, filing of patent
8. Patent specification, patent claims, compulsory licensing, Patent Cooperation Treaty, Patent search and patent database.
9. **In-Semester Examination**
10. Origin and history including a brief introduction to UPOV for protection of plant varieties Protection of plant varieties and farmers'rights.
11. Plant breeders rights, Registration of plant varieties under PPV&FR Act 2001,
12. Protection of other biological materials, ownership and period of protection;
13. Biodiversity protection, Protectable subject matters, protection in biotechnology,
14. National Biodiversity protection initiatives; Convention on Biological Diversity;. International Treaty on Plant Genetic Resources for Food and Agriculture;
15. Licensing of technologies, Material transfer agreements,
16. Research collaboration Agreement, License Agreement. Patent system in India, Patent search and patent database.
17. Traditional knowledge-meaning and rights of TK holders. Farmer's Rights, Tribal rights, Consumer rights, Indigenous people rights Food Security.

Text Books
1. Neeraj, P., & Khusdeep, D., (2014). Intellectual Property Rights. India: PHI learning Private Limited. pp1-268
2. Nithyananda, K, V., (2019). Intellectual Property Rights: Protection and Management. India: Cengage Learning India Private Limited. Pp. 1-396

Reference Books
1. Ahuja, V, K., (2017). Law relating to Intellectual Property Rights. India: Lexis Nexis. Pp. 10-150

Web-References

1. www.wipo.int/portal/index.html.en
2. www.wto.org/
3. www.uspto.gov
4. www.patentoffice.nic.in/
5. www.ipindia.nic.in/Niipm/index.htm
6. www.nbaindia.org/

Journals

1. Journal of Intellectual Property Rights
2. International Journal of Intellectual Property Rights
3. The Journal of World Intellectual Property

Course Nature: Only theory							
Total Marks (100)							
S.No.	**Category**	**Assessment Tools**					
		In- Semester Examination	Assignment	Record	Attendance	End-Semester Examination	Marks
1	Theory-External	-	-	-	-	*50*	*50*
2	Theory-Internal	*40*	*05*	-	*05*	-	*50*
						Grand Total	*100*

Course Code	SUP19601	Course Name	PROTECTED CULTIVATION AND SECONDARY AGRICULTURE	Course Category	S	Supplementary Course	L	T	P	C
							1	0	1	2

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Agricultural engineering	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	Impart knowledge on importance of protected cultivation			
CLR-2 :	Gain exposure to NFT, hydrophonics and aerophonics			
CLR-3 :	Develop knowledge on environmental control inside the greenhouse			
CLR-4 :	Learn post-harvesting techniques for different crops			
CLR-5 :	Study different drying methods and drying types of agriculture produce			
CLR-6 :	Impart knowledge on importance of protected cultivation			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	Exhibit skills of managing protected structures	3	95	90
CLO-2 :	Manage irrigation and fertigation systems	2	90	80
CLO-3 :	Plan and design the greenhouse construction	3	85	80
CLO-4 :	Apply the concept of greenhouse in crop production and post-harvest operations	2	75	65
CLO-5 :	Appraise post-harvesting techniques for different crops	3	85	70
CLO-6 :	Elaboarte on different drying methods and drying types of agriculture produces	2	70	65

		Program Learning Outcomes (PLO)														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Agriculture Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	Ability to solve scientific problems	Ability to implement knowledge gained in the applied field of Business Management	Ability to understand social and ethical responsibilities
CLO-1 :	Exhibit skills of managing protected structures	L									H		H	H	H	H
CLO-2 :	Manage irrigation and fertigation systems	H				M		M		H	H		H	H	H	H
CLO-3 :	Plan and design the greenhouse construction	H								M	H		H	H	H	H
CLO-4 :	Apply the concept of greenhouse in crop production and post-harvest operations	H	M								H		H	H	H	H
CLO-5 :	Appraise post-harvesting techniques for different crops	H	L								H		H	H	H	H
CLO-6 :	Elaboarte on different drying methods and drying types of agriculture produces	H	H								H		H	H	H	H

		Learning Unit / Module 1	Learning Unit / Module 2	Learning Unit / Module 3	Learning Unit / Module 4	Learning Unit / Module 5
Duration (hour)		3	3	3	4	3
S-1	SLO-1	Introduction, Scope, importance,	Greenhouse technology,	Typical applications - passive solar greenhouse ventilation,	Importance of engineering properties of grain crops.	Drying and dehydration: moisture measurement
	SLO-2	constraints of protected cultivation in India	Plant response to Greenhouse environment	heating and cooling systems - Fan and pad systems	Importance of engineering properties of grain crops.	EMC, drying theory
S-2-3	SLO-1	**LAB -** Study of different types and classification of greenhouses	**LAB -** Construction of greenhouse	**LAB -** Determination of drying rate of agricultural products inside green house.	**LAB -** Determination of moisture content of various grains by moisture meter	**LAB -** Visit to various Post Harvest Laboratories.
	SLO-2					
S-4	SLO-1	Hydroponics, NFT	Types of protected structures - net house, poly house	CO2 enrichment	Physical, thermal, aero and hydrodynamic properties of cereals	Commercial grain dryer (deep bed dryer, flat bed dryer, tray dryer)
	SLO-2	Aeroponics, vertical farming	Types of protected structures – glass house, greenhouse etc	light regulation	Physical, thermal, aero and hydrodynamic properties of pulses and oilseeds.	Commercial grain dryer (fluidized bed dryer, recirculatory dryer and solar dryer)
S-5-6	SLO-1	**LAB -** Study of greenhouse equipments	**LAB -** Testing of Soil And Water	**LAB -** Determination of moisture content of various grains by oven drying moisture method.	**LAB -** Visit to commercial protected cultivation units	**LAB -** Field visit to a seed processing plant.
	SLO-2					
S-7	SLO-1	-	Classification of greenhouses – based on cladding material	Containers and growing media,	Applications in Post-harvest technology	Material handling equipment; conveyer and elevators,
	SLO-2	-	Classification of greenhouses – based on cost and others	soil/media decontamination	Equipment design and operation.	Their principle, working and selection.
S-8-9	SLO-1	-	**LAB -** Determine the rate of air exchange in	**LAB -** Determination of moisture content of	**LAB -** Visit to hydroponic unit	**LAB -** Project preparation for protected

	SLO-2	-	*an active summer winter cooling system.*	*various grains by infrared moisture method.*		*cultivation of important horticultural crops.*
S-10	SLO-1	-	*Designing and erection of protected structures*	*Irrigation and fertigation systems*		
	SLO-2	-	*cladding/glazing/covering materials*	*mulch films*		
S-11-12	SLO-1	-	***LAB -** Regulation of irrigation and fertilizers through drip, fogging and misting*	***LAB -** Determination of engineering properties viz., shape, size, bulk density and porosity of biomaterials.*		
	SLO-2	-				

Learning Resources	6. *Brahma Singh, Balraj Singh, NavedSabir and MurtazaHasan, (2014).Advances in Protected Cultivation.New India Publishing Agency, New Delhi. pp 1-248* 7. *Donell Hunt, (2013).Farm Power and Machinery Management.10th edition.MedTec Publishers, New Delhi. pp 1-368*

	Level of Thinking	Continuous Learning Assessment (35% weightage)		University Practical Examination (15%)	End semester theory Examination (50%)
		In semester (20%)	Practical (15%)		
Level 1	Remember	40 %	40 %	50 %	50 %
	Understand				
Level 2	Apply	30 %	30 %	30 %	30 %
	Analyze				
Level 3	Evaluate	30 %	30 %	20 %	20 %
	Create				
	Total	100 %	100 %	100%	100 %

Course Designers		
Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
		Dr. Suresh Nivritti Khatawkar *Mr. Harish.* A

THEORY

Unit I – Introduction to Protected Cultivation
Introduction, Scope, importance and constraints of protected cultivation in India; hydroponics, NFT, aeroponics and vertical farming

Unit II – Classification and Construction of Greenhouse
Greenhouse technology, types of protected structures, Plant response to Greenhouse environment, classification of greenhouses, designing and erection of protected structures, cladding/glazing/covering materials

Unit III - Environmental Control
Typical applications - passive solar greenhouse, ventilation, heating and cooling systems - Fan and pad systems, CO2 enrichment, light regulation, containers and growing media, soil/media decontamination, Irrigation and fertigation systems, mulch films

Unit IV – Post Harvest Technology
Important Engineering properties; Physical, thermal and aero & hydrodynamic properties of cereals, pulses and oilseed; Applications in post-harvest technology equipment design and operation.

Unit V – Drying Methods and Different Types of Dryer
Drying and dehydration: moisture measurement, EMC, drying theory, various drying method; commercial grain dryer (deep bed dryer, flat bed dryer, tray dryer, fluidized bed dryer, recirculatory dryer and solar dryer); Material handling equipment; conveyer and elevators, their principle, working and selection.

Theory –Lecture Schedule
1. Introduction, Scope, importance and constraints of protected cultivation in India
2. Hydroponics, NFT, aeroponics and vertical farming
3. Greenhouse technology, Plant response to Greenhouse environment
4. Types of protected structures,
5. Classification of greenhouses
6. Designing and erection of protected structures, cladding/glazing/covering materials
7. Typical applications - passive solar greenhouse ventilation, heating and cooling systems - Fan and pad systems,
8. CO2 enrichment, light regulation,
9. **In semester examination**
10. Containers and growing media, soil/media decontamination
11. Irrigation and fertigation systems, mulch films
12. Importance of engineering properties of grain crops.
13. Physical, thermal, aero and hydrodynamic properties of cereals, pulses and oilseeds.
14. Applications in Post-harvest technology equipment design and operation.
15. Drying and dehydration: moisture measurement, EMC, drying theory.
16. Commercial grain dryer (deep bed dryer, flat bed dryer, tray dryer, fluidized bed dryer, recirculatory dryer and solar dryer)
17. Material handling equipment; conveyer and elevators, their principle, working and selection.

Practical Schedule
1. Study of different types and classification of greenhouses
2. Study of greenhouse equipments
3. Construction of greenhouse
4. Testing of Soil And Water
5. Determine the rate of air exchange in an active summer winter cooling system.
6. Regulation of irrigation and fertilizers through drip, fogging and misting
7. Determination of drying rate of agricultural products inside green house.
8. Determination of moisture content of various grains by oven drying moisture method.

9. Determination of moisture content of various grains by infrared moisture method.
10. Determination of engineering properties viz., shape, size, bulk density and porosity of biomaterials.
11. Determination of moisture content of various grains by moisture meter
12. Visit to commercial protected cultivation units
13. Visit to hydroponic unit
14. Visit to various Post Harvest Laboratories.
15. Field visit to a seed processing plant.
16. Project preparation for protected cultivation of important horticultural crops.
17. **University Practical Examination**

Text Books

5. Brahma Singh, Balraj Singh, NavedSabir and MurtazaHasan, (2014).Advances in Protected Cultivation.New India Publishing Agency, New Delhi. pp 1-248
6. Donell Hunt, (2013).Farm Power and Machinery Management.10th edition.MedTec Publishers, New Delhi. pp 1-368
7. Jana, B. L., (2008). Precision Farming.AgroTech Publishing Academy. pp 1-1040

Reference Books

1. Kali CharanSahu, (2008). Text Book of Remote Sensing and Geographical Information Systems.Atlantic Publishers and Distributors Pvt Ltd. pp 1-512
2. K. RadhaManohar and C. Ignathinathane. (2015). Greenhouse Technology and Management. 2nd edition. B. S. Publications. pp 1-234

Web-References

1. www.icar.org.in/ciphet.html
2. http://agrimoon.com/protected-cultivation-post-harvest-technology-pdf-book-pdf-book/
3. www.jains.com
4. www.gisdevelopment.net
5. www.lasercladding.com
6. www.epa.gov.
7. https://www.agroengineering.org
8. https://www.asabe.org/Applied Engineering in Agriculture
9. https://ecourses.icar.gov.in/
10. https://nptel.ac.in/courses
11. www.ciae.in.nic.in
12. www.ciphet.in

Journals

7. Horticultural Science
8. Horticultural Technology
9. Floriculture Today
10. Hi-tech Horticulture
11. Acta Horticulture

Course Nature: Theory based Practical							
Total Marks (100)							
S.No.	Category	Assessment Tools					
		In- Semester Examination	Assignment	Record	Attendance	End-Semester Examination	Marks
1	Theory-External	-	-		-	*50*	*50*
2	Theory-Internal	*20*	-			-	*20*
3	Practical-External	-	-		-	*15*	*15*
4	Practical-Internal	-	*05*	*05*	*05*	-	*15*
						Grand Total	*100*

Course Code	HOR19605	Course Name	POST HARVEST MANAGEMENT AND VALUE ADDITION OF FRUITS AND VEGETABLES	Course Category	S	*Supportive Course*	L	T	P	C
							1	0	1	2

Pre-requisite Courses	Nil	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Horticulture*		Data Book / Codes/Standards	*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	*Gain knowledge on the contributions of postharvest technology vegetables and fruits*			
CLR-2 :	*Obtain technical skill on shelf life of fruits and vegetables*			
CLR-3 :	*Learn about the post and pre harvest treatments to vegetables and fruits*			
CLR-4 :	*Describe the postharvest scenario of horticulture*			
CLR-5 :	*Infer the scope and importance postharvest technology*			
CLR-6 :	*Understand the role of ethylene and ethylene management in postharvest technology*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	*Exhibit skills on identify field heating*	*3*	*90*	*80*
CLO-2 :	*Manage the factors of postharvest losses*	*1*	*95*	*85*
CLO-3 :	*Demonstrate hands on training in packing and storage technology*	*2*	*80*	*70*
CLO-4 :	*Handle postharvest losses in vegetable crops*	*3*	*75*	*65*
CLO-5 :	*Identify the postharvest diseases and insects*	*2*	*75*	*60*
CLO-6 :	*Elaborate about the preparation of value added products*	*2*	*75*	*65*

Program Learning Outcomes (PLO)															
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Agriculture Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	Ability to solve scientific problems	Ability to implement knowledge gained in the applied field of Business Management	Ability to understand social and ethical responsibilities
M								*M*	*H*		*H*	*H*	*H*	*H*
H								*L*	*H*		*H*	*H*	*H*	*H*
M		*L*	*L*					*L*	*H*		*H*	*H*	*H*	*H*
M			*L*	*L*				*M*	*H*		*H*	*H*	*H*	*H*
L	*L*							*M*	*H*		*H*	*H*	*H*	*H*
L						*H*		*M*	*H*		*H*	*H*	*H*	*H*

		Learning Unit / Module 1	Learning Unit / Module 2	Learning Unit / Module 3	Learning Unit / Module 4	Learning Unit / Module 5
Duration (hour)		3	4	3	4	3
S-1	SLO-1	*Scope of Postharvest technology*	*Factors affecting postharvest of fruits and vegetables*	*Various deterioration of harvest fruits and vegetables*	*Skill in unit preservation*	*Skill fruits used for preservation*
	SLO-2	*Important Institutions*	*Vase life of fruits and vegetables*	*Knowledge on ripening processes of fruits and vegetables*	*Precautions methods of hygienic conditions*	*RTS, Natural and chemical preservatives*
S 2-3	SLO-1	*Practical:1 Importance of food processing Nutritive value and nutraceutical properties of horticulture produces*	*Practical4: Factors affecting ripening can be physiological or biotic factor*	*Practical7: Methods of storage-precooling, pre storage treatments, low temperature storage, controlled atmosphere storage, hypobaric storage, irradiation and low cost storage structures*	*Practical11: Unit layout-selection of site and precautions for hygienic conditions of the unit*	*Practical15: Preparation of jams, jellies, marmalades, candies, crystallized and glazed fruits, preserves, chutneys, pickles, ketchup, sauce, puree, syrups, juices, squashes and cordials*
	SLO-2					
S-4	SLO-1	*Importance of postharvest for vegetables*	*Pre and postharvest treatment for fruits and vegetables*	*Skill on storage precooling and treatments*	*Preservation technology*	*Identifying Enzymes and microbials food spoilage*
	SLO-2	*Nutrition value of vegetable and fruits*	*Grading technology*	*Storage structures*	*Different heating and storage methods*	*Precaution methods of food spoilage*
S 5-6	SLO-1	*Practical2: Maturity indices, harvesting and postharvest handling of fruits and vegetables*	*Practical5: Pre harvest factors affecting postharvest quality of fruits and vegetables*	*Practical8:: Various methods of packaging-packaging materials and transport*	*Practical12: Preservation through canning, bottling, freezing, dehydration, drying, ultraviolet and ionizing radiations*	*Practical16: Spoilage of canned products – biochemical, enzymatic and microbial spoilage*
	SLO-2					
S-7	SLO-1	*Maturity indices for special markets*	*Pre cooling and pre storage treatments*	*packaging-packaging materials*	*Fruits and vegetables suitable for chemical preservatives*	*Skill on preservatives in foods*
	SLO-2	*Store life of fruits crops*	*Maturity index for fruits and vegetables*	*Vase life and transports*	*Technical preservation and vase life of stored products*	*Permitted, unit of food preservatives in India*
S 8-9	SLO-1	*Practical3: Maturity and ripening process*	*Practical6: Methods Chemicals used for*	*Practical9: Study of various Packaging*	*Practical13: Preparation of jams, jellies,*	*Practical16: Preservatives, colors*

	SLO-2	*of fruits and vegetable*	*fruits and vegetable Ripening*	*technology in fruits and vegetables*	*marmalades, candies, crystallized and glazed fruits, preserves, chutneys, pickles, ketchup, sauce, puree, syrups, juices, squashes and cordials*	*permitted and prohibited in India*
S-10-11	SLO-1	-	-	*Principles of preservation*	-	**-**
	SLO-2		-	*Methods of preservation*	-	-
S 12-13		-	-	*Practical10: Principles of preservation by heat, low temperature, chemicals and fermentation*	-	-
					-	-

Learning Resources	1. *R.P. Srivastava and Sanjeev Kumar (2019) Fruit and vegetable preservation principles and practices 3th edition* 2. *Sasikumar.R (2016) Postharvest technology of fruits and vegetables Published by Biotech 1st edition*

	Level of Thinking	Continuous Learning Assessment (35% weightage)		University Practical Examination (15%)	End semester theory Examination (50%)
		In semester (20%)	Practical (15%)		
Level 1	Remember	40 %	30 %	35%	30 %
	Understand				
Level 2	Apply	40 %	40 %	35%	40 %
	Analyze				
Level 3	Evaluate	20 %	30 %	30%	30 %
	Create				
	Total	*100 %*	*100 %*	*100%*	*100 %*

Course Designers		
Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
Mr. Elangovan, Avvai food enterprise No.92 pulliyankudi, kokkerivai, papanasan taluk, ammapet, Thanjavur-614402	*Dr. S. Anuja Professor in vegetable breeding and post harvest technology dept of Horticulture* *Annamalai university*	*K.Nivetha* *Dr. Anandhi* *Dr. S.sheela*

THEORY

Unit I: Post-Harvest Losses
Postharvest Losses and Postharvest Management – Definition and importance -Postharvest technology scenario of horticultural crops in India – Factors of postharvestlosses- Maturity indices and harvesting methods of fruits and vegetables – Harvesting forspecific market requirement.

Unit II: Management of Postharvest Losses
Preharvest factors affecting postharvest quality and shelf life of fruits andvegetables – pre and postharvest treatments for enhancing shelf life – grading - pre coolingand pre storage treatments- maturity and ripening of fruits – physiological and biochemicalchanges associated with ripening – role of ethylene and ethylene management.

Unit III: Packaging and Storage
Packaging and cushioning materials – advanced packaging technologies for fruits andvegetables – crop specific packaging to meet export standards in mango, banana, grapes,mandarin and sweet orange - Storage methods – traditional and advanced methods ofstorage (controlled atmospheric storage, hypobaric storage, irradiation and low cost storagestructure) – physiological disorders during storage.

Unit IV: Post Harvest Pests and Diseases
Browning in fruits and vegetables - Post harvest disease and insect management Hotwater treatment, irradiation, vapors heat treatment, chemical treatment and use of bioagents.

Unit V: Preservation
Principles and methods of preservation - Preservation through canning, bottling,freezing, dehydration and drying – enzymatic and non-enzymatic spoilage of preservedproducts – permitted preservatives and colors.

Theory schedule
1. Importance of food processing Nutritive value and nutraceutical properties of horticulture produces
2. Maturity indices, harvesting and postharvest handling of fruits and vegetables
3. Maturity and ripening process of fruits and vegetable
4. Factors affecting ripening can be physiological or biotic factor
5. Pre harvest factors affecting postharvest quality of fruits and vegetables
6. Methods of Chemicals used for fruits ripening
7. Methods of storage-precooling, pre storage treatments, low temperature storage, controlled atmosphere storage, hypobaric storage, irradiation and low cost storage structures
8. Various methods of packaging- packaging materials and transport
9. **In-semester examination**
10. Study of various Packaging technology in fruits and vegetables
11. Principles of preservation by heat, low temperature, chemicals and fermentation
12. Unit layout-selection of site and precautions for hygienic conditions of the unit
13. Preservation through canning, bottling, freezing, dehydration, drying, ultraviolet and ionizing radiations
14. Preparation of jams, jellies, marmalades, candies, crystallized and glazed fruits, preserves,
15. Preparation of chutneys, pickles, ketchup, sauce, puree, syrups, juices, squashes and cordials
16. Spoilage of canned products – biochemical, enzymatic and microbial spoilage
17. Preservatives, colors permitted and prohibited in India

Practical Schedule
1. Practice in judging the maturity of various fruits and vegetables.
2. Construction of zero energy cool chambers for on farm storage.
3. Determination of physiological loss in weight (PLW), total soluble solids (TSS), total sugars, acidity and ascorbic and content in fruits and vegetables.
4. Packing methods and types of packing and importance of ventilation.
5. Pre cooling packing methods for export or international trade.
6. Methods of prolonging storage life.
7. Effect of ethylene on ripening of banana, mango and sapota.

8. Identification of equipment and machinery used in preservation of fruits and vegetables.
9. Preservation by drying and dehydration.
10. Preparation of jam, jelly and marmalades.
11. Preparation of squash, cordials and syrups.
12. Preparation of chutneys, pickles sauces and ketchup.
13. Visit to local processing units.
14. Visit to local market yards and cold storage units.
15. Quality evaluation of products- physical-chemical, nutritional and sensory
16. Visit to local market and packing industries.
17. **University Practical Examination**

Text Books

1. Bijendra Singh and Sudhir Singh (2018) Advances in postharvest technologies of vegetable crops Publish by Apple academic press2nd edition pp.1-235
2. Ron B.H.Wills and John Brett Golding (2008)Advance in postharvest; fruits and vegetable technology pp.1-123
3. Sasikumar.R (2016) Postharvest technology of fruits and vegetables Published by Biotech 1st edition pp.165
4. Srivastava.R.P and Sanjeev Kumar (2019) Fruit and vegetable preservation principles and practices 3th edition pp.101-154
5. Sudheer.K.P (2007) Post harvest technology of horticulture crops Published New India 1st edition pp1-214
6. Sumati R. Mudambi and M.V. Rajagopal (2018) Fundamentals of foods, nutrition and diet therapy 6th edition pp1-268

References Books

1. Loasecke, H.W.V. (2001).Drying and dehydration of foods. Agrobios (India), Jodhpur 1st edition pp236
2. Pandey, P.H. (2002) Postharvest Technologies of fruits and vegetables. 1st eidition pp.1-256
3. Saraswathy S., T.L. Preethi, S. Balasubramanyan, J. Suresh, N. Revathy and S.Natarajan. (2008). Postharvest Management of Horticultural Crops.pp 210
4. Srivastava, R.P and Sanjeev Kumar. (1994). Fruit and vegetable preservation. Principles and practices. International book Distributing Co., Lucknow.st edition pp.1-201
5. Sudheer, K.P. and V. Indira. (2007). Postharvest Technology of Horticultural Crops.New Delhi Publishing Agency, India. pp.1-169
6. Sumanbhatti and Uma Varma.(1995). Fruit and vegetable processing. CBS publishers and distributors, New Delhi 1st edition pp.1-262
7. Thompson, A.K. (1996). Postharvest technology of fruits and vegetables. Blckwell science, Inc. Cambrdige.1st edition pp240
8. Verma, L.R and V.K. Joshi (2000). Postharvest technology of fruits and vegetables (Voll and II) Indus publishing company, New Delhi.2nd edition pp1-217

Web-References

1. https://doi.org/10.1002/9780470751015.ch8
2. https://doi.org/10.1002/9780470751015.app2
3. https://www.researchgate.net/publication/315835335
4. http://www.indiaagronet.com/
5. http://www.intuxford.tripod.com/
6. jhpr.birjand.ac.ir
7. Academicjournals.org

Journals

1. Postharvest Biology and Technology - Journal - Elsevier
2. International Journal of Postharvest Technology and Innovation
3. Journal of Postharvest technology
4. Journal of Horticulture and Postharvest Research
5. Journal of Stored Products and Postharvest Research
6. International Journal of Processing & Post Harvest Technology

Course Nature: Theory based Practical							
Total Marks (100)							
S.No.	Category	Assessment Tools					
		In- Semester Examination	Assignment	Record	Attendance	End-Semester Examination	Marks
1	Theory-External	-	-		-	*50*	*50*
2	Theory-Internal	*20*	-			-	*20*
3	Practical-External	-	-		-	*15*	*15*
4	Practical-Internal	-	*05*	*05*	*05*	-	*15*
						Grand Total	*100*

Course Code	HOR19606	Course Name	PRINCIPLES OF FOOD SCIENCE AND NUTRITION	Course Category	S	Supportive Course	L	T	P	C
							1	0	1	2

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Food Science & Nutrition	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1 :	Gain basic knowledge on food science and nutrition
CLR-2 :	Understand the importance of food, its nutritional and functional parameters
CLR-3 :	Learn about the therapeutic properties of food and functional characteristics of agricultural produces
CLR-4 :	Infer technical knowledge on the food processing setup
CLR-5 :	Gain awareness on the food adulteration
CLR-6 :	Learn about formulating new need based diet plans

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	Perform biochemical analysis of food	3	75	60
CLO-2 :	Elaborate different processing method of agricultural produces	1	95	85
CLO-3 :	Interpret the food laws, rules and regulations	2	80	70
CLO-4 :	Test food scientifically as per laboratory standards	3	75	65
CLO-5 :	Explain about on animal food products	2	95	85
CLO-6 :	Demonstrate adulteration techniques in various food	2	90	80

Program Learning Outcomes (PLO)														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Agriculture Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	Ability to solve scientific problems	Ability to implement knowledge gained in the applied field of Business Management	Ability to understand social and ethical responsibilities
M								M	H		H	H	H	H
H	H							L	H		H	H	H	H
M		L	L					L	H		H	H	H	H
M	L		L	L				M	H		H	H	H	H
L								M	H		H	H	H	H
L	H					H		M	H		H	H	H	H

		Learning Unit / Module 1	Learning Unit / Module 2	Learning Unit / Module 3	Learning Unit / Module 4	Learning Unit / Module 5
Duration (hour)		3	4	2	4	3
S-1	SLO-1	Concept of food science	Major nutrients (carbohydrate, fat, protein and fibre)	Cereals – composition, nutrition	Meat – composition, nutrition	Food packaging
	SLO-2	Classification of food science	Minerals nutrition	Millets – composition, nutrition	Fish – composition, nutrition	Food labeling
S-2	SLO-1	Composition of foods	Vitamins	Pulses – composition, nutrition	Milk – composition, nutrition	Food adulteration
	SLO-2	Methods of cooking	Nutraceutical and therapeutic properties	Spices and condiments	Poultry and quail – composition, nutrition	Food hygienic practices
S-3	SLO-1	Stages of sugar cookery	Nutritional disorder	Types of oils	egg– composition, nutrition	Food laws
	SLO-2					

Learning Resources	
	1. Srilakshmi .B. (2015). Nutrition Science. New Age International Pvt. Ltd. New Delhi.
	2. James G. Brennan. (2006). Food Processing Handbook. Wiley – VCH Verlag GmbH & Co. KGaA, Weingeim, Germany.
	3. Vijaya Khader. (2001). Textbook of Food Science and Technology, Indian Council of Agricultural Research, New Delhi.

	Level of Thinking	Continuous Learning Assessment (35% weightage)		University Practical Examination (15%)	End semester theory Examination (50%)
		In semester (20%)	Practical (15%)		
Level 1	Remember Understand	40 %	30 %	35%	30 %
Level 2	Apply Analyze	40 %	40 %	35%	40 %
Level 3	Evaluate Create	20 %	30 %	30%	30 %
	Total	100 %	100 %	100%	100 %

Course Designers		
Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
Mr.A.Harishpriyadharsan, *Vijayalakshmi dairy Land, Rajiv Gandhi street,* *Coimbatore – 641025*	*Dr. Kamalasundari S, Associate Professor, Department of Food Science and Technology, Community Science College and Research Institute, TNAU, Madurai- 625104*	*Dr. P. Sheela*

THEORY

Unit I – Concept of Food Science

Food science: definition – Classification of foods: functional, nutritional and food groups; composition of foods; measurement of foods; Methods of cooking – moist heat, dry heat and microwave cooking – principles, merits and demerits. Sugar cookery: stages; Fats – functions in cooking, rancidity – types, prevention

Unit II – Food Nutrition

Classification, functions, digestion and absorption of carbohydrate, fat, protein. Minerals and vitamins sources, recommended dietary allowances. Nutraceutical and therapeutic properties of food. Malnutrition - Nutritional disorders, balanced diet and diet planning

Unit III – Properties of Cereals, Pulses, Nuts and Oil seeds

Cereals – rice, wheat and millets – composition – nutritive value – changes during cooking of starch – gelatinization, dextrinization and retrogradation; Pulses – composition – nutritive value – antinutritional factors – methods of eliminating / reducing; Nuts, oilseeds, spices and condiments- flavouring principles – types of oil – properties of oil

Unit IV – Properties of Animal Foods

Meat - composition - post mortem changes, tenderization - changes during cooking. Fish - composition, characteristics of fresh fish and changes during cooking. Milk - composition, types, functional properties and use in cookery. Poultry and Japanese quail – composition – nutritional characteristics, Egg - structure, composition, grading and quality evaluation, changes during cooking

Unit V – Food Quality Control

Food packaging materials - requirements - methods - labeling. Food adulterants and detection methods. Food laws and regulations and quality control standards – national and international standards

Theory –Lecture Schedule

1. Food science: definition, Classification of foods: functional, nutritional and food groups and composition of foods and measurement of foods
2. Methods of cooking: moist heat, dry heat and microwave cooking, principles, merits and demerits
3. Stages of Sugar cookery: crystalline and non crystalline candies and Fats – functions in cooking, rancidity – types and prevention
4. Classification, functions, digestion and absorption of carbohydrate, fat and protein
5. Minerals – importance in human health – sources – RDA
6. Vitamins – importance in human health – sources – RDA
7. **In semester examination**
8. Nutraceutical and therapeutic properties of food, Malnutrition and nutritional disorders, balanced diet and diet planning for various age group
9. Composition, nutritive value of cereals, millets, pulses – changes during cooking
10. Composition of nuts, oil seeds, spices and condiments, flavouring principles, types and properties
11. Meat – composition, cookery - postmortem changes - tenderization - factors affecting tenderness
12. Fish - composition - characteristics of fresh fish - cooking of fish
13. Milk - composition, functional properties, use in cookery
14. Poultry, Japanese quail and egg- structure, composition - characteristics, grading and quality evaluation, denaturation and changes during cooking.
15. Food packaging materials, requirements, methods and labeling
16. Food adulterants and detection methods
17. Food laws and regulations and quality control standards – national and international standards

Practical Schedule

1. Identifying food processing equipments and handling methods
2. Cooking quality test for cereals and pulses
3. Estimation of moisture
4. Estimation of protein
5. Estimation of fat
6. Estimation of crude fibre

7. Estimation of iron
8. Planning diet for various age group
9. Stages of sugar cookery
10. Puffing of pulses
11. Flaking and extrusion of cereals and millets
12. Preparation of indigenous milk products – khoa and rasagola
13. Processing of animal products – pickles and dried fish
14. Development of convenience foods
15. Common food adulterants
16. Visit to food processing and quality control lab
17. **University practical examination**

Text Books

1. Gaurav Tewari and Vijay K. Juneja. (2007). Advances in Thermal and Non-Thermal Food Preservation. Blackwell Publishing, Ames, Iowa, USA.
2. James G. Brennan. (2006). Food Processing Handbook. Wiley-VCH Verlag GmbH & Co. KGaA, Weinheim, Germany, PP 1-602.
3. M. Shafiur Rahman. (2007). Handbook of Food Preservation, 2nd Ed. CRC Press, Boca Raton, FL, USA, PP 1-1088.
4. Marcus Karel and Darvl B. Lund. (2003). Physical Principles of Food Preservation, 2nd Ed. Marcel Dekker, Inc., NY, USA, PP 1-640.
5. Norman N. Potter and Joseph H. Hotchkiss. (1995). Food Science, 5th Ed. Chapman & Hall, NY, USA.
6. Srilakshmi, B. (2018). Food Science (7th Ed). New Age International Ltd, publishers, New Delhi, India, PP 1-512.
7. Stavros Yanniotis. (2008). Solving Problems in Food Engineering. Springer Science + Business Media, NY, USA.

Reference Books

1. Potter, N. (2005).Food Science, CBS Publishers and Distributors, Delhi
2. Srilakshmi .B. (2015). Nutrition Science. New Age International Pvt. Ltd. New Delhi.
3. Vijaya Khader. (2001). Textbook of Food Science and Technology, Indian Council of Agricultural Research, New Delhi.

Web-References

1. http://www.ifis.org
2. http://www.fao.org/infoods/index_en.stm
3. https://fstjournal.org

Journals

1. Advances in Nutrition
2. Annual Reviews of Food Science and Technology
3. Comprehensive reviews in Food Science and Food Safety
4. Food Research International
5. Nutrients
6. Trends in Foods Science and Technology

Course Nature: Theory based Practical							
Total Marks (100)							
S.No.	Category	Assessment Tools					
		In- Semester Examination	Assignment	Record	Attendance	End-Semester Examination	Marks
1	Theory-External	-	-		-	*50*	*50*
2	Theory-Internal	*20*	-			-	*20*
3	Practical-External	-	-		-	*15*	*15*
4	Practical-Internal	-	*05*	*05*	*05*	-	15
						Grand Total	*100*

Course Code	ELC19601	Course Name	COMMERCIAL PLANT BREEDING	Course Category	E	*Elective Course*	L	T	P	C
							1	0	1	2

Pre-requisite Courses	Nil	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Genetics and Plant Breeding*	Data Book / Codes/Standards	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1 :	*Learn the modes of reproduction and breeding lines*
CLR-2 :	*Learn about the genetic purity and seed production*
CLR-3 :	*Gain the knowledge on cultivars and IPR protection,*
CLR-4 :	*Acquire knowledge on variety test*
CLR-5 :	*Acquire knowledge on variety release*

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	*Describe the types of seeds in crops*	*1*	*90*	*85*
CLO-2 :	*Explain about seed production*	*2*	*95*	*85*
CLO-3 :	*Explain about seed quality*	*2*	*80*	*70*
CLO-4 :	*Enumerate the protocol for variety test*	*2*	*95*	*85*
CLO-5 :	*Explain about variety release*	*2*	*80*	*70*

Program Learning Outcomes (PLO)														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Agriculture Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	Ability to solve scientific problems	Ability to implement knowledge gained in the applied field of plant breeding	Ability to understand social and ethical responsibilities
H			*H*			*H*		*M*	*H*		*H*	*H*	*H*	*H*
H			*H*					*L*	*H*		*H*	*H*	*H*	*H*
M		*M*	*M*			*H*		*L*	*H*		*H*	*H*	*H*	*H*
H			*H*					*L*	*H*		*H*	*H*	*H*	*H*
M		*M*	*M*			*H*		*L*	*H*		*H*	*H*	*H*	*H*

		Learning Unit / Module 1	Learning Unit / Module 2	Learning Unit / Module 3	Learning Unit / Module 4	Learning Unit / Module 5
Duration (hour)		4	4	3	2	3
S-1	SLO-1	*Types of crops*	*Introduction to genetic purity test*	*Quality seed production of vegetable crops*	*Alternative strategies for the development of the line and cultivars:*	*Variety testing*
	SLO-2	*Modes of plant reproduction*	***Genetic purity test of commercial hybrids***	*Open and protected environment for seed production*	*Haploid inducer*	*Release and notification systems in India*
S-2,3	SLO-1	***Lab.1.*** *Floral biology in self and cross pollinated crops*	***Lab.4.*** *Learning techniques in hybrid seed production using male-sterility in field crops and difficulties in hybrid seed production*	***Lab.8.*** *Hybrid seed production techniques in rice*	***Lab.12.*** *Hybrid seed production techniques in vegetable crops*	***Lab. 15*** *Screening techniques during seed processing viz., grading and packaging*
	SLO-2					
S-4	SLO-1	*Line development*	*Hybrid seed production of maize and rice*		*Tissue culture techniques*	*Principles and techniques of seed production*
	SLO-2	***Maintenance breeding***	*Hybrid seed production of sorghum and pearl millet*		-	-
S-5,6	SLO-1	***Lab.2.*** *Selfing and crossing techniques*	***Lab.5.*** *Tools and techniques for optimizing hybrid seed production*	***Lab.9*** *Hybrid seed production techniques in rapeseed-mustard*	***Lab. 13.*** *Sampling and analytical procedures for purity testing and detection of spurious seed*	
	SLO-2					
S-7	SLO-1		*Hybrid seed production of castor*		*Biotechnological tools*	*Types of seeds*
	SLO-2		*Hybrid seed production of sunflower*		-	-
S-8,9	SLO-1	*Lab.3 Techniques of seed production in self and cross pollinated crops using A/B/R and two line system*	***Lab.6.*** *Concept of line its multiplication and purification in hybrid seed production*	***Lab.10.*** *Hybrid seed production techniques in sunflower and castor*		***Lab. 16.*** *Visit to public private seed production units*
	SLO-2					
S-10	SLO-1		*Hybrid seed production in cotton*		*IPR issues in commercial plant breeding*	*Quality testing in self pollinated crops*

	SLO-2		*Hybrid seed production in Pigeon pea and brassica*			*Quality testing in cross pollinated crops*
S-11	SLO-1		***Lab.7.** Hybrid seed production techniques in sorghum, pearl millet and maize*	***Lab 11:** Hybrid seed production techniques in pigeon pea and cotton*	*Lab 14: Seed drying and seed storage structure in quality seed management*	
	SLO-2					
S-12	SLO-1				*DUS testing*	
	SLO-2				***Registration of varieties under PPV & FR Act***	

Learning Resources	1. *Agrawal, R.L. (2008). Seed Technology. New Delhi : Oxford & IBH Publishing Co. pp. 1- 821.* 2. *Dharmendra Jat, Sai Prasad, S. V. & Sheela Verma. (2014). Seed Science and Technology (2nd ed.) New Delhi: New Vishal Publications. pp. 1- 304.* 3. *Khare, D . (2014). Seed Technology (2nd ed.). Jodhpur: Scientific Publishers India. pp. 1- 944.*

	Level of Thinking	Continuous Learning Assessment (35% weightage)		University Practical Examination (15%)	End semester theory Examination (50%)
		In semester (20%)	Practical internal (15%)		
Level 1	Remember	40 %	30 %	35%	30 %
	Understand				
Level 2	Apply	40 %	40 %	35%	40 %
	Analyze				
Level 3	Evaluate	20 %	30 %	30%	30 %
	Create				
	Total	100 %	100 %	100%	100 %

Course Designers		
Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
Dr. S M .Prabhu, Ph. D. *Senior Breeder (Paddy Breeding and Transgenic)* *R&D centre,* *Rasi Seeds (P) Ltd., Attur, Salem – 636141.*	*Dr. T. Sabesan* *Associate rofessor* *Department of Genetics and Plant Breeding* *Faculty of Agriculture, Annamalai University,* *Annamalai nagar , Chidambaram - 608 002* *sabavani@gmail.com*	*Dr. G. Selvakumar , Assistant Professor (GPB)* *Dr. R. Mahendran, Assistant Professor (GPB)* *Dr. J. Vanitha, Tutor (GPB)*

THEORY

Unit I- Modes of Reproduction and Breeding Lines
Types of crops and modes of plant reproduction. Line development and maintenance breeding in self and cross pollinated crops (A/B/R and two line system) for development of hybrids and seed production.

Unit II- Genetic Purity
Genetic purity test of commercial hybrids. Advances in hybrid seed production of maize, rice, sorghum, pearl millet, castor, cotton, pigeon pea, brassica etc.

Unit III- Seed Production
Quality seed production of vegetable crops under open and protected environment.

Unit IV- Cultivars and IPR Protection
Alternative strategies for the development of the line and cultivars: haploid inducer, tissue culture techniques and biotechnological tools. IPR issues in commercial plant breeding: DUS testing and registration of varieties under PPV & FR Act.

Unit V - Variety Test and Release
Variety testing, release and notification systems in India. Principles and techniques of seed production, types of seeds, quality testing in self and cross pollinated crops.

Theory - Lecture Schedule
1. Types of crops and modes of plant reproduction
2. Line development and maintenance breeding in self and cross pollinated crops (A/B/R and two line system) for development of hybrids and seed production
3. Genetic purity test of commercial hybrids
4. Advances in hybrid seed production of maize, rice, sorghum, pearl millet
5. Advances in hybrid seed production of castor, sunflower
6. Advances in hybrid seed production of cotton, pigeon pea, brassica
7. Quality seed production of vegetable crops under open and protected environment
8. Alternative strategies for the development of the line and cultivars: haploid inducer
9. **In Semester examination**
10. Tissue culture techniques
11. Biotechnological tools
12. IPR issues in commercial plant breeding
13. DUS testing and registration of varieties under PPV & FR Act
14. Variety testing, release and notification systems in India
15. Principles and techniques of seed production
16. Types of seeds
17. Quality testing in self and cross pollinated crops

Practical Schedule
1. Floral biology in self and cross pollinated crops
2. Selfing and crossing techniques
3. Techniques of seed production in self and cross pollinated crops using A/B/R and two line system
4. Learning techniques in hybrid seed production using male-sterility in field crops and difficulties in hybrid seed production
5. Tools and techniques for optimizing hybrid seed production
6. Concept of line its multiplication and purification in hybrid seed production
7. Hybrid seed production techniques in sorghum, pearl millet and maize
8. Hybrid seed production techniques in rice
9. Hybrid seed production techniques in rapeseed-mustard

10. Hybrid seed production techniques in sunflower and castor
11. Hybrid seed production techniques in pigeon pea and cotton
12. Hybrid seed production techniques in vegetable crops
13. Sampling and analytical procedures for purity testing and detection of spurious seed
14. Seed drying and seed storage structure in quality seed management
15. Screening techniques during seed processing viz., grading and packaging
16. Visit to public private seed production units
17. **University Practical Examination**

Text Books

1. Agrawal, R.L. (2008). *Seed Technology.* New Delhi : Oxford & IBH Publishing Co. pp. 1- 821.
2. Dharmendra Jat, Sai Prasad, S. V. & Sheela Verma. (2014). *Seed Science and Technology* (2nd ed.) New Delhi: New Vishal Publications. pp. 1- 304.
3. Khare, D . (2014). *Seed Technology* (2nd ed.). Jodhpur: Scientific Publishers India. pp. 1- 944.
4. Padmavathi, S. (2012). *A Text Book of Seed Science and Technology.* New Delhi: New India Publishing Agency. pp. 1- 282.

Reference Books

1. Basra, A. S. (2006). *Handbook of Seed Science and Technology.* New York: Food Products Press. pp. 1- 749.
2. Lawrence O. Copeland & Miller McDonald. (2001). *Principles of Seed Science and Technology.* USA: Springer Science. pp. 1- 390.
3. Sreenivas, Y.S. (2009). *Seed Production of Commercial Vegetables.* Oxford: Oxford Book Company. pp. 1- 325.
4. Subir Sen & Nabinananda Ghosh. (2012). *Seed Science and Technology.* New Delhi: Kalyani Publishers. pp. 1- 277.
5. Vanangamudi, K., Prabhu, M. & Bhaskaran. (2010). *Vegetable Hybrid Seed Production and Management.* InIdia*:* Agrobios. pp. 1- 339.

Web-References

1. https://agro.au.dk/en/research/research-areas/seed-science-and-technology/
2. www.seednet.gov.in
3. https://www.fabinet.up.ac.za/index.php/research-groups/seed-science

Journals

1. Seed Science Research
2. . Research Journal of Seed Science
3. Advanced Journal of Seed Science and Technology
4. Journal of Seed Science - Scimago

Course Nature: Theory based Practical							
Total Marks (100)							
S.No.	**Category**	**Assessment Tools**					
		In- Semester Examination	Assignment	Record	Attendance	End-Semester Examination	Marks
1	Theory-External	-	-		-	*50*	*50*
2	Theory-Internal	*20*	-			-	*20*
3	Practical-External	-	-		-	*15*	*15*
4	Practical-Internal	-	*05*	*05*	*05*	-	*15*
						Grand Total	*100*

Course Code	ELC19602	Course Name	AGROCHEMICALS	Course Category	C	Elective Course	L	T	P	C
							1	0	1	2

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Soil Science		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1 :	Define Agrochemicals
CLR-2 :	Identify different types of Agrochemicals
CLR-3 :	Understand the fate of agrochemicals in soil
CLR-4 :	Gain knowledge on the role and importance of agrochemicals
CLR-5 :	Learn about the 99effective use of agrochemicals

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	List out different agrochemicals	1	90	85
CLO-2 :	Outline the importance of agrochemicals in agriculture	1	95	85
CLO-3 :	Elaborate about the manufacturing process of fertilizers	2	80	70
CLO-4 :	Explain the mode of action of agrochemicals.	2	85	75
CLO-5 :	Calculate the agrochemical doses for recommendation	3	85	90

Program Learning Outcomes (PLO)														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Agriculture Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	Ability to solve scientific problems	Ability to implement knowledge gained in the applied field of Business Management	Ability to understand social and ethical responsibilities
H			H			H		M	H		H	H	H	H
H			H					L	H		H	H	H	H
M		M	M			H		L	H		H	H	H	H
M			H					M	H		H	H	H	H
M								M	H		H	H	H	H

		Learning Unit / Module 1	Learning Unit / Module 2	Learning Unit / Module 3	Learning Unit / Module 4	Learning Unit / Module 5
Duration (hour)		5	3	3	3	2
S-1	SLO-1	Agrochemicals: types, roles, effects	Introduction to insecticides	Herbicides: major classes, properties	Fertilizers and their importance	Mixed and complex fertilizers
	SLO-2	Agricultural usage	Classification of insecticides	Fate of herbicides	Manufacturing processes	Manufacturing processes
S-2,3	SLO-1	Lab.1. Sampling of fertilizers and pesticides	Lab.6. Application technology to study about various pesticides appliances	Lab.9. Estimation of N in urea	Lab.12. Estimation of K in MOP/SOP	Lab.15. Determination of active ingredient content in Thiram
	SLO-2					
S-4	SLO-1	Managements of agrochemicals	Insecticides act and rules	Bio-pesticides	Phosphatic fertilizers	Fertilizer control order
	SLO-2	Sustainable agriculture	Insecticide banned, withdrawn	Characteristics and uses	Manufacturing processes	Fertilizer logistics and marketing
S-5,6	SLO-1	Lab.2. Study and identification of various agrochemicals and its formulation available in market	Lab.7. Quick tests for identification common fertilizers	Lab.10. Estimation of water soluble P in SSP	Lab.13. Determination of Cu in Copper oxychloride	Lab.16. Determination of active ingredient content in Ziram
	SLO-2					
S-7	SLO-1	Fungicides – characters, preparation	Fate of insecticides in soil	Plant bio-pesticides	Potassic fertilizers	
	SLO-2	Mode of action	Fate of insecticides in plant	Bio-insect repellent	Manufacturing processes	
S-8,9	SLO-1	Lab.3. Calculation of doses of fertilizers	Lab.8. Identification of anion and cation in fertilizers	Lab.11. Estimation of citrate soluble P in phosphatic fertilizer	Lab.14. Determination of S in sulphur fungicides	
	SLO-2					
S-10	SLO-1	Organic fungicides				
	SLO-2	Mode of action				
S-11,12	SLO-1	Lab. 4. Calculation of doses of herbicides and fungicides				
	SLO-2					
S - 13	SLO-1	Systemic fungicides				
	SLO-2	Characteristics and use				
S-	SLO-1	Lab.5. Calculation of doses of insecticides				

14,15	SLO-2					

Learning Resources	1. *Sathe, T.V. (2011). Agrochemicals and pest management.. Daya publishing house. pp. 1 - 222.* 2. *Prasad, M.N.V. (2020). Agrochemicals Detection, Treatment and Remediation. (1st ed.). Elsevier. pp. 1 - 694.*

	Level of Thinking	Continuous Learning Assessment (35% weightage)		University Practical Examination (15%)	End semester theory Examination **(50%)**
		In semester (20%)	*Practical (15%)*		
Level 1	Remember	40 %	30 %	35%	30 %
	Understand				
Level 2	Apply	40 %	40 %	35%	40 %
	Analyze				
Level 3	Evaluate	20 %	30 %	30%	30 %
	Create				
	Total	100 %	100 %	100%	100 %

Course Designers		
Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
Mr. B. Prabhu *Grenicon Agrotech Pvt. Ltd.,* *No. 23, 1st floor, 17th main road, Anna nagar west, Chennai – 40.*	*Dr. M.V. Sriramachandrasekharan* *Professor (SSAC), Annamalai University, Annamalainagar – 608002.*	*Dr. R. Angelin Silviya* *Dr. S.N.Chikkaraju*

THEORY

Unit I – Agrochemicals and Fungicides

An introduction to agrochemicals, their type and role in agriculture, effect on environment, soil, human and animal health, merits and demerits of their uses in agriculture, management of agrochemicals for sustainable agriculture. Fungicides - Classification – Inorganic fungicides - characteristics, preparation and use of sulphur and copper, Mode of action - Bordeaux mixture and copper oxychloride. Organic fungicides - Mode of action - Dithiocarbamates - characteristics, preparation and use of Zineb and maneb. Systemic fungicides - Benomyl, carboxin, oxycarboxin, Metalaxyl, Carbendazim, characteristics and use

Unit II- Insecticides

Introduction and classification of insecticides: inorganic and organic insecticides Organochlorine, Organophosphates, Carbamates, Synthetic pyrethroids Neonicotinoids, Biorationals; Insecticide Act and rules, Insecticides banned, withdrawn and restricted use, Fate of insecticides in soil & plant.

Unit III – Herbicides, Bio Pesticides and Insecticide Act

Herbicides - Major classes, properties and important herbicides. Fate of herbicides. IGRs Biopesticides, Reduced risk insecticides, Botanicals, plant and animal systemic insecticides their characteristics and uses. Plant bio-pesticides for ecological agriculture, Bio- insect repellent.

Unit IV - Fertilizers

Fertilizers and their importance. Nitrogenous fertilizers: Feedstocks and Manufacturing of ammonium sulphate, ammonium nitrate, ammonium chloride, urea. Slow release N- fertilizers. Phosphatic fertilizers: feedstock and manufacturing of single superphosphate. Preparation of bone meal and basic slag. Potassic fertilizers: Natural sources of potash, manufacturing of potassium chloride, potassium sulphate and potassium nitrate.

Unit V – Mixed, Complex Fertilizers and FCO

Mixed and complex fertilizers: Sources and compatibility–preparation of major, secondary and micronutrient mixtures. Complex fertilizers: Manufacturing of ammonium phosphates, nitrophosphates and NPK complexes. Fertilizer control order. Fertilizer logistics and marketing.

Theory – Lecture Schedule

1. An introduction to agrochemicals: types, roles, effect on environment - soil, human and animal health; Agricultural usage: merits and demerits;
2. Management of agrochemicals for sustainable agriculture.
3. Fungicides - Classification – Inorganic fungicides - characteristics, preparation and use of sulphur and copper, Mode of action - Bordeaux mixture and copper oxychloride.
4. Organic fungicides - Mode of action - Dithiocarbamates - characteristics, preparation and use of Zineb and maneb.
5. Systemic fungicides - Benomyl, carboxin, oxycarboxin, Metalaxyl, Carbendazim, characteristics and use
6. Introduction and classification of insecticides: inorganic and organic insecticides; Organochlorine, Organophosphates, Carbamates, Synthetic pyrethroids Neonicotinoids, Biorationals.
7. Insecticide Act and rules, Insecticides banned, withdrawn and restricted use.
8. Fate of insecticides in soil & plant.
9. In-semester Examination
10. Herbicides - Major classes, properties and important herbicides. Fate of herbicides
11. IGRs Biopesticides, Reduced risk insecticides, Botanicals, plant and animal systemic insecticides - characteristics and uses.
12. Plant bio-pesticides for ecological agriculture, Bio- insect repellent.
13. Fertilizers and their importance. Nitrogenous fertilizers: Feedstock and Manufacturing of different N fertilizers.
14. Phosphatic fertilizers: feedstock and manufacturing different P fertilizers.
15. Potassic fertilizers: Natural sources of potash, manufacturing of different K fertilizers.
16. Mixed and complex fertilizers: Sources and compatibility; Preparation of secondary, micronutrient mixtures and complex fertilizers.
17. Fertilizer control order. Fertilizer logistics and marketing.

Practical Schedule

1. Sampling of fertilizers and pesticides.
2. Study and identification of various agrochemicals and its formulation available in the market.
3. Calculation of doses of fertilizers.
4. Calculation of doses of herbicides and fungicides.

5. Calculation of doses of insecticides.
6. Application technology to study about various pesticides appliances.
7. Quick tests for identification of common fertilizers.
8. Identification of anion and cation in fertilizers.
9. Estimation of Nitrogen in Urea.
10. Estimation of water soluble P_2O_5 in single super phosphate.
11. Estimation of citrate soluble P_2O_5 in phosphatic fertilizer
12. Estimation of potassium in Muriate of Potash/ Sulphate of Potash by flame photometer.
13. Determination of copper content in copper oxychloride.
14. Determination of sulphur content in sulphur fungicide.
15. Determination of active ingredient content in Thiram.
16. Determination of active ingredient content in ziram.
17. University practical examination.

Textbooks

1. Gupta, A. (2006). Pesticide Residue in Food commodities. Agrobios, pp.1 - 331.
2. Handa.S.K. (2004). Principles of Pesticide Chemistry. Agrobios. pp.1 - 252.
3. John Havlin, James Beaten, Samuel Tisdale, Werner Nelson, (2014). Soil Fertility and Fertilizers - An Introduction to Nutrient Management (8th ed.). NJ: Prentice Hall. pp.1 - 536.
4. Sathe T.V. (2011). Agrochemicals and pest management. Daya Publishing House, pp.1 - 222.
5. SreeRamulu, U.S. (1979). Chemistry of Insecticides and Fungicides. New Delhi: Oxford and IBH Publishing Co. pp.1 - 342.

Reference Books

1. Muller, F (Ed.). (2000). Agrochemicals: Composition, production, toxicology, applications. Wiley VCH. pp 1 - 1046.
2. Prasad, M.N.V. (2020). Agrochemicals Detection, Treatment and Remediation. (1st ed.). Elsevier. pp.1 - 694.
3. Roy, N.K. (2010). Chemistry of pesticides. (1st ed.) CBS Publications. pp. 1 - 346.
4. Tandon, H.L.S. (1994). Fertilizer, Organic Manures, Recyclable Wastes and Bio fertilizers New Delhi: Fertilizer Development and Consultation Organization.
5. Valkenburg, W.V., Sugavanam, B and Khetan, S.K. (2004). Pesticide formulation (1st ed.). New Age international. pp. 1 - 488.

Web References

1. www.fspublishers.org/ijab/past-issues/IJABVOL_5_NO_3/47.pdf
2. www.springerlink.com/index/l011256h8t325054.pdf
3. www.fao.org/wairdocs/ilri/x5546e/x5546e08.htm
4. https://youtu.be/gfcHJn191OE
5. https://youtu.be/phg8BB_fwTY

Journals

1. Pesticide Biochemistry and Physiology
2. Journal of Pesticides and Bio Fertilizers
3. Journal of fertilizers and pesticides
4. International Journal of Applied Chemistry
5. Journal of Pesticide Science

Course Nature: Theory based Practical							
Total Marks (100)							
S.No.	Category	Assessment Tools					
		In- Semester Examination	Assignment	Record	Attendance	End-Semester Examination	Marks
1	Theory-External	-	-		-	*50*	*50*
2	Theory-Internal	*20*	-			-	*20*
3	Practical-External	-	-		-	*15*	*15*
4	Practical-Internal	-	*05*	*05*	*05*	-	*15*
						Grand Total	*100*

Course Code	ELC19603	Course Name	LANDSCAPING	Course Category	E	Elective Course	L	T	P	C
							1	0	1	2

Pre-requisite Courses	Nil	Co-requisite Courses	NIL	Progressive Courses	NIL
Course Offering Department	Horticulture			Data Book / Codes/Standards	Nil

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	Gain knowledge on gardening scenario			
CLR-2 :	Understand the principles and elements of Landscaping			
CLR-3 :	Identify of the plant and non plant components			
CLR-4 :	Practice designing with softwares for landscaping			
CLR-5 :	Practice layout of different styles of Garden.			
CLR-6 :	Describe bio-aesthetic planning and lawn making			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	Explain the different styles of garden	1	95	85
CLO-2 :	Elaborate on different types of garden tools	1	80	75
CLO-3 :	Appraise about different uses of plants in a garden	1	75	65
CLO-4 :	Analyze the application of GIS in landscaping	2	75	65
CLO-5 :	Design different gardens for rural and public places	2	90	80
CLO-6 :	Perform designing of lawn	2	95	90

		Program Learning Outcomes (PLO)														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Agriculture Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	Ability to solve scientific problems	Ability to implement knowledge gained in the applied field of Business Management	Ability to understand social and ethical responsibilities
CLO-1 :	Explain the different styles of garden	H								H	M		H	H	H	H
CLO-2 :	Elaborate on different types of garden tools	H								L	H		H	H	H	H
CLO-3 :	Appraise about different uses of plants in a garden	M		L	L					L	H		H	H	H	H
CLO-4 :	Analyze the application of GIS in landscaping	M			L	L				M	H		H	H	H	H
CLO-5 :	Design different gardens for rural and public places	L	L							M	H		H	H	H	H
CLO-6 :	Perform designing of lawn	L						H		M	H		H	H	H	H

		Learning Unit / Module 1	Learning Unit / Module 2	Learning Unit / Module 3	Learning Unit / Module 4	Learning Unit / Module 5
Duration (hour)		3	3	4	3	4
S-1	SLO-1	Gardening scenario	Plant components	Trees in landscaping	Steps in Preparation of rural garden	Study of lawn making
	SLO-2	Importance of Gardening	Non plant components	Shrubs in landscaping	Steps in Preparation of industrial garden	Study of turf management
S-2,3	SLO-1	Lab1:Study of Garden equipments	Lab5: Description and designing of garden components	Lab 8: Designing and layout of rockery and terrace garden.	Lab 11: Layout of traffic islands.	Lab 14: Designing and practicing of bonsai.
	SLO-2					
S-4	SLO-1	Styles of Garden	Terrace gardening	Annuals an perennials in landscaping	Corporate landscaping	Study of bonsai making
	SLO-2	Themes of Garden	Vertical gardening	Climbers in landscaping	Interiorscaping	Study of bonsai principles
S-5,6	SLO-1	Lab2: Identification and description of annuals, shrubs and herbaceous perennials	Lab6: Designing of garden components	Lab 9: Designing and layout of sunken garden and water garden.	Lab 12: Practicing landscape design for urban and rural locations.	Lab 15: Practice of landscape with computer softwares.
	SLO-2					
S-7	SLO-1	Bio-aesthetic planning- Definition	Rock gardening	Palms in landscaping	Avenue planting	Use of computer softwares
	SLO-2	Bio-aesthetic planning-need	Water gardening	Cacti and succulents in landscaping	Roadside planting	Application of GIS
S-8,9	SLO-1	Lab3: Identification and description of trees, climbers and ground covers.	Lab7: Training and pruning of plants for special effects.	Lab10: Practicing landscape design and plan for home and industrial garden.	Lab 13: Lawn and turf management	Lab16:Visit to large-scale gardens /dam sites.
	SLO-2					
S-10	SLO-1	-	-	Pot plants arrangements	-	-
	SLO-2	-	-	Interiorscaping	-	-
S-11	SLO-1	Lab 4: Identification and description of cacti, succulents, palms, ferns and indoor plants	-	-	-	-
	SLO-2		-	-	-	-

Learning Resources	1. *Prasad, S. and Kumar, U. (2013). A hand book of Floriculture. Jodhpur, Agrobios. (pp.1-654).* 2. *Tiwari, A.K. (2012). Fundamentals of Ornamental Horticulture and Landscape Gardening. New Delhi, NIPA. (pp.1 – 588)*

	Level of Thinking	Continuous Learning Assessment (35% weightage)		University Practical Examination (15%)	End semester theory Examination **(50%)**
		In semester (20%)	Practical internal (15%)		
Level 1	Remember Understand	40 %	30 %	35%	30 %
Level 2	Apply Analyze	40 %	40 %	35%	40 %
Level 3	Evaluate Create	20 %	30 %	30%	30 %
	Total	100 %	100 %	100%	100 %

Course Designers		
Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
Gorthi Nagarjuna Naidu *General Manager(TANFLORA)* *naidugorthi@gmail.com*	-	*Dr. Gobu* *Dr. Anandhi* *Mrs. C. Kanimozhi*

THEORY

Unit I - Importance and Scope

Importance and scope of gardening – historical background - gardens in India – definition, principles and concepts of landscape gardening - styles and types of gardens - Hindu, Moghul, English, Italian, Persian and Japanese gardens – bio-aesthetic planning – definition and need – ornamental landscaping in environmental protection.

Unit II - Garden Designs

Garden components and adornments – importance and designing – plant components and non-plant components - rosary, topiary, trophy, rockery, pond, sunken garden, flower beds, arboretum, conservatory, roads, walks, paths, hedges, edges, carpet garden, arch, pergola, arbour, fountains, cascades, garden seats, statues, hanging baskets, trellies, ornamental vases, ornamental urns and window boxes. Special types of gardens - principles and design – water garden, terrace garden, rockery, vertical garden.

Unit III - Garden Plants for Landscaping

Study of foliage and flowering plants and their design and values in landscaping – ornamental annuals - shrubs - trees – herbaceous perennials – climbers and creepers – palms and palmatum- ferns and fernery – cacti and succulents- Indoor plants.

Unit IV - Landscape Designing and planning

Design, planning and management of natural and built environment –landscape planning – home garden, public, urban, peri- urban – institutional – schools, railway lines, factories, bus stands, airports, buildings, dams, riverbanks, parks and industrial gardening- avenue planting.

Unit V - Turf Management and Software application

Importance and scope – turf grasses – species and types – selection of site–media and field preparation – types of lawn making – turf establishment- bonsai - methods, styles and maintenance- Landscape architecture – design, planning and management of natural and built environments. Computer aided design (CAD).

Theory Lecture Schedule

1. Scope and importance and basic principles of landscape gardening.
2. Study of styles and types of garden.
3. Bio aesthetic planning – definition and need.
4. Study of principles and designing of plant components and non-plant components.
5. Study of special types of gardens – Terrace Garden and vertical garden.
6. Study of special types of Gardens- Rock garden and water garden
7. Study of trees, shrubs and their role in landscaping.
8. Role of annuals, herbaceous perennials, climbers and ground covers in landscape gardening.
9. **In-Semester Examination**
10. Study of palms, ferns, cacti and succulents in landscaping.
11. Study of pot plants/indoor plants in landscape gardening.
12. Designing rural , urban, Peri- urban and industrial gardens
13. Designing of corporate landscaping and interior gardening.
14. Planning and planting of avenues and roadside planting.
15. Importance, scope and species of lawn, establishment of lawn, maintenance and rejuvenation of lawn.
16. Study of styles and types of bonsai making.
17. Planning and designing of natural and built environments using computer soft wares.

Practical Lecture Schedule

1. Study of garden equipment.
2. Identification and description of annuals, shrubs and herbaceous perennials.
3. Identification and description of trees, climbers and ground covers.
4. Identification and description of cacti, succulents, palms, ferns and indoor plants
5. Description and designing of garden components – arches, bowers, pergolas, paths, walks, bridges, fountains and statues.

6. Designing of garden components – edges, hedges, rosary and flower borders.
7. Training and pruning of plants for special effects.
8. Designing and layout of rockery and terrace garden.
9. Designing and layout of sunken garden and water garden.
10. Practicing landscape design and plan for home and industrial garden.
11. Layout of traffic islands.
12. Practicing landscape design for urban and rural locations.
13. Lawn and turfs – preparation of land, planting, after care and turf economics.
14. Designing and practicing of bonsai.
15. Practice of landscape with computer softwares.
16. Visit to large scale gardens /dam sites/ lawns /turf nurseries.
17. **University practical examination**

Text Books

1. Auto CAD – 2010 Edition
2. Arora, J.S. (2006). Introductory Ornamental Horticulture. Ludhiana, Kalyani Publishers. .(pp.1-188)
3. Bhattacharjee,S.K. (2004). Landscape Gardening and Design with plants.
4. Jaipur, Aavishkar Publishers and Distributers.
5. Dharmendra Kaulani and Arati Joshi. (2018). A textbook of Ornamental Horticulture. Nepal, Heritage Publishers.
6. Prasad, S. and Kumar, U. (2013). A hand book of Floriculture. Jodhpur, Agrobios. (pp.1-654).

Reference Books

4. Bhattacharjee,S.K. (2004). Landscape Gardening and Design with plants. Jaipur, Aavishkar Publishers and Distributers.
5. Grant, W. Reid Asla. (2002). Landscape Graphics. Colorado, Watson Guptil Publisher. (2nd ed. pp.1 – 208).
6. Suresh K Malhotra Lallan Ram .(2017). Advances in Floriculture and Landscape Gardening. Nagaland ,Central Institute of Horticulture. (pp.1 - 322).
7. Tiwari, A.K. (2012). Fundamentals of Ornamental Horticulture and Landscape Gardening. New Delhi, NIPA. (pp.1 – 588).
8. Thompson Ian, H. (2014). Landscape Architecture. Oxford University Press. (pp.1 -152).

Web References

1. www.bestgarden.net
2. www.indiaagronet.com
3. www.intuxford.tripod.com
4. www.webct.uark.edu
5. www.personal.psu.edu
6. www.sunny.crk.umn.edu/courses
7. www.lawngrasses.com
8. www.mediatoday@vsnl.com
9. www.hsi1942.org

Journals

1. Journal of Ornamental Horticulture.
2. Journal of Floriculture and Landscaping.
3. Indian Journal of Horticulture.
4. The American Journal of Horticulture and Floriculture Research.
5. International Journal of Horticulture and Floriculture.

Course Nature: Theory based Practical							
Total Marks (100)							
S.No.	Category	Assessment Tools					
		In- Semester Examination	Assignment	Record	Attendance	End-Semester Examination	Marks
1	Theory-External	-	-		-	*50*	*50*
2	Theory-Internal	*20*	-			-	*20*
3	Practical-External	-	-		-	*15*	*15*
4	Practical-Internal	-	*05*	*05*	*05*	-	*15*
						Grand Total	*100*

Course Code	STR19701	Course Name	Student READY - Rural Agricultural Work Experience (RAWE) and Agro-Industrial Attachment (AIA)	Course Category	S	Student READY	L	T	P	C
							0	0	20	20

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Agricultural Extension	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1 :	Understand the rural setting in relation to agriculture and allied activities.
CLR-2 :	Understand socio-economic conditions of the farmers and their problems.
CLR-3 :	Learn diagnostic and remedial knowledge to the students relevant to real field situations through practical training.
CLR-4 :	Develop communication skills in students using extension teaching methods in transfer of technology.
CLR-5 :	Inculcate confidence and competence to solve agricultural problems.
CLR-6 :	Gain information about on-going extension and rural development programmes.

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	Perceive farmers issues and address them effectively	1	80	75
CLO-2 :	Comprehend various farming activities	2	85	80
CLO-3 :	Apply theoretical concepts in field conditions	3	80	75
CLO-4 :	Analyze various institutions in rural setting and understand the importance of rural institutions in problem solving and development	3	75	70
CLO-5 :	Comprehend the role of Agricultural Departments in Agricultural development	2	80	75
CLO-6 :	Appreciate the role of NGOs in overall development of India	3	75	70
CLO-7:	Appraise the functions of agro-based companies functions	2	85	80

Program Learning Outcomes (PLO)															
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Agriculture Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	Ability to solve scientific problems	Ability to implement knowledge gained in the applied field of Business Management	Ability to understand social and ethical responsibilities
M					H			M	H		H	M	M	L
H					H			L	H		H	M	M	L
M					H			L	H		H	M	M	L
M					H			M	H		H	M	M	L
L					H			M	H		H	M	M	L
M					H			H	L		M	M	M	L
M					H			H	L		M	M	M	L

UNIT I Village Stay Program (60 Days)

Study of rural situation – village settlement pattern, demography, climate, land utilization pattern, resources inventory, infrastructure facilities, rural institutions, organizations, groups, customs, beliefs and value systems - Study of cropping pattern, cropping systems, extent of adoption of latest technologies and constraints – cereals, millets, pulses, oilseeds – productivity – Decline in productivity – Yield gap – constraints in production -Understanding social participation, leadership pattern, scientific orientation and role of women and youth in agricultural development -Extension methods and Audio Visual Aids – Practicing individual, group and mass contact methods - Studying the existing Indigenous Technical Knowledge and its importance for technology generation-Conducting PRA to assess the resources. Understanding the communication pattern in villages- Studying farm women associations / farmers associations / commodity groups and learning their functioning and use of their services for dissemination- Conducting need based skill demonstrations in the villages- Developing Whole Village Development Plan- Contacting individual farmers to assess the farming systems practiced by marginal, small, medium, big farmers and Farm Women- Preparation of Individual farm plan - Documentation of success stories of the farmers.

UNIT II ADA Attachment (10 Days)

Study the organizational structure and schemes implemented by the various Development Departments- Study of Agricultural Department – Organization pattern, role and functions of Department of Agriculture and allied departments.

UNIT III NGO Attachment (10 DAYS)

Study of NGO – Roles and objectives – organizational pattern – sources of funding – extension activities of NGO – Contacting target groups.

Unit IV In-Plant Training/ Industrial Attachment (10 Days)

Study of Agro Industry – Nature of business – Brief history of the firm - Licensing and other legal aspects of the firm- Study of Production Management, Materials Management, Marketing Management and Financial Management.

Course Nature: Practical			
Total Marks (100)			
S.No.	**Category**	**Assessment Tools**	**Marks**
1	Practical-Internal	*Purely internal based on the participation, involvement and contribution of students in the activities pertaining to the course and the assessment criteria be as follows,*	
		Daily Observation Note	*20*
		Placement Record	*25*
		Exhibition	*25*
		Oral Presentation	*25*
		Attendance	*05*
		Grand Total	***100***

Course Code	Course Title	T	P	Credit
STR19702	All India Study Tour	0	1	1
Course Orientation: To familiarize the students with the flora , fauna and other research activities of SAUs, research institutes, forest industries, govt. and private organization of different parts of India. To expose the students to various national / heritage monuments as part of national integration activity.				

Course Outcome

The course will provide an opportunity for the students to study the functioning of important national and international institutes related to agriculture and allied fields. The students will be taken for a fifteen day trip to various national and international institutions and industries related to agriculture, horticulture, forestry and other allied fields in various regions of the country. During the tour programme, the students will gain first-hand information on different agro-climatic zones, crops grown, cultivation practices, socio-cultural and economic status of the farming communities. The students will be evaluated as indicated below:

Course Nature: Practical			
Total Marks (100)			
S.No.	**Category**	**Assessment Tools**	**Marks**
1	*Practical-Internal*	*Purely internal based on the participation, involvement and contribution of students in the activities pertaining to the course and the assessment criteria be as follows,*	
		Written Test	*40*
		Behaviour (Punctuality and Discipline)	*20*
		Observation Note Book	*25*
		Viva-Voce	*10*
		Attendance	*05*
		Grand Total	*100*

Course Code	STR19801	Course Name	BIO-INOCULANTS PRODUCTION TECHNOLOGY	Course Category	E	Student Ready-Experimental Learning Programme	L	T	P	C
							0	0	10	10

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Agricultural Microbiology	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1 :	Acquire skills on the isolation of nitrogen fixing bacteria
CLR-2 :	Gain skills on Blue Green Algae and Azolla cultivation
CLR-3 :	Gain knowledge on the isolation of P solubilizing bacteria and P mobilizing microorganisms
CLR-4 :	Learn about the operation of a bioreactor
CLR-5 :	Acquire skills on the skills on the mass production of bioinoculant
CLR-6 :	Gain knowledge on the establishment and marketing of bioinoculants

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	Demonstrate the isolation of the nitrogen fixing bacteria	3	90	80
CLO-2 :	Explain about BGA and Azolla cultivation	1	95	85
CLO-3 :	Elaborate about the biofertilizer industrial setup and its requirements	2	75	65
CLO-4 :	Attribute about the operation principles and maintenance of a bioreactor	1	80	70
CLO-5 :	Perform mass production of bio inoculants	3	75	60
CLO-6 :	Develop a biofertilizer unit	3	80	70

Program Learning Outcomes (PLO)														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Agriculture Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	Ability to solve scientific problems	Ability to implement knowledge gained in the applied field of Business Management	Ability to understand social and ethical responsibilities
M								L	H		H	H	H	H
H								L	H		H	H	H	H
L	H	H	L					L	H		H	H	H	H
L	H	H	L					L	H		H	H	H	H
H	H	H		L				M	H	L	H	H	H	H
H	L	H						M	H		H	H	H	H

		Learning Unit / Module 1	Learning Unit / Module 2	Learning Unit / Module 3	Learning Unit / Module 4	Learning Unit / Module 5
Duration (hour)		3	3	3	3	4
S-1	SLO-1	Week 1-: : Isolation and characterization of Rhizobium from root nodules of legumes	Week 4: Isolation and characterization of phosphobacteria and Pseudomonas sp from rhizosphere soil	Week 7: Mass production of bioinoculants	Week 10: Mass production of Azolla and BGA	Week 13 : Seed Treatment of Bacterial Biofertilizer
	SLO-2					
S-2	SLO-1	Week 2: Isolation and characterization of Azospirillum spp from rice roots	Week 5: Isolation and characterization of Gluconacetobacter from sugarcane	Week 8: Development of lignite based bioinoculant	Week 11; Isolation of PPFM's from the phyllosphere of crops	Week 14: Development of liquid Biofeeeertilizer
	SLO-2					
S-3	SLO-1	Week 3: Isolation and characterization of Azotobacter from soil	Week 6:: Isolation of zinc and silicate solubilizing bacteria	Week 9: Quality assessment of bacterial biofertilizer	Week 12. Mass Production of AM fungi	Week 15: Economics of biofertilizer production
	SLO-2					
S-4	SLO-1	-				Week 16: Visit to biofertilizer production unit

Learning Resources	
	1. Deshmukh, A. M., Khobragade, R. M., and Dixit, P. P. (2007). Handbook of biofertilizers and biopesticides (1st Edn.). India, Oxford Book,ISBN: B1-B9473.15). .,pp 1-645
	2. Subba, R. (2017). Soil microbiology (4th Edn,), India: Oxford and IBH Publishing, (ISBN-10: 8120413830). pp 1-426

	Level of Thinking	Final internal Examination (100%)
Level 1	Remember	*20 %*
	Understand	
Level 2	Apply	*40 %*
	Analyze	
Level 3	Evaluate	*40 %*
	Create	
	Total	*100 %*

Course Designers		
Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
Mr. C. Vaithilingam *Romvijay Biotech PVT LTD* *NH32, Mullodai, Kanniyakoil, Puducherry 607402*	*Dr.Sivakumaar PK, Professor, Department of Microbiology, Faculty of Agriculture, Annamalai University, Annamalainagar-608002*	*Dr. Anbukarasi K* *Dr. Melvin Joe M*

Practical

Biofertilizer- Introduction, status and scope. Structure and characteristic features of bacterial biofertilizers- *Azospirillum* sp., *Azotobacter* sp., *Bacillus* sp., *Pseudomonas* sp., *Rhizobium* sp. and *Frankia*; *Azolla* and BGA ,fungal biofertilizers- AM mycorrhiza. Mass production of various nitrogenous bioinoculants -*Rhizobium, Azospirillium, Azotobacter, Gluconacetobacter diozotrophicus, Azolla* and BGA. Production of phosphatic bioinoculants-AM fungi and phosphate solublizers. PPFM, PGPR, zinc solublizers, silicate solubilizers, potash releasers and sulphur oxidizer. Fermentation- fermenter types and operation-downstream processing- Use of bioreactor in biofertilizer production-commercial bioinoculants production viz., BIS standards for quality testing of various bioinoculants. Newer formulations of biofertilizer. Application methods for biofertilizers. Visit to commercial biofertilizer production unit, Establishment of bioinoculants production unit- facilities and equipment's required for laboratory scale, pilot scale and large scale, marketing of products and project preparation for establishing bioinoculants production unit. Basic concepts on Artificial intelligence - Predictive microbiology (RSM)

Text Books

1. Deshmukh, A. M., Khobragade, R. M., and Dixit, P. P. (2007). Handbook of biofertilizers and biopesticides (1st Edn.). India: Oxford Book,ISBN: B1-B9473.15). pp. 1-645.
2. Glick, B. R. (2015). Beneficial plant-bacterial interactions (2nd Edn), Germany:Springer, (ISBN 978-3-030-44467-2). pp. 1-243.
3. Subba Rao, N.S. (1999). Biofertilizers in Agriculture and Agroforestry (3rd Edn),India : Oxford and IBH, (SBN:1881570290).pp.1-426.
4. Subba, R. (2017). Soil microbiology (4th Edn), India: Oxford and IBH Publishing, (ISBN-10: 8120413830).pp. 1-426.

Reference Books

1. Kannaiyan, S. (Ed.). (2002). Biotechnology of biofertilizers (1st Edn), Germany: Springer Science & Business Media, (ISBN 1-4020-0219-X). pp. 1-376.
2. Motsara, M.R., Bhattacharyya, P. and Srivastava, B., (1995). Biofertilizer-Technology, Marketing and Usage. 9(1st Ed). India: Fertilizer Development and Consultant Organization,(ISBN-139788185116389). pp. 1-184.
3. Rai M.K. 2006. Handbook of Microbial Biofertilizers.(1st Edn,), New York: Food Products Press, (ISBN 13: 978-1 55022-269 9). pp.1-543.
4. Singh, T., and Purohit, S. S. (2008). Biofertilizer Technology (1st Edn,), New Delhi: Agrobios. (ISBN 13: 9788177543827).pp 1-764.

Web-References

1. 1.https://ecourses.icar.gov.in/e-Leaarningdownload3_new.aspx?Degree_Id=01
2. 2.http://ecoursesonline.iasri.res.in/Courses/Agricultural%20Microbiology/AMBE101/Start%20to%20read%20the%20Course.html
3. 3.https://sites.google.com/site/soilagrlmicrobiol/
4. 4.https://www.rhizobia.co.nz/taxonomy/rhizobia
5. 5.https://sites.google.com/site/soilagrlmicrobiol/books-book-chapters/Biofertilizers%20and%20sustainability.pdf?attredirects=0
6. 6.https://www.youtube.com/watch?v=bq1bTduTzC0

Course Nature: Only Practical			
Total Marks (100)			
S.No.	**Category**	**Assessment Tools**	**Marks**
1	*Practical-Internal*	*Purely internal based on the participation, involvement and contribution of students in the activities pertaining to the course*	
		Continuous evaluation of routine activities	*30*
		Execution skill and Product generation/ Competence	*20*
		Written test	*20*
		Record and Observation Note	*20*
		Viva-Voce	*05*
		Attendance	*05*
		Grand Total	***100***

Course Code	STR19802	Course Name	PRODUCTION TECHNOLOGY OF BIO-CONTROL AGENTS	Course Category	E	*Student Ready-Experimental Learning Programme*	L	T	P	C
							0	0	10	10

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Plant Pathology		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1 :	*Understand the principles of biological control of plant diseases & pests*
CLR-2 :	*Knowledge about the laboratory equipments used for biocontrol agent production*
CLR-3 :	*Information on different biocontrol agents for the management of diseases and insect pests*
CLR-4 :	*Outline about the isolation and culturing of biocontrol agent*
CLR-5 :	*Perceive about the selection of efficient biocontrol agent*
CLR-6 :	*Knowledge on mass production of biocontrol agents, quality testing and delivery*

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning			Program Learning Outcomes (PLO)													
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Agriculture Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	Ability to solve scientific problems	Ability to implement knowledge gained in the applied field of Business Management	Ability to understand social and ethical responsibilities
CLO-1 :	*Exhibit skills on the isolation and culturing of micro-organisms responsible for plant disease management*	*1*	*95*	*80*	*M*			*L*					*M*	*H*		*H*	*L*	*H*	*H*
CLO-2 :	*Demonstrate on the screening of efficient bioagent*	*2*	*90*	*85*	*M*			*M*					*L*	*H*		*H*	*L*	*H*	*H*
CLO-3 :	*Extend mass multiply of the effective bioagent*	*2*	*85*	*70*	*M*								*L*	*H*		*H*	*M*	*H*	*H*
CLO-4 :	*Knowledge the quality control and production economics of bioinoculants*	*1*	*75*	*65*	*M*	*M*							*M*	*H*		*H*	*L*	*H*	*H*
CLO-5 :	*Apply the concept of beneficial insects for insect pest management*	*2*	*75*	*60*	*L*								*M*	*H*		*H*	*M*	*H*	*H*
CLO-6 :	*Express confidence as potential entreprenuer*	*3*	*75*	*65*	*L*	*L*	*M*		*L*		*H*		*M*	*H*		*H*	*L*	*H*	*H*

		Learning Unit / Module 1	Learning Unit / Module 2	Learning Unit / Module 3	Learning Unit / Module 4	Learning Unit / Module 5
Duration (hour)		4	3	3	3	3
S-1	SLO-1	*Week 1- Principles and concepts of biological control*	*Week 5 – Identification of antagonists (fungi and bacteria)*	*Week 8 – Screening Identification of suitable bioagent*	*Week 11- Mass multiplication Trichoderma sp, Bacillus sp., and Pseudomonas sp*	*Week 14 - Selection and maintenance of colonies Corcyra cephalonica and Maconellicoccus hirsutus*
	SLO-2					
S-2	SLO-1	*Week 2- Laboratory equipments and their Principle.s*	*Week 6- Isolation of antagonistic microbes Rhizosphere soil , Phyllosphere microbes & Endophytes*	*Week 9 - Identification of potential biocontrol agent*	*Week 12 -Mass multiplication ofPaecilomyces sp, and Pasteuria sp.*	*Week 15 - Mass production Trichogramma, Chrysoperla and Cryptolaemus montrouzieri*
	SLO-2					
S-3	SLO-1	*Week 3- Culturing techniques and Media preparation*	*Week 7- Isolation of antagonistic microbes*	*Week 10- Morphology and molecular confirmation*	*Week 13- Carrier material and application methods*	*Week 16 - Mass production Enumeration, standardization and quality control.*
	SLO-2					
S-4	SLO-1	*Week 4- Culturing of Soil microbes and antagonists*	-	-	-	-
	SLO-2		-	-	-	-

Learning Resources	Text Books:	Reference Books:
	1. *Chaube, H.S. and Pundhir. V.S. (2009). Crop diseases and their management. New Delhi:PHI Learning Private Limited. pp. 1-724.* 2. *Mukherjee P.K, Horwitz B.A, et al. (2013). Trichoderma biology and applications. CABI. pp. 1-344.*	1. *Narayanasamy, P. (2008). Biological Management of Diseases of crops. New York: Springer. pp.1-673.*

	Level of Thinking	Final Internal Evaluation (100%)
Level 1	Remember	*20%*
	Understand	
Level 2	Apply	*40%*
	Analyze	
Level 3	Evaluate	*40%*
	Create	
	Total	***100%***

Course Designers		
Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
Mr. N. Muralitharan *Regional Manager* *NACL Industries limited.* *Ph- 9677780714*	*Dr. S. Nakkeeran, Professor, Department of Biotechnology, Centre for Plant Molecular Biology & Biotechnology, AC & RI, TNAU, Coimbatore -641003*	*Dr.L.Ramazeame (Assistant professor)* *Agricultural Entomology* *Dr. Rageshwari S* *Assistant Professor (Plant Pathology)* *Dr. Vinod Kumar S* *Assistant Professor (Plant Pathology)*

Practical

Principle and concept of biological control; laboratory equipments; media preparation and sterilization methods; calibration of microscope; spore observation: use of haemocytometer, assessment of spore load and colony forming units; Antagonistic microorganisms: isolation of biocontrol agents *viz., Trichoderma sp, Pseudomonas sp, Bacillus sp, Paecilomyces sp, and Pasteuria sp* – morphological characterization and molecular characterization, *in vitro* screening, quality control, delivery system, screening with different carrier materials, compatibility study with other biocontrol agents, fungicides and pesticides, economics, project preparation. Natural enemies and entomopathogens: economic importance; establishment of model biocontrol agents, production units; selection and maintenance of healthy colonies of host insects: *Corcyra cephalonica* and *Maconellicoccus hirsutus;* mass production of *Trichogramma*, *Chrysoperla* and *Cryptolaemus montrouzieri* and entomopathogenic fungi: enumeration, standardization and quality control.

Text Books

1. Ashok Pande and Mukerji. (2006). *Biological control of plant diseases*. CRC
2. Press. pp. 1-246.
3. Chaube, H.S. and Pundhir. V.S. (2009). *Crop diseases and their management*. New Delhi: PHI Learning Private Limited. pp 1-724.
4. Gnanamanickam S. S. (2002). *Biological control of crop diseases*. CRC Press. pp 1-480.
5. Mukherjee P.K, Horwitz B.A, et al. (2013). *Trichoderma biology and applications*. CABI. pp.1-344.
6. Upadhyy, R.K, Mukerji, K.G. and Chamola, B.P. (2000). *Biocontrol potential and its exploitation in sustainable agriculture*. Vol 1: Crop diseases, weeds, and nematodes. New York: Springer. pp. 1-294.

Reference Books

1. Ajay Singh, Nagina Parmar and Ramesh C.Kuhad. (2011). *Bioaugmentation, Biostimulation and Biocontrol*. New York: Springer. pp.1-364.
2. Narayanasamy, P. (2008). *Biological Management of Diseases of crops*. New York: Springer. pp.1-673.
3. Reddy P. P. (2014). *Plant growth promoting rhizobacteria for horticultural crop protection*. India: Springer. pp. 1-310.
4. Siddiqui Z. A. (2006). *PGPR: biocontrol and biofertilization*. Netherlands: Springer. pp. 1-318.
5. Zhang K-Q, Hyde K. D. (2014). *Nematode-trapping fungi*. Netherlands: Springer Science & Business. pp. 1-392.

Web-References

1. https://www.youtube.com/watch?v=ARCbgCv6ln8
2. https://www.youtube.com/watch?v=Gews2FoBMZY
3. https://www.youtube.com/watch?v=hWdmL8sGCB4
4. https://www.youtube.com/watch?v=14zmmbXsyuM

Journals

1. Biological control
2. Biocontrol science and technology
3. Biocontrol
4. Crop protection
5. European journal of plant pathology
6. Phytopathology

Course Nature: Only Practical			
Total Marks (100)			
S.No.	**Category**	**Assessment Tools**	**Marks**
1	Practical-Internal	*Purely internal based on the participation, involvement and contribution of students in the activities pertaining to the course*	
		Continuous evaluation of routine activities	*30*
		Execution skill and Product generation/ Competence	*20*
		Written test	*20*
		Record and Observation Note	*20*
		Viva-Voce	*05*
		Attendance	*05*
		Grand Total	***100***

Course Code	STR19803	Course Name	MUSHROOM CULTIVATION TECHNOLOGY	Course Category	E	*Student Ready-Experimental Learning Programme*	L	T	P	C
							0	0	10	10

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Plant Pathology		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1 :	*Understand the importance of mushroom*
CLR-2 :	*Knowledge about nutritive and medicinal value of mushroom*
CLR-3 :	*Outline on different types of mushroom*
CLR-4 :	*Obtain skill for mushroom cultivation*
CLR-5 :	*Gain information about different value added products of mushroom*
CLR-6 :	*Develop the potential needed for a business entrepreneur*

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning			Program Learning Outcomes (PLO)													
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Agriculture Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	Ability to solve scientific problems	Ability to implement knowledge gained in the applied field of Business Management	Ability to understand social and ethical responsibilities
CLO-1 :	*Recognize the importance of mushroom*	*1*	*95*	*80*	*M*			*L*					*M*	*H*		*H*	*L*	*H*	*H*
CLO-2 :	*Demonstrate skill on spawn cultivation*	*2*	*90*	*85*	*M*	*L*		*M*					*L*	*H*		*H*	*L*	*H*	*H*
CLO-3 :	*Exhibit skill in isolating and culturing techniques of different types of edible mushrooms*	*2*	*85*	*70*	*M*	*L*							*L*	*H*		*H*	*M*	*H*	*H*
CLO-4 :	*Excel in various techniques of mushroom cultivation.*	*1*	*80*	*75*	*M*	*M*							*M*	*H*		*H*	*L*	*H*	*H*
CLO-5 :	*Preparation of different value added products of mushroom*	*2*	*75*	*60*	*L*		*M*						*M*	*H*		*H*	*M*	*H*	*H*
CLO-6 :	*Express confidence as an entrepreneur*	*3*	*75*	*65*	*L*	*L*	*M*		*L*		*H*		*M*	*H*		*H*	*L*	*H*	*H*

		Learning Unit / Module 1	Learning Unit / Module 2	Learning Unit / Module 3	Learning Unit / Module 4	Learning Unit / Module 5
Duration (hour)		3	4	3	3	3
S-1	SLO-1	*Week 1-Introduction to mushroom*	*Week 5- Preparation of media for isolation of mushroom*	*Week 8- Mother bed preparation for oyster mushroom*	*Week11- Mother bed preparation for Paddy straw mushroom*	*Week 14- Exposure visit to different mushroom production units.*
	SLO-2					
S-2	SLO-1	*Week 2- Different types of mushroom*	*Week 6- Isolation and maintenance of pure culture of mushroom*	*Week 9- Mother bed preparation for milky mushroom*	*Week 12- Exposure visit to different mushroom production units.*	*Week 15- Cost benefit analysis of mushroom cultivation.*
	SLO-2					
S-3	SLO-1	*Week 3- Nutritional and medicinal value of mushroom*	*Week 7- Spawn preparation*	*Week 10 – Casing methods- Milky mushroom*	*Week 13- Pest and diseases of mushroom*	*Week 16. - Value addition of mushroom*
	SLO-2					
S-4	SLO-1	*Week 4- Types of media for isolation of mushroom culture*	-	-	-	-
	SLO-2					

Learning Resources	Text Books:	Reference Book:
	1. *Krishnamoorthy, A.S., Marimuthu, T., and S. Nakkeeran. (2005). Mushroom Biotechnology. Sivakasi, India: Vijay Books.* 2. *Singh, P.K. and Jha, S.K. (2014). Mushroom production and utilization. India: Scientific publishers. pp.1-189*	1. *Robin Gogoi, Yella Rathaiah, Tasvina Rahman Borah. (2006). Mushroom Cultivation Technology (pp. 1-130). India: Scientific publisher.*

	Level of Thinking	Final Internal Evaluation (100%)
Level 1	Remember	*20%*
	Understand	
Level 2	Apply	*40%*
	Analyze	
Level 3	Evaluate	*40%*
	Create	
	Total	*100%*

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
D. Sekaran *Arun mushroom agri farms* *Kottaikadu village* *Cheyyur (TK)* *Chengalpattu district* *Tamil Nadu- 603 304* *Ph: +91 99403 38374, +91 99525 08318* *Email: arunmushroomagri2004@gmail.com*	*Dr. A.S. Krishnamoorthy, Professor* *Registrar,* *Tamil Nadu Agricultural University* *Coimbatore – 641003.* *Ph: + 9790499006* *milkmushapk2@yahoo.com*	*Dr. Rageshwari S* *Assistant Professor, Plant Pathology* *Dr. Vinod Kumar S* *Assistant Professor, Plant Pathology*

Practical

Introduction to mushroom - types of mushroom – nutritional and medicinal values of mushroom- button mushroom, oyster mushroom, milky mushroom, paddy straw mushroom, types of mushroom cultivation, media preparation - types of media - isolation and maintenance of pure culture of mushroom - different types of bed preparation - spawn preparation – cultivation of oyster mushroom, milky mushroom, button mushroom, and paddy straw mushroom, mother bed preparation – casing of mushroom beds, mushroom harvesting -pest and diseases of mushroom- management of pest and diseases of mushroom– value addition of mushrooms- cost benefit ratio. Visit to mushroom cultivation units.

Text Books

1. Gour Pathak and Yadav. (2020). *Mushroom production and processing technology*. India: Agrobios International Book Distributor. pp. 1-179.
2. Ragav J.C and Singh, U.C. (2014). *Modern Mushroom Cultivation*. India: Agrobios. pp. 1-244.
3. Reeti Singh and U.C. Singh. (2009). *Modern mushroom cultivation*. India: Agrobios. pp. 1-248.
4. Krishnamoorthy, A.S., Marimuthu, T., and S. Nakkeeran. (2005). *Mushroom Biotechnology*. Sivakasi, India: Vijay Books.
5. Marimuthu, T., A.S Krishnamoorthy, K.Sivaprakasam and R.Jeyarajan. (1989). *Oyster mushroom production*. Sivakasi, India: Vijay Books.
6. Singh, P.K. and Jha, S.K. (2014). *Mushroom production and utilization*. India: Scientific publishers. pp.1-189.

Reference Books

1. Robin Gogoi, Yella Rathaiah, Tasvina Rahman Borah. (2006). *Mushroom Cultivation Technology*. India: Scientific publisher. pp. 1-130.
2. Tavis Lynch. (2018). *Mushroom Cultivation: An Illustrated Guide to Growing Your Own Mushrooms at Home*. USA: Wuarto pulishing Group, USA Inc. pp. 1-144.

Web-References

1. https://www.youtube.com/watch?v=oormRweSf3E
2. https://www.youtube.com/watch?v=9JwkHjCTKtQ
3. https://www.youtube.com/watch?v=T8LrW-AFq9g

Journals

1. International journal of medicinal mushroom.
2. Mycoscience
3. Mushroom science and Biotechnology
4. Journal of Mushrooms

Course Nature: Only Practical			
Total Marks (100)			
S.No.	**Category**	**Assessment Tools**	**Marks**
1	*Practical-Internal*	*Purely internal based on the participation, involvement and contribution of students in the activities pertaining to the course*	
		Continuous evaluation of routine activities	*30*
		Execution skill and Product generation/ Competence	*20*
		Written test	*20*
		Record and Observation Note	*20*
		Viva-Voce	*05*
		Attendance	*05*
Grand Total			***100***

Course Code	STR19804	Course Name	COMMERCIAL BEEKEEPING	Course Category	S	*Student Ready-Experimental Learning Programme*	L	T	P	C
							0	0	10	10

Pre-requisite Courses	Nil	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Agricultural Entomology*			Data Book / Codes/Standards	*Nil*

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1 :	*Obtain Knowledge on importance of bee species*
CLR-2 :	*Learn about equipments required for honey production*
CLR-3 :	*Gain knowledge on bee pasturage, Insect pests and diseases of honey bee and seasonal management of honey bee*
CLR-4 :	*Acquire knowledge on bee products*
CLR-5 :	*Obtain basic information on preparation of floral calendar and honey extraction*
CLR-6 :	*To learn about the preparation of bankable project*

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	*Exhibit skills on honey bee species*	*3*	90	80
CLO-2 :	*Demonstrate on equipments & seasonal management of honey bees*	*2*	70	80
CLO-3 :	*Explain about the bee pasturage*	*1*	75	70
CLO-4 :	*Intrepret about of pests and diseases affecting honey bee*	*2*	80	60
CLO-5 :	*Manage of swarming of honey bee*	*3*	75	60
CLO-6 :	*Demonstrate the methods of collection of bees' wax, bee pollen, propolis, bee venom and royal jelly*	*2*	75	65

Program Learning Outcomes (PLO)															
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Agriculture Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	Ability to solve scientific problems	Ability to implement knowledge gained in the applied field of Business Management	Ability to understand social and ethical responsibilities
H								M	H		H	H	H	H
H								L	H		H	H	H	H
M			L					M	H		H	H	H	H
M		L		L				L	H		H	H	H	H
L	L		L					M	H		H	H	H	H
L						H		M	H		H	H	H	H

		Learning Unit / Module 1	Learning Unit / Module 2	Learning Unit / Module 3	Learning Unit / Module 4	Learning Unit / Module 5
Duration (hour)		4	3	3	3	3
S-1	SLO-1	*Week :1 Honey bee Species; identification and study of social biology*	*Week :5 Visit to migratory bee keeping sites Visit to commercial bee farm,*	*Week :8 Management in nectar flow season, Dearth period of honey bee*	*Week :11 Insect, mite and bird enemies of honeybees*	*Week :14 Protecting bees from pesticides*
	SLO-2	*Week :2 Bee pasturage; preparation of bee floral calendar; Bees conservation*	*Week : 6 Honey extraction, processing, purity testing and value addition*	*Week :9 Management of swarming, absconding and laying workers;*	*Week :12 Brood and adult diseases*	*Week :15 Marketing and economics of honey and bee products;*
S-2	SLO-1	*Week : Honey Beehives, beekeeping equipments*	*Week :7; Hive inspection, Maintenance of hive records*	*Week :10 Dividing of honey bee, Uniting bee colonies and Artificial feeding*	*Week : 13 Methods of collection of bees' wax, bee pollen, propolis, bee venom, royal jelly*	*Week :16 Preparation of bee keeping projects for bank funding*
	SLO-2	*Week 3: Hiving feral Indian bee colony,*	-	-	-	-
S-3	SLO-1	*Week : 4 Site selection for apiary*	-	-	-	-
			-	-	-	-

Learning Resources	
	1. *Abrol D.P. (2011). Beekeeping – A comprehensive guide to bees and beekeeping. Scientific Publishers, Jodhpur,pp1- 896.*
	2. *2. Atwal, A.S. (2000). Essentials of Bee Keeping and Pollination. Kalyani Publishers, Ludhiana. pp1-394 .*

	Level of Thinking	Final internal Examination (100%)
Level 1	Remember	*20 %*
	Understand	
Level 2	Apply	*40 %*
	Analyze	
Level 3	Evaluate	*40 %*
	Create	
	Total	*100 %*

Course Designers		
Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
Dr. K. Ramesh Ph.D *Principal Biologist –Rice Insecticide and Nematicide, South Asia* *Co-chair for insecticide resistance action committee(IRAC), India* *Corteva Agrisciences (Dow Dupont)* *Madhapur, Hyderabad, India* *e- mail :ramesh.kaliaperumal@corteva.com* *mobile : 9952885708*	*Dr. K. Kumar, Professor and Head, Department of Agricultural Entomology, PAJANCOA&RI, Karaikal-609603*	*Dr. L.Ramazeame*

Practical

Honey bee Species; identification and study of social biology; Bee pasturage; preparation of bee floral calendar; Bees conservation; honey harvest; Beehives, beekeeping equipments; Hiving feral Indian bee colony, site selection for apiary, visit to migratory bee keeping sites and commercial bee farm; Honey extraction, processing, purity testing and value addition; Hive inspection, maintenance of hive records, management in nectar flow season, dearth period, management of swarming, absconding and laying workers; Dividing, uniting bee colonies, artificial feeding, protecting bees from pesticides; Insect, mite and bird enemies of honeybees, brood and adult diseases; Methods of collection of bees' wax, bee pollen, propolis, bee venom, royal jelly; Marketing and economics of honey and bee products; preparation of bee keeping projects for bank funding

Text Books

1. Abrol D.P.(2011).Beekeeping – A comprehensive guide to bees and beekeeping. *Scientific Publishers, Jodhpur*, pp1-896.
2. Atwal, A.S. (2000). Essentials of Bee Keeping and Pollination. *Kalyani Publishers, Ludhiana*. pp1-394.
3. Tina Ranjan Das. (2006). Beekeeping with *Apis cerana indica* (in Tamil) Megens Jensens, Denmark, pp1-130.

Reference Books

1. Roger A. Morse, (1994). The new complete guide to beekeeping. *The Countryman Press, Woodstock, Vermont*, pp1-207.
2. Robert Owen. (2016). Australian bee keeping manual, Exisle Publishing, pp1-816.
3. Srivastava, K.P. and Dhaliwal, G.S. (2013). A text book of applied entomology, Volume 2. Kalyani Publishers, India, pp1-368.

Web References

1. https://www.studyandscore.com/studymaterial-detail/apiculture-introduction-bee-colony-and-bee-dance
2. https://www.slideshare.net/safeermanhas/apiculture-95442492
3. http://agritech.tnau.ac.in/farm_enterprises/fe_apiculture_home.html
4. https://youtu.be/qhzfT8iqplU
5. https://youtu.be/hvuZ1LQBTsc

Journals

1. Journal of Apicultural Research
2. The Journal of Apicultural Science

Course Nature: Only Practical			
Total Marks (100)			
S.No.	**Category**	**Assessment Tools**	**Marks**
1	*Practical-Internal*	*Purely internal based on the participation, involvement and contribution of students in the activities pertaining to the course*	
		Continuous evaluation of routine activities	*30*
		Execution skill and Product generation/ Competence	*20*
		Written test	*20*
		Record and Observation Note	*20*
		Viva-Voce	*05*
		Attendance	*05*
		Grand Total	***100***

Course Code	STR19805	Course Name	COMMERCIAL SERICULTURE	Course Category	E	*Student Ready-Experimental Learning Programme*	L	T	P	C
							0	0	10	10

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Crop Health-Sericulture	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1 :	*Understand the importance of silk*
CLR-2 :	*Attain skills for mulberry nursery production techniques*
CLR-3 :	*Gain skill for mulberry cultivation*
CLR-4 :	*Acquire knowledge about Chawki silkworm rearing techniques*
CLR-5 :	*Infer late age silkworm rearing and cocoon production techniques*
CLR-6 :	*To develop the potential for business entrepreneur*

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	*Discuss about the importance of silk*	*1*	*95*	*80*
CLO-2 :	*Establish mulberry saplings production unit*	*2*	*90*	*85*
CLO-3 :	*Able to establish a chawki silkworm rearing center*	*2*	*85*	*70*
CLO-4 :	*Develop a cocoon trading center.*	*1*	*80*	*75*
CLO-5 :	*Establish and demonstrate a seri clinic center*	*2*	*75*	*60*
CLO-6 :	*Gainconfidence as an entrepreneur*	*3*	*75*	*65*

Program Learning Outcomes (PLO)														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Agriculture Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	Ability to solve scientific problems	Ability to implement knowledge gained in the applied field of Business Management	Ability to understand social and ethical responsibilities
M			*L*					*M*	*H*		*H*	*L*	*H*	*H*
M	*L*		*M*					*L*	*H*		*H*	*L*	*H*	*H*
M	*L*							*L*	*H*		*H*	*M*	*H*	*H*
M	*M*							*M*	*H*		*H*	*L*	*H*	*H*
L		*M*						*M*	*H*		*H*	*M*	*H*	*H*
L	*L*	*M*		*L*		*H*		*M*	*H*		*H*	*L*	*H*	*H*

		Learning Unit / Module 1	Learning Unit / Module 2	Learning Unit / Module 3	Learning Unit / Module 4	Learning Unit / Module 5
Duration (week)		3	4	3	3	3
S-1	SLO-1	*Week 1-Introduction to sericulture*	*Week 5- Nursery plant protection measures, irrigation and weed management methods*	*Week 8- Mulberry main field irrigation and weed management and plant protection measures (Chawki and Late age silkworm mulberry field)*	*Week11- Chawki rearing methods*	*Week 14- Coccon harvest methods and cocoon market*
	SLO-2					
S-2	SLO-1	*Week 2- Nursery field preparation methods*	*Week 6- saplings uprooting and transporting system*	*Week 9- Mulberry leaf harvest and leaf preservation (Chawki and Late age silkworm mulberry field)*	*Week 12- Late age silkworm rearing methods*	*Week 15- Cost benefit analysis of mulberry cocoon production.*
	SLO-2					
S-3	SLO-1	*Week 3- Mother plant selection techniques*	*Week 7- Mulberry main field selection and preparation methods (Chawki and Late age silkworm mulberry field)*	*Week 10 – Selection and construction of Chawki and late age silkworm rearing house. Rearing tools and equipment's.*	*Week 13- silkworm pest and disease management*	*Week 16. - Exposure visit to different sericulture units..*
	SLO-2					
S-4	SLO-1	*Week 4- Nursery manure, bio-fertilizers and fertilizer application methods*	*Mulberry main field manures and fertilizers application (Chawki and Late age silkworm mulberry field)*	-	-	-
	SLO-2					

Learning Resources	**Text Books:**	**Reference Book:**
	1. Balavenkatasubbiah,M. MalReddy,N. Munirathnian Reddy, N. Rajashekar,K. and Sathish Verma.(2017).South zone mulberry sericulture, Central Sericultural Research and Training Institute, Mysuru. Pp. 1-89.	*1. Jolly, M.S., S.K. Sen, T.N. Sonwalkar and G.K. Prasad. (1978). Sericultural Manual, Food and Agriculture Organization, Rome, Pp. 1-450.*

	Level of Thinking	Final Internal Evaluation (100%)
Level 1	Remember	*20%*
	Understand	
Level 2	Apply	*40%*
	Analyze	
Level 3	Evaluate	*40%*
	Create	
	Total	*100%*

Course Designers		
Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
Mr.R.V.Vinothkumar *Vinayaga Chawki Rearing Center* *Manasipalliyam village* *Palladam (TK)* *Thirupur district* *Tamil Nadu* *Ph: +91 9942072679* *Email: jsacrc1970@gmail.com*	*Dr.R. Krishnan, Professor* *O/o the Dean (Agriculture)* *Tamil Nadu Agricultural University* *Coimbatore – 641003.* *Ph: + 9443209452*	*Dr.N.Murugan* *Assistsnt Professor, Sericulture*

Practical

Introduction to sericulture, Nursery field preparation methods, Manures and Fertilizers application methods, Mother plant selection, Mulberry cutting preparation, Pre-treatments, Plant protection techniques, uprooting, Transport. Main field – primary & secondary tillage equipment's, Field preparation methods, Manures and Fertilizers application, Planting methods, Irrigation methods, Fertigation, weeding methods, Plant Protection methods, Pruning techniques, Harvesting. Leaf Harvest method, Leaf preservation techniques, shoot harvest method. Mulberry pests and diseases, Management Practices. Rearing house, site selection, types, Environmental condition. Silkworm rearing tools and equipment's, disinfectants. Chawki and Late age worms rearing, mounting, cocoon harvest, cocoon market. Silkworm pests and Diseases. Their management practices. Visit to Chawki Rearing Center, Late age worms rearing unit and cocoon market. Final Examination.

Reference Books

1. Balavenkatasubbiah, M. Mal Reddy, N. Munirathnian Reddy, N. Narendrakumar,J.B. Rajashekar,K. and Sathish Verma.(2017).South zone mulberry sericulture, Central Sericultural Research and Training Institute, Mysuru. Pp. 1-89.
2. Sivaprasath, VHimanatharaj, M.T. Sathish Verma and Mogali, T. (2015). Commercial Chawki Rearing, Central Sericultural Research and Training Institute, Mysuru. Pp. 1-54.
3. Sureshkumar, N. Singh, H. and A.K.Singh. (2015). A text book on silkworm rearing Technology, Central Silk Board, Bengaluru, Pp. 1-360.
4. Singh, T. and Saratchandra, B. (2004). Principles and techniques of silkworm seed production. Discovery publishing house, New Delhi, Pp. 1-360.

Journals

1. Indian Silk.
2. Indian Journal of Sericulture
3. Seridoc

Course Nature: Only Practical			
Total Marks (100)			
S.No.	**Category**	**Assessment Tools**	**Marks**
1	*Practical-Internal*	*Purely internal based on the participation, involvement and contribution of students in the activities pertaining to the course*	
		Continuous evaluation of routine activities	*30*
		Execution skill and Product generation/ Competence	*20*
		Written test	*20*
		Record and Observation Note	*20*
		Viva-Voce	*05*
		Attendance	*05*
		Grand Total	***100***

Course Code	STR19806	Course Name	SOIL, PLANT, WATER, MANURE AND FERTILIZERS TESTING	Course Category	S	*Student Ready-Experimental Learning Programme*	L	T	P	C
							0	0	10	10

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Soil Science		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	***The purpose of learning this course is to:***	**Learning**		
		1	2	3
CLR-1 :	*Outline the sampling techniques involved in soil water and plant samples*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-2 :	*Learn about problematic soils and its reclamation.*			
CLR-3 :	*Identify the plant nutritional deficiencies.*			
CLR-4 :	*Describe the quality and standards of irrigation water.*			
CLR-5 :	*Perform the soil and water health management practices.*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*			
CLO-1 :	*List out the common analytical reagents used for the analysis of soil, plant, water, manure and fertilizer testing.*	*1*	*90*	*80*
CLO-2 :	*Describe the analytical procedures followed in the laboratory.*	*1*	*90*	*80*
CLO-3 :	*Calculate the analytical data based on analytical procedures.*	*2*	*95*	*85*
CLO-4 :	*Interpret the analytical data for prescribing the fertilizers*	*3*	*85*	*75*
CLO-5 :	*Apply the technology to maintain the irrigation water quality*	*3*	*80*	*70*

Program Learning Outcomes (PLO)															
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Agriculture Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	Ability to solve scientific problems	Ability to implement knowledge gained in the applied field of Business Management	Ability to understand social and ethical responsibilities
H					*L*			*M*	*H*		*H*	*H*	*H*	*H*
M					*L*			*M*	*H*		*H*	*H*	*H*	*H*
H	*M*	*M*	*M*		*L*			*M*	*H*		*H*	*H*	*H*	*H*
M					*M*			*M*	*H*		*H*	*H*	*H*	*H*
M	*M*				*M*			*L*	*H*		*H*	*H*	*H*	*H*

		Learning Unit / Module 1	Learning Unit / Module 2	Learning Unit / Module 3	Learning Unit / Module 4	Learning Unit / Module 5
Duration (hour)		**3**	**3**	**3**	**4**	**3**
S-1	SLO-1	*Good laboratory practices: Do's and Don'ts*	*Soil texture – feel method*	*Determination of soil pH, EC, CEC*	*Determination of major plant nutrients*	*Fertilizer recommendation for crops; Software usage*
	SLO-2	*Principles of analytical chemistry*	*Soil texture – international pipette method*	*Estimation of soil organic carbon*	*Determination of minor plant nutrients*	*Soil health: productivity and fertility index*
S 2	SLO-1	*Instrumentation techniques*	*Soil density*	*Estimation of soil macro and micro nutrients*	*Physio-chemical analysis of organic manures*	*Soil health management plan*
	SLO-2	*Instrument usage*	*Soil colour*	*Estimation of lime and gypsum requirement*	*Analysis of major and minor nutrients of organic manures*	*Soil clinic: roles, functions, startup procedures*
S-3	SLO-1	*Sample collection*	*Soil moisture*	*Water quality assessment*	*Identifying, detecting and sampling of fertilizers*	*Soil health card preparation*
	SLO-2	*Processing and storage*	*Soil temperature*	*Standards of irrigation water*	*Analysis of nitrate fertilizers*	*Project set up (pilot project) and report*
S 4	SLO-1				*Analysis of phosphate and potassic fertilizers*	
	SLO-2				*Analysis of micronutrient fertilizers*	

Learning Resources	1. *Durai, M.V. (2014). Handbook of soil, plant, water, fertilizer and manure analysis. New India publishing Agency.pp. 1 - 245.* 2. *Piper, C.S. (2014). Soil and Plant analysis. Scientific Publishers. pp. 1 - 368.*

	Level of Thinking	Final internal Examination (100%)
Level 1	Remember	*20 %*
	Understand	
Level 2	Apply	*40 %*
	Analyze	
Level 3	Evaluate	*40 %*
	Create	
	Total	*100 %*

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Mr. S. Suresh *Senior Agricultural Officer, STL, Kanchipuram.*	*Dr. M.V. Sriramachandrasekharan* *Professor (SSAC), Annamalai University, Annamalainagar – 608002.*	*Dr. R. Angelin Silviya* *Dr. S.N. Chikkaraju*

Practical Schedule

Good laboratory practices (GLP): Do's and Don'ts in a soil chemical laboratory and first aid in a laboratory. Principles of analytical chemistry: concepts, preparation of standard solutions and standardization. Soil, plant, water, manure and fertilizer analysis – importance, objectives and instrumentation principles; Sample collection, processing, storage and analytical techniques; Soil health management: Definition and concept; Measures of soil health: Physically, chemical and biological properties of soil; Soil health index: productivity index and soil quality/fertility index; Cause of soil quality deterioration; Soil health management plan; Strategies of soil health management; Soil clinic – start up procedure, its role, functions, importance, funding sources; Soil health card preparation.

Text books

1. Durai, M.V. (2014). Handbook of soil, plant, water, fertilizer and manure analysis. New India publishing Agency. pp. 1 - 245.
2. Hesse, P.R. (2002). A textbook of soil chemical analysis. CBS Publishers and Distributors.pp. 1 - 520.
3. Jaiswal, P.C. (2006). Soil, Plant and Water Analysis (2nd ed.). Ludhiana: Kalyani Publishers. pp. 1 - 450.
4. Manikandan K., S. Thiyageswari and J. Prabhaharan. (2016). Beginner's guide to Analytical Chemistry (1st ed.). New Delhi: Jain Brother. pp. 1 - 223.
5. Motsara, M.R and R.N. Roy. (2008). Guide to laboratory establishment for plant nutrient analysis. FAO fertilizer and plant nutrition bulletin, FAO. pp. 1 - 203.

Reference books

1. Jackson, M.L. (1967). Soil Chemical Analysis. Oxford and IBH Publishing Co., pp. 1 - 498.
2. Piper, C.S. (2014). Soil and Plant analysis.. Scientific Publishers. pp. 1 - 368.
3. Singh, K.K., Asha, J, Singh, A.K and Alka, T. (2007). Air, water and soil pollution. Kalyani Publishers.pp. 1 - 445.
4. Tandon, H.L.S. (2013). Methods of analysis of soil, plant, water and fertilizers. New Delhi: FDCO. pp. 1 - 143.
5. Umkovich, M.J., Pate, J.S and Neil, A.M. (2010). Stable isotope techniques in the study of biological processes and functioning of Ecosystem. Springer. pp. 1 - 293.

Web references

1. http://ecoursesonline.iasri.res.in/course/view.php?id=584
2. https://www.intechopen.com/books/metals-in-soil-contamination-and
3. remediation/radioactive- isotopes-in-soils-and-their-impact-on-plant-growth
4. https://ag.umass.edu/cafe/nifa-planned-extension-initiatives/soil-fertility- nutrient management
5. https://youtu.be/Al1v-jARhLM
6. tps://youtu.be/qoSvbbd1d18o

Journals

1. Soil Science and Plant Nutrition
2. International journal of Plant and Soil Sciences
3. Communications in Soil Sciences and plant analysis
4. Journal of environmental radioactivity
5. Water, Air and Soil pollution

Course Nature: Only Practical			
Total Marks (100)			
S.No.	**Category**	**Assessment Tools**	**Marks**
1	Practical-Internal	*Purely internal based on the participation, involvement and contribution of students in the activities pertaining to the course*	
		Continuous evaluation of routine activities	*30*
		Execution skill and Product generation/ Competence	*20*
		Written test	*20*
		Record and Observation Note	*20*
		Viva-Voce	*05*
		Attendance	*05*
		Grand Total	*100*

Course Code	STR19807	Course Name	COMMERCIAL SEED PRODUCTION	Course Category	E	*Student Ready-Experimental Learning Programme*	L	T	P	C
							0	0	10	10

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Genetics and Plant Breeding	Data Book / Codes/Standards		Nil	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1 :	*Attain knowledge on types and characteristic features of seeds.*
CLR-2 :	*Learn about commercial seed production techniques*
CLR-3 :	*Learn about commercial hybrid test through both phenotypic and genotypic manner.*
CLR-4 :	*Acquire knowledge on DNA markers in commercial seed production*
CLR-5 :	*Infer about genetics of seeds and maintenance*

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	*Explain about and handle parental lines*	*1*	*95*	*80*
CLO-2 :	*Select parental lines and their proportion of raising for hybridization*	*2*	*90*	*85*
CLO-3 :	*Demonstarte emasculation and pollination techniques of commercial hybrid development*	*2*	*85*	*70*
CLO-4 :	*Perform extraction of seeds from fruits*	*1*	*75*	*65*

Program Learning Outcomes (PLO)														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Agriculture Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	Ability to solve scientific problems	Ability to implement knowledge gained in the applied field of Business Management	Ability to understand social and ethical responsibilities
M			*L*					*M*	*H*		*H*	*L*	*H*	*H*
M			*M*					*L*	*H*		*H*	*L*	*H*	*H*
M								*L*	*H*		*H*	*M*	*H*	*H*
M	*M*							*M*	*H*		*H*	*L*	*H*	*H*

		Learning Unit / Module 1	Learning Unit / Module 2	Learning Unit / Module 3	Learning Unit / Module 4	Learning Unit / Module 5
Duration (Week)		8	6	6	6	6
S-1	*SLO-1*	*Week 1- Introduction to varieties their characteristic features for quality seed production; resistant, tolerance, adaptability, crossability, combining ability, yield*	*Week 5 – Male sterility and incompatibility system in hybrid seed production, development and maintenance of A, B and R lines*	*Week 8 Methods of synchronizing flowering in parental lines; staggered sowing*	*Week 11- Salient features of hybrid seed production in sorghum and bajra*	*Week 14 Extraction and post-harvest handling of hybrid seeds*
	SLO-2					
S-2	*SLO-1*	*Week 2- Seed quality concept and importance of genetic purity in seed production; their maintenance in self, cross pollinated crops and factors responsible for genetic deteriorat*	*Week 6- Use of chemical hybridizing agents. Role of pollinators and their management*	*Week 9 - Emasculation, pollination, covering and tagging process in hybrid generation in crops*	*Week 12 - Salient features of hybrid seed production in maize, sunflower, cotton and other major vegetables*	*Week 15 - Hybrid test; GOT*
	SLO-2					
S-3	*SLO-1*	*Week 3- Seed production in self and cross pollinated crops*	*Week 7- Sowing strategies for the parents; sequence of plant rows, ratio and population density in relation to hybrid seed yield*	*Week 10- Salient features of hybrid seed production in rice*	*Week 13- Identification of fruit confined with perfect cross pollination and harvesting*	*Week 16 - DNA markers for hybrid confirmation*
	SLO-2					
S-4	*SLO-1*	*Week 4- Artificial modifications of reproductive system and structure according to pollination mechanisms for hybrid seed production*	-	-	-	-
	SLO-2					

Learning Resources	1. *Agrawal, R.L. (2008). Seed Technology. New Delhi : Oxford & IBH Publishing Co. pp. 1- 821.* 2. *Dharmendra Jat, Sai Prasad, S. V. & Sheela Verma. (2014). Seed Science and Technology (2nd ed.) New Delhi: New Vishal Publications. pp. 1- 304.* 3. *3. Khare, D . (2014). Seed Technology (2nd ed.). Jodhpur: Scientific Publishers India. pp. 1- 944.*

	Level of Thinking	**Final Internal Evaluation (100%)**
Level 1	Remember Understand	*20%*
Level 2	Apply Analyze	*40%*
Level 3	Evaluate Create	*40%*
	Total	***100%***

Course Designers		
Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
Dr. S M .Prabhu, Ph. D. *Senior Breeder (Paddy Breeding and Transgenic)* *R&D centre,* *Rasi Seeds (P) Ltd., Attur, Salem – 636141.*	*Dr. T. Sabesan* *Associate rofessor* *Department of Genetics and Plant Breeding* *Faculty of Agriculture, Annamalai University,* *Annamalai nagar , Chidambaram - 608 002* *sabavani@gmail.com*	*Dr. G. Selvakumar ,* *Assistant Professor, Plant Breeding & Genetics* *Dr. R. Mahendran,* *Assistant Professor, Plant Breeding & Genetics* *Dr. J. Vanitha,* *Tutorr, Plant Breeding & Genetics*

Practical Schedule

1. Introduction to varieties their characteristic features for quality seed production; resistant, tolerance, adaptability, crossability, combining ability, yield
2. Seed quality concept and importance of genetic purity in seed production; their maintenance in self, cross pollinated crops and factors responsible for genetic deterioration
3. Seed production in self and cross pollinated crops
4. Artificial modifications of reproductive system and structure according to pollination mechanisms for hybrid seed production
5. Male sterility and incompatibility system in hybrid seed production, development and maintenance of A, B and R lines
6. Use of chemical hybridizing agents. Role of pollinators and their management
7. Sowing strategies for the parents; sequence of plant rows, ratio and population density in relation to hybrid seed yield
8. Methods of synchronizing flowering in parental lines; staggered sowing
9. Emasculation, pollination, covering and tagging process in hybrid generation in crops
10. Salient features of hybrid seed production in rice
11. Salient features of hybrid seed production in sorghum and bajra
12. Salient features of hybrid seed production in maize, sunflower, cotton and other major vegetables
13. Identification of fruit confined with perfect cross pollination and harvesting
14. Extraction and post-harvest handling of hybrid seeds
15. Hybrid test; GOT
16. DNA markers for hybrid confirmation

Text Books

1. Agrawal, R.L. (2008). *Seed Technology.* New Delhi : Oxford & IBH Publishing Co. pp. 1- 821.
2. Dharmendra Jat, Sai Prasad, S. V. & Sheela Verma. (2014). *Seed Science and Technology* (2nd ed.) New Delhi: New Vishal Publications. pp. 1- 304.
3. Khare, D. (2014). *Seed Technology* (2nd ed.). Jodhpur: Scientific Publishers India. pp. 1- 944.
4. Padmavathi, S. (2012). *A Text Book of Seed Science and Technology.* New Delhi: New India Publishing Agency. pp. 1- 282.

Reference Books

1. Basra, A. S. (2006). *Handbook of Seed Science and Technology.* New York: Food Products Press. pp. 1- 749.
2. Lawrence O. Copeland & Miller McDonald. (2001). *Principles of Seed Science and Technology.* USA: Springer Science. pp. 1- 390.
3. Sreenivas, Y. S. (2009). *Seed Production of Commercial Vegetables.* Oxford: Oxford Book Company. pp. 1- 325.
4. Subir Sen & Nabinananda Ghosh. (2012). *Seed Science and Technology.* New Delhi: Kalyani Publishers. pp. 1- 277.
5. Vanangamudi, K., Prabhu, M. & Bhaskaran. (2010). *Vegetable Hybrid Seed Production and Management.* InIdia*:* Agrobios. pp. 1- 339.

Web-References

1. https://agro.au.dk/en/research/research-areas/seed-science-and-technology/
2. www.seednet.gov.in
3. https://www.fabinet.up.ac.za/index.php/research-groups/seed-science

Journals

1. Seed Science Research
2. Research Journal of Seed Science
3. Advanced Journal of Seed Science and Technology
4. Journal of Seed Science - Scimago

Course Nature: Practical			
Total Marks (100)			
S.No.	**Category**	**Assessment Tools**	**Marks**
1	Practical-Internal	*Purely internal based on the participation, involvement and contribution of students in the activities pertaining to the course*	
		Continuous evaluation of routine activities	*30*
		Execution skill and Product generation/ Competence	*20*
		Written test	*20*
		Record and Observation Note	*20*
		Viva-Voce	*05*
		Attendance	*05*
		Grand Total	***100***

Course Code	STR19808	Course Name	COMMERCIAL HORTICULTURE	Course Category	E	*Student Ready-Experimental Learning Programme*	L	T	P	C
							0	0	10	10

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	*Nil*
Course Offering Department	Horticulture			Data Book / Codes/Standards	*Nil*

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	*Learn the basic knowledge on propagation*			
CLR-2 :	*Gain knowledge on use of media and container in plant propagation*			
CLR-3 :	*Attain knowledge about different propagation methods*			
CLR-4 :	*Acquire technical knowledge on the propagation structures and rootstocks in plant multiplication*			
CLR-5 :	*Acquire skills on the establishment micropropagation unit*			
CLR-6 :	*Develop practice on commercial multiplication of horticultural crops*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	*Exhibit skills on the planning and layout of commercial nursery*	*2*	*95*	*80*
CLO-2 :	*Demonstrate he commercial propagation methods*	*2*	*90*	*85*
CLO-3 :	*Perform multiplication of horticultural plants*	*1*	*85*	*70*
CLO-4 :	*Apply independent skills to manage pest and disease in nursery plants*	*2*	*75*	*65*
CLO-5 :	*Expertise in manage horticultural nurseries*	*1*	*75*	*60*
CLO-6 :	*Establish a commercial nursery*	*3*	*75*	*65*

		Program Learning Outcomes (PLO)														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Agriculture Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	Ability to solve scientific problems	Ability to implement knowledge gained in the applied field of Business Management	Ability to understand social and ethical responsibilities
CLO-1 :	*Exhibit skills on the planning and layout of commercial nursery*	*M*		*H*				*H*		*M*	*H*		*H*	*H*	*H*	*H*
CLO-2 :	*Demonstrate he commercial propagation methods*	*H*				*H*		*H*		*L*	*H*		*H*	*H*	*H*	*H*
CLO-3 :	*Perform multiplication of horticultural plants*	*H*				*H*		*H*		*L*	*H*		*H*	*H*	*H*	*H*
CLO-4 :	*Apply independent skills to manage pest and disease in nursery plants*	*M*	*M*					*L*		*M*	*H*		*H*	*H*	*H*	*H*
CLO-5 :	*Expertise in manage horticultural nurseries*	*H*	*M*					*H*		*M*	*H*		*H*	*H*	*H*	*H*
CLO-6 :	*Establish a commercial nursery*	*L*		*H*		*H*				*M*	*H*		*H*	*H*	*H*	*H*

		Learning Unit / Module 1	Learning Unit / Module 2	Learning Unit / Module 3	Learning Unit / Module 4	Learning Unit / Module 5
Duration (hour)		**40**	**30**	**30**	**30**	**30**
S-1	SLO-1	*Site selection and basic criteria for set up a new nursery for production of fruit seedlings and planting materials.*	*Certification, packaging and marketing quality control for planting materials produced in fruit nursery.*	*Management and maintenance of ornamental nursery.*	*Study of protected cultivation of flowers.*	*Post-harvest handling of flowers and vegetables*
	SLO-2					
S-2	SLO-1	*Raising of quality rootstocks of different fruit crops for grafting.*	*Ornamental nursery establishment – Site selection – basic criteria – study about suitable environmental factors.*	*Sale and marketing of produced planting materials and potted plants to create income generation.*	*Practicing nursery raising/procurement and transplanting in horticultural crops.*	*Quality control and marketing of planting materials produced in the nursery*
	SLO-2					
S-3	SLO-1	*Practicing of different types of grafting and budding in fruit crops*	*Practicing of different types of propagation methods / multiplication of plantlets and potted plants.*	*Study of protected cultivation of vegetables and different types of protected structures for different vegetables.*	*Management and maintenance of protected cultivation of vegetables and flowers.*	*Visit to commercial / local nurseries.*
	SLO-2					
S-4	SLO-1	*Studies of various management practices in grafted plants*	-	-	-	-
	SLO-2					

Learning Resources	
	1. *Hartmann, H.T., D.E. Kester, F.T. Davies and R.L. Greneve. (1997). Plant propagation – Principles and Practices. Prentice Hall of India Private Ltd., New Delhi. pp 1-869*
	2. *Peter, K.V., S. Rajan and Baby Lissy Markose. (2007). Propagation of Horticultural. Crops. Horticulture Science Series – 6. New India Publishing Agency. pp 1-263*

	Level of Thinking	Final Internal Evaluation (100%)
Level 1	Remember	*20%*
	Understand	
Level 2	Apply	*50%*
	Analyze	
Level 3	Evaluate	*30%*
	Create	
	Total	*100%*

Course Designers		
Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
		Dr. Gopu *Assistatn Professor* *Mr. Harish. A* *Tutor* *Mrs. Kanimozhi. C* *Tutor*

Practical

Nursery production of fruit crops: Raising of rootstocks, grafting and budding of rootstocks, management of grafted plants, plant certification, packaging and marketing, quality control. Nursery production of ornamentals: Production of plantlets, production of potted plants, management and maintenance, sale and marketing. Protected cultivation of vegetables and flowers: Nursery raising/procurement and transplanting, management and maintenance of the crop, postharvest handling, quality control and marketing.

Practical schedule

1. Site selection and basic criteria for setting up a new nursery for production of fruit seedlings and planting materials.
2. Raising of quality rootstocks of different fruit crops for grafting.
3. Practicing of different types of grafting and budding in fruit crops
4. Studies of various management practices in grafted plants
5. Certification, packaging and marketing quality control for planting materials produced in fruit nursery.
6. Ornamental nursery establishment – Site selection – basic criteria – study about suitable environmental factors.
7. Practicing of different types of propagation methods / multiplication of plantlets and potted plants.
8. Management and maintenance of ornamental nursery.
9. Sale and marketing of produced planting materials and potted plants to create income generation.
10. Study of protected cultivation of vegetables and different types of protected structures for different vegetables.
11. Study of protected cultivation of flowers.
12. Practicing nursery raising/procurement and transplanting in horticultural crops.
13. Management and maintenance of protected cultivation of vegetables and flowers.
14. Post-harvest handling of flowers and vegetables
15. Quality control and marketing of planting materials produced in the nursery
16. Visit to commercial / local nurseries.

Text Books

1. Hartmann, H.T., D.E. Kester, F.T. Davies and R.L. Greneve. (1997). Plant propagation – Principles and Practices. Prentice Hall of India Private Ltd., New Delhi. pp 1-869
2. Joe.J.Hanan. (1998). Green houses: Advanced Technology for Protected Horticulture, CRC Press, LLC. Florida. pp 1-720
3. Peter, K.V., S. Rajan and Baby Lissy Markose. (2007). Propagation of Horticultural. Crops. Horticulture Science Series – 6. New India Publishing Agency. pp 1-263

Reference Books

1. Prasad, S. and U. Kumar. (2005). Greenhouse management for horticultural crops. 2nd ed. Agrobios. pp 1-500
2. Tiwari, G.N. (2003). Green house technology for controlled environment. Narosa Publ. House. pp 1 – 547

Web-References

1. www.icar.org.in/ciphet.html
2. www.jains.com
3. www.gisdevelopment.net
4. www.lasercladding.com
5. www.epa.gov.
6. https://www.youtube.com/watch?v=qXdw-hBiu1A

Journals

1. Hort. Science
2. Horticultural Technology
3. Floriculture Today
4. Hi-tech Horticulture
5. Acta Horticulture

Course Nature: Practical			
Total Marks (100)			
S.No.	**Category**	**Assessment Tools**	**Marks**
1	Practical-Internal	*Purely internal based on the participation, involvement and contribution of students in the activities pertaining to the course*	
		Continuous evaluation of routine activities	*30*
		Execution skill and Product generation/ Competence	*20*
		Written test	*20*
		Record and Observation Note	*20*
		Viva-Voce	*05*
		Attendance	*05*
		Grand Total	***100***

Course Code	STR19809	Course Name	FLORICULTURE AND LANDSCAPE ARCHITECTURE	Course Category	E	Student Ready-Experimental Learning Programme	L	T	P	C
							0	0	10	10

Pre-requisite Courses	Nil	Co-requisite Courses	Rural Agricultural Work Experience	Progressive Courses	Nil
Course Offering Department	*Horticulture*		**Data Book / Codes/Standards**	*Nil*	

Course Learning Rationale (CLR):	***The purpose of learning this course is to:***
CLR-1 :	*Acquire skills on Landscaping.*
CLR-2 :	*Gain knowledge on use of softwares in designing.*
CLR-3 :	*Share knowledge on the flowering crops*
CLR-4 :	*Categorise different styles of Gardening*
CLR-5 :	*To learn skills on the establishment of hedges and edges in garden.*
CLR-6 :	*Acquire knowledge about establishment of Lawn making*

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	**Learning**		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	*Practice, gain confidence and competence in establishment of Garden designs.*	*3*	*90*	*80*
CLO-2 :	*Distinguish the plant and non plant components*	*3*	*95*	*85*
CLO-3 :	*Practice landscaping styles.*	*3*	*85*	*65*
CLO-4 :	*Identify the ornamental crops*	*1*	*80*	*70*
CLO-5 :	*Define Turfing*	*2*	*75*	*60*
CLO-6 :	*Analyze Project Report for landscaping designs*	*3*	*80*	*70*

Program Learning Outcomes (PLO)														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Agriculture Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	Ability to solve scientific problems	Ability to implement knowledge gained in the applied field of Business Management	Ability to understand social and ethical responsibilities
M	*M*	*H*	*H*	*M*		*H*	*L*	*L*	*H*		*H*	*H*	*H*	*H*
H	*M*	*H*	*H*	*L*		*H*	*L*	*L*	*H*		*H*	*H*	*H*	*H*
L	*H*	*H*	*H*	*M*		*H*	*M*	*L*	*H*		*H*	*H*	*H*	*H*
L	*H*	*H*	*H*	*M*		*H*	*L*	*L*	*H*		*H*	*H*	*H*	*H*
H	*H*	*H*	*M*	*L*		*H*	*M*	*M*	*H*	*L*	*H*	*H*	*H*	*H*
H	*L*	*H*	*M*	*H*		*H*	*M*	*M*	*H*	*H*	*H*	*H*	*H*	*H*

		Learning Unit / Module 1	**Learning Unit / Module 2**	**Learning Unit / Module 3**	**Learning Unit / Module 4**	**Learning Unit / Module 5**
Duration (hour)		**40**	**30**	**30**	**30**	**30**
S-1	SLO-1	*Pract 11: Preparation of project report, soil and water analysis, preparation of land and layout.*	*Pract 5:Harvesting and post harvest handling of produce*	*Pract 8: Institutional Management*	*Pract 11:Planning and designing, site analysis, selection and use of plant material for landscaping*	*Pract 14:Making of lawns, use of software in landscape*
	SLO-2					
S-2	SLO-1	*Pract 2:Plant materials for landscaping and their identification –Plant components*	*Pract 6: Marketing of produce*	*Pract 9:Visit to Flower growing areas and Export House*	*Pract12:Formal and informal garden, features, styles, principles and elements of landscaping*	*Pract 15:Making of bouquets, button hole, wreath, veni and festoons, car and marriage hall decoration*
	SLO-2					
S-3	SLO-1	*Pract 3:Study of various features of an ornamental garden with suitable plants and identification of plants for each feature.*	*Pract 7: Cost Analysis*	*Pract 10Attachment with private landscape agencies*	*Pract13:Preparation of landscape plans of home gardens, farm complexes, public parks, institutions, high ways, dams and avenues.*	*Pract 16:Dry flower Technology*
	SLO-2					
S-4	SLO-1	*Pract 4:Production and Management of commercial flowers*	-	-	-	-
	SLO-2					

Learning Resources	1. *Arora, J.S. (2006). Introductory Ornamental Horticulture.(pp.1-188). Ludhiana: Kalyani Publishers.* 2. *Bhattacharjee,S.K. (2004). Landscape Gardening and Design with plants. Jaipur,: Aavishkar Publishers and Distributers..*

	Level of Thinking	Final internal Examination (100%)
Level 1	Remember	*20 %*
	Understand	
Level 2	Apply	*40 %*
	Analyze	
Level 3	Evaluate	*40 %*
	Create	
	Total	*100 %*

Course Designers		
Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
Gorthi Nagarjuna Naidu General manager (Tanflora) naidugorthi@gmail.com	Dr. Arumugam Head of department TNAU Periyakulam	*Dr. B. Gopu* *Assistant Professor* *Mrs. C. Kanimozhi* *Tutor*

Practical

Preparation of project report, soil and water analysis, preparation of land and layout-Production and Management of commercial flowers- Harvesting and postharvest handling of produce-Marketing of produce, Cost Analysis, Institutional Management- Visit to Flower growing areas and Export House, Attachment with private landscape agencies-Planning and designing, site analysis, selection and use of plant material for landscaping-Formal and informal garden, features, styles, principles and elements of landscaping- Preparation of landscape plans of home gardens, farm complexes, public parks, institutions, high ways, dams and avenues- Making of lawns, use of software in landscape.-Making of bouquets, button hole, wreath, veni and gazaras, car and marriage palaces-Dry flower Technology.

Text Books

1. Arora, J.S. (2006). Introductory Ornamental Horticulture. Ludhiana: Kalyani Publishers. .(pp.1-188).
2. Bhattacharjee,S.K. (2004). Landscape Gardening and Design with plants.
3. Jaipur, Aavishkar Publishers and Distributers.
4. Dharmendra Kaulani and Arati Joshi.(2018). A textbook of Ornamental Horticulture. Nepal: Heritage Publishers.
5. Peter.K.V (2009). Ornamental plants. New Delhi: New India publishing agency.
6. Prasad, S. and Kumar, U. (2013). A hand book of Floriculture. Jodhpur: Agrobios. (pp.1-654).

Reference Books

1. Karuppaiah, P. and Manivannan, K.(2018). Ornamental Horticulture. Jodhpur: Agrobios. (pp.1-648).
2. Supriya Kumar Bhattacharjee.(2006). Ornamental Crop Production Technology Jaipur: Pointer Publisher. .(pp.1-344).
3. Supriya Kumar Bhattacharjee.(2005). Flowering Shrubs and Seasonal Ornamentals. Jaipur: Pointer Publisher. .(pp. 1-359).
4. Suresh K Malhotra Lallan Ram .(2017). Advances in Floriculture and Landscape Gardening. Nagaland :Central Institute of Horticulture. (pp.1 - 322).
5. Tiwari, A.K. (2012). Fundamentals of Ornamental Horticulture and Landscape Gardening. New Delhi: NIPA. (pp.1 – 588).

Web references

1. www.bestgarden.net
2. www.indiaagronet.com
3. www.intuxford.tripod.com
4. www.webct.uark.edu
5. www.personal.psu.edu
6. www.sunny.crk.umn.edu/courses
7. www.lawngrasses.com
8. www.mediatoday@vsnl.com
9. www.hsi1942.org

Journals

1. Journal of ornamental Horticulture.
2. Journal of Floriculture and Landscaping.
3. Indian Journal of Horticulture.
4. The American Journal of Horticulture and Floriculture Research.
5. International journal of Horticulture and Floriculture.

Course Nature: Only Practical			
Total Marks (100)			
S.No.	**Category**	**Assessment Tools**	**Marks**
1	Practical-Internal	*Purely internal based on the participation, involvement and contribution of students in the activities pertaining to the course*	
		Continuous evaluation of routine activities	*30*
		Execution skill and Product generation/ Competence	*20*
		Written test	*20*
		Record and Observation Note	*20*
		Viva-Voce	*05*
		Attendance	*05*
		Grand Total	***100***

Course Code	STR19810	Course Name	PROTECTED CULTIVATION OF HIGH VALUE HORTICULTURE CROPS	Course Category	E	Student Ready-Experimental Learning Programme	L	T	P	C
							0	0	10	10

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Horticulture			Data Book / Codes/Standards	Nil

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	Gain knowledge on special practices in horticulture crops			
CLR-2 :	Infer technical knowledge on protected cultivation of cut flowers			
CLR-3 :	Gain information on cultivation systems and practices followed in green house cultivation			
CLR-4 :	To attain technical knowledge about micro irrigation system			
CLR-5 :	Learn about technical knowledge about Hi tech vegetable nursery production			
CLR-6 :	Appraise about postharvest handling			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	Explain the skills to manage protected cultivation	3	95	80
CLO-2 :	Imparting skills of emasculation and pollination in vegetable crops	2	90	85
CLO-3 :	Ability in large scale production of cut flowers	3	85	70
CLO-4 :	Elaborate about the quality control and postharvest technology	3	75	65
CLO-5 :	Establish hi-tech vegetable nursery production	3	75	60
CLO-6 :	Create a commercial protected cultivation unit	3	75	65

Program Learning Outcomes (PLO)															
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Agriculture Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	Ability to solve scientific problems	Ability to implement knowledge gained in the applied field of Business Management	Ability to understand social and ethical responsibilities
M			L					M	H		H	L	H	H
M			M					L	H		H	L	H	H
M								L	H		H	M	H	H
M	M							M	H		H	L	H	H
L								M	H		H	M	H	H
L	L	M		L		H		M	H		H	L	H	H

		Learning Unit / Module 1	Learning Unit / Module 2	Learning Unit / Module 3	Learning Unit / Module 4	Learning Unit / Module 5
Duration (hour)		40	30	30	30	30
S-1	SLO-1	Study of different media	Preparation of seed beds	Addition of manures of fertilizers	Visit to commercial polyhouses	Study of grading – pre-cooling – holding solutions for enhancement of vase life
	SLO-2					
S-2	SLO-1	Study of solarization	Study of jiffy bags	Practice of special horticultural techniques, Training and pruning techniques	Study of pollination techniques	Study of different types of packaging materials, storage methods
	SLO-2					
S-3	SLO-1	Preparation of beds	Study of climate management techniques	Study of fertigation techniques	Study of harvesting techniques	Visit to export houses, Market intelligence, marketing of produce, cost analysis, institutional management.
	SLO-2					
S-4	SLO-1	Fixing of supports	-	-	-	-
	SLO-2					

Learning Resources	
	1. Prasad, S. and U. Kumar. (2005). Greenhouse management for horticultural crops. 2nd ed. Agrobios. pp 1-500
	2. Paul V. Nelson. (1991). Greenhouse operation and management. Ball publishing USA. pp 1-512

	Level of Thinking	Final Internal Evaluation (100%)
Level 1	Remember	*20%*
	Understand	
Level 2	Apply	*50%*
	Analyze	
Level 3	Evaluate	*30%*
	Create	
	Total	*100%*

Course Designers		
Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
		Mr. Harish. A Tutor

Practical

Visit to commercial poly houses, Project preparation and planning. Specialized lectures by commercial export house. Study of designs of green- house structures for cultivation of crops. Land preparation and soil treatment. Planting and production: Visit to export houses; Market intelligence; Marketing of produce; cost analysis; institutional management. Report writing and viva-voce.

Practical schedule

1. Study of different media, organic – soilless – synthetic media. Preparation of different media mixtures for cultivation of Roses, Caranation, Chrysanthemum, Gerbera, Anthurium and Orchids.
2. Study of solarization – fumigation of polyhouses – methods of fumigation
3. Preparation of beds for growing cut flower crops and vegetables in polyhouses
4. Fixing of supports – trellies, arrangement of net supports – study of different types of nets Materials used for preparation of nets
5. Preparation of seed beds – poly trays – for raising nursery seedlings of capsicum, cucumber and tomato
6. Study of jiffy bags – propagation techniques of Roses, Gerbera, Carnation, Orchid Anthuriums and Chrysanthemum. Study of corms and cormels. Dormancy breaking techniques of Gladiolus
7. Study of climate management techniques – practices to manipulate the climate in polyhouses
8. Addition of manures of fertilizers – planting techniques of cut flower crops and vegetables
9. Practice of special horticultural techniques like pinching disbudding – deshooting – deleafing in cut flowers and vegetables, Training and pruning techniques in cut flower crops and vegetables
10. Study of fertigation techniques – Identification of different soluble fertilizers and their composition. Preparation of stock solutions. Practice fertigation in polyhouse grown crops
11. Visit to commercial polyhouses around colleges, Project preparation and planning. Specialized lectures by commercial export house.
12. Study of pollination techniques – Different methods of pollination – practice pollination in capsicum and tomato
13. Study of harvesting techniques for different purposes in cut flowers and vegetables.
14. Study of grading – pre-cooling – holding solutions for enhancement of vase life.
15. Study of different types of packaging materials, storage methods – visit to cold storages and commercial markets
16. Visit to export houses, Market intelligence, marketing of produce, cost analysis, institutional management.

Text Books

1. Joe.J.Hanan. (1998). Green houses: Advanced Technology for Protected Horticulture, CRC Press, LLC. Florida. pp 1-720
2. Prasad, S. and U. Kumar. (2005). Green house management for horticultural crops. 2nd ed. Agrobios. pp 1-500
3. Tiwari, G.N. (2003). Green house technology for controlled environment. Narosa Publ. House. pp 1-547

Reference Books

1. Paul V. Nelson. (1991). Greenhouse operation and management. Ball publishing USA. pp 1-512
2. Radha Manohar and Igathanathane. (2000). Greenhouse Technology and Management. BSP. BS Publication, Hyderabad. pp 1-234

Web-References

1. www.icar.org.in/ciphet.html
2. www.jains.com
3. www.gisdevelopment.net
4. www.lasercladding.com
5. www.epa.gov.
6. https://www.youtube.com/watch?v=qXdw-hBiu1A

Journals

1. Hort. Science
2. Horticultural Technology
3. Floriculture Today
4. Hi-tech Horticulture
5. Acta Horticulture

Course Nature: only Practical			
Total Marks (100)			
S.No.	**Category**	**Assessment Tools**	**Marks**
1	Practical-Internal	*Purely internal based on the participation, involvement and contribution of students in the activities pertaining to the course*	
		Continuous evaluation of routine activities	*30*
		Execution skill and Product generation/ Competence	*20*
		Written test	*20*
		Record and Observation Note	*20*
		Viva-Voce	*05*
		Attendance	*05*
		Grand Total	*100*

Course Code	STR19811	Course Name	AGRICULTURE WASTE MANAGEMENT	Course Category	E	*Student Ready-Experimental Learning Programme*	L	T	P	C
							0	0	10	10

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	*Environmental Sciences*	**Data Book / Codes/Standards**		*Nil*	

Course Learning Rationale (CLR):	***The purpose of learning this course is to:***	**Learning**		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	*Acquire skills on management of different agricultural wastes*			
CLR-2 :	*To obtain knowledge on methods of conversion of waste to wealth and waste into farm inputs*			
CLR-3 :	*To gain knowledge about the methods of recycling of agricultural waste and production of manures*			
CLR-4 :	*To demonstrate on integrated agricultural waste management*			
CLR-5 :	*Acquire skills on the analysis and grading of manures*			
CLR-6 :	*To Impart knowledge about the establishment and marketing of manures*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	**Learning**		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	*Categorize about different types of agricultural wastes and its characteristics*	*1*	90	80
CLO-2 :	*Practice, gain confidence and competence in management of agricultural wastes*	*3*	95	85
CLO-3 :	*Independent skill to manage large quantity of agricultural and farm animal waste*	*3*	85	65
CLO-4 :	*Comprehend management of sustainable technologies for the agricultural wastes, recommend processes to recycle agricultural wastes*	*3*	80	70
CLO-5 :	*Execute the production and marketing of compost, vermicompost, biogas and briquette*	*3*	75	60
CLO-6 :	*Plan project proposals on agricultural waste management and self enterprising activity*	*3*	80	70

Program Learning Outcomes (PLO)															
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Agriculture Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	Ability to solve scientific problems	Ability to implement knowledge gained in the applied field of Business Management	Ability to understand social and ethical responsibilities
M	M	H	H	M	M	H	L	L	H		H	H	H	H
H	M	H	H	L		H	L	L	H		H	H	H	H
L	H	H	H	M		H	M	L	H		H	H	H	H
L	H	H	H	M		H	L	L	H		H	H	H	H
H	H	H	M	L		H	M	M	H	L	H	H	H	H
H	L	H	M	H	L	H	M	M	H	H	H	H	H	H

		Learning Unit / Module 1	**Learning Unit / Module 2**	**Learning Unit / Module 3**	**Learning Unit / Module 4**	**Learning Unit / Module 5**
Duration (Weekly)		**3**	**4**	**4**	**2**	**3**
S-1	SLO-1	*Week 1:Collection and characterization of agricultural wastes*	*Week 4: Composting- different methods of composting*	*Week 8: Vermicomposting - collection and pre-processing of waste materials*	*Week 12: Establishment of biogas production unit*	*Week 14: Biocharproduction*
	SLO-2					
S-2	SLO-1	*Week 2: Survey of different agricultural production systems*	*Week 5: Preparation of different types of compost*	*Week 9: Preparing of bedding materials and production of vermicompost*	*Week 13: Biodigester maintenance*	*Week 15: Briquette making*
	SLO-2					
S-3	SLO-1	*Week 3: Visit to a landfill site*	*Week 6: Evaluation of compost maturity*	*Week 10: Maintenance, harvesting, storage and packing the vermicompost*	-	*Week 16: Preparation of project proposal and work plan for establishing commercial compost and vermicompost production unit*
	SLO-2					
S-4	SLO-1	-	*Week 7: Compost- Nutrient analysis*	*Week 11: visit to compost and vermicompost production unit*	-	--
	SLO-2					

Learning Resources	
	1. *Foster, C.N. (2015). Agricultural Wastes: Characteristics, Types and Management (Waste and Waste Management). UK: Nova Science Publishers Inc. pp.1-287.*
	2. *Zakaria, Z. A. (2018). Sustainable Technologies for the Management of Agricultural Wastes. Singapore: Springer. pp. 1-154.*

	Level of Thinking	Final internal Examination (100%)
Level 1	Remember	*20 %*
	Understand	
Level 2	Apply	*40 %*
	Analyze	
Level 3	Evaluate	*40 %*
	Create	
	Total	*100 %*

Course Designers		
Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
Mr.M.Panneer Selvam, Environmental Engineer, VIRDT, Dharmapuri.	*Dr. A. Balusamy, Scientist,* *Division of Natural Resource Management,* *ICAR-Research Complex for North Eastern Hill Region.*	*Dr. M. Sanjeevagandhi,* *Assistant Professor (ENS)*

Practical

Introduction: agricultural wastes – source segregation methods - plant and animal refuges - collection, storage and handling of solid, liquid and gaseous wastes from field, livestock and agro-industries - analyzing physical, chemical and biological properties. Survey of different agricultural production systems: observe types of wastes generated – quantification and classification of wastes – methods of waste processing. Visit to a landfill site: study about volume, size and chemical reduction techniques - leachate treatment facilities – assessment of pollution problems.

Composting: principles - factors affecting composting- different methods of composting-aerobic - windrow composting - aerated static pile composting - other methods of composting –sheet composting –in vessel composting – biodynamic composting - preparation of compost by trench method- anaerobic composting-merits- demerits-microorganisms in composting - EM compost - preparation of different types of compost -co-composting-troubleshooting - compost regulations - national and international standards for compost quality parameters - evaluation of compost maturity - maturity indices of compost - determinations of C:N ratio, temperature, colour, odour, moisture content, pH, EC and nutrient contents -detection of pathogens and heavy metals - compost stability test.

Vermcomposting: infrastructure required for vermicompost - site selection- methods- windrow – wedge – container - commercial model - continuous flow systems - collection and pre-processing of waste materials - precautions during the process - selection of earthworm - preparing of bedding materials - controlling temperature and moisture – vermiweeds - natural enemies and their control - maintenance and harvesting the vermicompost and worms – sieving - storage - packing-designing different commercial vermicomposting bin - integrating traditional composting and vermicomposting - value-added products – vermiwash - enriched vermicompost - visit to compost and vermicompost production unit.

Biogas production: typical biodigester designs, fixed dome biodigester-floating dome biodigester, tubular bag biodigester - advantages – disadvantages- biodigester maintenance and troubleshooting, utilization of slurry as fertilizer, quality control of biogas plants, economic analysis of biogas production - -visit to commercial biogas production unit–- prepare a lay out plan.

Rapid thermo-chemical processing of agricultural wastes- pyrolysis -biochar production– briquette making - equipment for briquetting – selection of raw materials – steps involved in briquettes – mixing and blending the materials - pressure maintenance – storage, packing and Marketing. Preparation of project proposal and work plan for establishing commercial compost and vermicompost production unit- report preparation - working out cost benefit ratio for compost production -marketing of compost products.

Text Books

1. Foster,C.N. (2015). *Agricultural Wastes: Characteristics, Types and Management (Waste and Waste Management).* UK: Nova Science Publishers Inc. pp.1-287.
2. Loehr, R. (1974). *Agricultural Waste Management: Problems, Processes, and Approaches.* USA: Academic Press. pp. 1-590.

Reference Books

1. Afuilio, A. (2014). *Integrated solid waste management. Hand book for Beginners, Planners, Environmentalists, Students and policy makers.* Nairobi, Kenya: Warmra Twechoprise. pp.1-218.
2. Diaz,I.F., Bertoldi, M.D., & Bidlingmaier, W. (2007). *Compost science and technology,* Elsevier pub. pp. 1-380.
3. Dinesh, K., & Maheshwari. (2014). *Composting for Sustainable Agriculture (Sustainable Development and Biodiversity).* Switzerland: Springer international publishing. pp.1-290.
4. Edwards, C. A., Arancon, N. Q., & Sherman, R.L. (2010). *Vermiculture Technology: Earthworms, Organic Wastes, and Environmental Management.* USA: CRC Press. pp.1- 623.
5. Jefrey, P.T. (2013). *Eco-Fuel Briquettes*. Latvia: LAP Lambert Academic Publishing. pp. 1-200.
6. Kelly Smith. (2012). *How to build, maintain and use a compost system*. Florida: Atlantic publishers. pp.1-288.
7. Roland Ulrich. (2014). *Creating humus on farm – The controller heat method of composting.* Colorado: Outskirts press. pp. 1-56.
8. Yong, S.O., Uchimiya, S.M., Chang, S. X., & Bolan, N. (2015). *Biochar-production characterization and applications.* USA. CRC press. pp. 1-438
9. Zainul, A.Z. (2018). *Sustainable Technologies for the Management of Agricultural Wastes.* Singapore: Springer, pp. 1-154.

E -References:

1. http.//www.Compost.css.cornnell.ed
2. http.//www.composting council.org
3. http.//www.eartheasy.com
4. http.//www.Epa.gov/compost
5. http://www.fao.org/3/a-bp845e.pdf
6. https://www.ctc-n.org/system/files/dossier/3b/briquette_production_manual_2.pdf
7. https://www.planetnatural.com
8. https://www.youtube.com/watch?v=2YLPB52zVX8
9. https://www.youtube.com/watch?v=9Ig1BKMdJS0

Journal

1. Global Ecology and Conservation

2. International Journal of Environment and Waste Management
3. International Journal of Recycling of Organic Waste in Agriculture

Course Nature: Only Practical			
Total Marks (100)			
S.No.	**Category**	**Assessment Tools**	**Marks**
1	Practical-Internal	*Purely internal based on the participation, involvement and contribution of students in the activities pertaining to the course*	
		Continuous evaluation of routine activities	*30*
		Execution skill and Product generation/ Competence	*20*
		Written test	*20*
		Record and Observation Note	*20*
		Viva-Voce	*05*
		Attendance	*05*
		Grand Total	*100*

Course Code	STR19812	Course Name	FOOD PROCESSING	Course Category	E	Student Ready-Experimental Learning Programme	L	T	P	C
							0	0	10	10

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department		**Data Book / Codes/Standards**		*Nil*	

Course Learning Rationale (CLR):	***The purpose of learning this course is to:***	**Learning**		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	*Acquire knowledge on processing of agricultural products*			
CLR-2 :	*Develop analytical and entrepreneurial skills in food processing*			
CLR-3 :	*Learn hands on experience in processing food products*			
CLR-4 :	*Understand business strategic methods involved in running a food processing industry*			
CLR-5 :	*Gain technical knowledge on the food processing setup*			
CLR-6 :	*Learn about establishment of food industries*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	**Learning**		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	*Comprehend the techniques of value added products of agricultural produces*	1	90	80
CLO-2 :	*Intrepret on analysis of the marketability of food products*	2	95	85
CLO-3 :	*Comprehend project proposals of a food processing industry*	2	85	65
CLO-4 :	*Prepare a project proposal for running a value added food product industry*	3	80	70
CLO-5 :	*Demonstrate sales strategies of a food processing industry*	3	75	60
CLO-6 :	*Manage and initiate a food product enterprise*	3	90	80

Program Learning Outcomes (PLO)															
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
Agriculture Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	Ability to solve scientific problems	Ability to implement knowledge gained in the applied field of Business Management	Ability to understand social and ethical responsibilities	
H	H	M	L	H		H	L	M	H	H	H	H	H	H	
H	M	H	H	L		H	L	L	H		H	H	H	H	
M	H	H	H	M		H	M	M	H		H	H	H	H	
M	H	H	H	M		H	L	L	H		H	H	H	H	
H	H	H	M	L		H	M	M	H	L	H	H	H	H	
H	L	H	M	H		H	M	M	H	M	H	H	H	H	

		Learning Unit / Module 1	**Learning Unit / Module 2**	**Learning Unit / Module 3**	**Learning Unit / Module 4**	**Learning Unit / Module 5**
Duration (hour)		**30**	**30**	**30**	**30**	**40**
S-1	SLO-1	*Practical 1: identification of product, analyzing the existing status*	*Practical 4: Processing of value added products from bakery products*	*Practical 7: Preparation of ready to eat food*	*Practical 10: Preparation of fish pickles*	*Practical 13: Identifying suitable packaging material for the developed product*
	SLO-2					
S-2	SLO-1	*Practical 2: Processing of value added products from cereals*	*Practical 5: Processing of value added products from milk and milk products*	*Practical 8: Preparation of sugar based value added products*	*Practical 11: Analysis of sensory evaluation*	*Practical 14: Designing layout of food processing industry*
	SLO-2					
S-3	SLO-1	*Practical 3: Processing of value added products from millets*	*Practical 6: Preparation of convenience foods*	*Practical 9: Preparation of chocolates*	*Practical 12: evaluation of cost analysis*	*Practical 15: Quality assessment and maintenance of production records Food safety standards*
	SLO-2					
S-4	SLO-1	-	-	-	-	*Practical 16: Pilot scale production*
	SLO-2					

Learning Resources	1. *Khader, V. (2001). Text book of Food Science and Technology. Directorate of Information and Publications of Agriculture, ICAR, KrishiAnusandhanBhawan, Pusa, New Delhi* 2. *Sudheer, K.P and V.Indira. (2007). Post Harvest Technology of Horticultural Crops. New India Publishing Agency, PitamPura, New Delhi*

	Level of Thinking	Final internal Examination (100%)
Level 1	Remember	*20 %*
	Understand	
Level 2	Apply	*40 %*
	Analyze	
Level 3	Evaluate	*40 %*
	Create	
	Total	*100 %*

Course Designers		
Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
Mr. Elangovan, *Avvai Foods Enterprise, No.92, Puliyankuti, Kokkeri vai,* *Papanasam Taluk, Ammapet, Thanjavur - 614402*	*Dr. Selvi J, Assistant Professor, Department of Food Science and Technology, Community Science College and Research Institute, TNAU, Madurai- 625104*	*Dr. P.Sheela*

Practical

Identification of product available in the market, analyzing the existing status, market survey and identifying the target customer. Processing of value added product from cereals, millets, milk and milk products. Preparation of bakery products, convenience foods, and ready to eat foods, sugar based value added products, manufacturing of chocolates, pickles from fish. Analysis of sensory evaluation and cost analysis. Identifying suitable packaging material for the developed products. Designing and layout of food processing industry and identifying the resources. Project proposal preparation, quality assessment and maintenance of production records and food safety standards and pilot scale production

Text Book

1. James G. Brennan. (2006). Food Processing Handbook. Wiley-VCH Verlag GmbH & Co. KGaA, Weinheim, Germany.
2. M. Shafiur Rahman. (2007). Handbook of Food Preservation, (2nd Ed). CRC Press, Boca Raton, FL, USA.
3. Norman N. Potter and Joseph H. Hotchkiss. (1995). Food Science, (5th Ed). Chapman & Hall, NY, USA.
4. Srilakshmi, B. (2018). Food Science (7th Ed). New Age International Ltd, publishers, New Delhi, India, PP: 1-508.
5. Stavros Yanniotis. (2008). Solving Problems in Food Engineering. Springer Science + Business Media, NY, USA.

Reference Books

1. Potter, N. (2005).Food Science, CBS Publishers and Distributors, Delhi
2. Verma, L.R. and V.K. Joshi. (2000). Post Harvest Technology of Fruits and Vegetables. Vol. 1 and 2. Indus Publishing Company. New Delhi.
3. Vijaya Khader. (2001). Textbook of Food Science and Technology, Indian Council of Agricultural Research, New Delhi.

Web-References

1. http://www.ifis.org
2. http://www.fao.org/infoods/index_en.stm
3. https://fstjournal.org
4. www.foodnetbase.com
5. www.cfs.purdue.edu/class

Journals

1. Trends in Foods Science and Technology
2. Annual Reviews of Food Science and Technology
3. Food Research International
4. Indian Food Industry
5. Indian food packer

Course Nature: Only Practical			
Total Marks (100)			
S.No.	**Category**	**Assessment Tools**	**Marks**
1	Practical-Internal	*Purely internal based on the participation, involvement and contribution of students in the activities pertaining to the course*	
		Continuous evaluation of routine activities	*30*
		Execution skill and Product generation/ Competence	*20*
		Written test	*20*
		Record and Observation Note	*20*
		Viva-Voce	*05*
		Attendance	*05*
		Grand Total	***100***

Course Code	STR 19813	Course Name	PROCESSING OF FRUITS AND VEGETABLES FOR VALUE ADDITION	Course Category	E	Student Ready-Experimental Learning Programme	L	T	P	C
							0	0	10	10

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	*Food Science & Nutrition*	**Data Book / Codes/Standards**	*Nil*		

Course Learning Rationale (CLR):	***The purpose of learning this course is to:***	**Learning**		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	*Gain knowledge on processing of Horticultural produces*			
CLR-2 :	*Develop of analytical and entrepreneurial skills in value addition*			
CLR-3 :	*Understand providing hands on experience in value addition of horticultural produces*			
CLR-4 :	*Describe business strategic involved in running a food processing industry*			
CLR-5 :	*Obtain technical knowledge on the food processing setup*			
CLR-6 :	*Learn about establishment of food industries*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*			
CLO-1 :	*Comprehend the techniques of value added products of horticultural produces*	*1*	90	80
CLO-2 :	*Attain knowledge on analyze the marketability of a food product*	*2*	95	85
CLO-3 :	*Comprehend project proposals of a food processing industry*	*2*	85	65
CLO-4 :	*Prepare a project proposal for running a value added food product industry*	*3*	80	70
CLO-5 :	*Demonstrate sales strategies of a food processing industry*	*3*	75	60
CLO-6 :	*Manage and initiate food product enterprises*	*3*	90	80

Program Learning Outcomes (PLO)														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Agriculture Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	Ability to solve scientific problems	Ability to implement knowledge gained in the applied field of Business Management	Ability to understand social and ethical responsibilities
H	H	M	L	H		H	L	M	H	H	H	H	H	H
H	M	H	H	L		H	L	L	H		H	H	H	H
M	H	H	H	M		H	M	M	H		H	H	H	H
M	H	H	H	M		H	L	L	H		H	H	H	H
H	H	H	M	L		H	M	M	H	L	H	H	H	H
H	L	H	M	H		H	M	M	H	M	H	H	H	H

		Learning Unit / Module 1	**Learning Unit / Module 2**	**Learning Unit / Module 3**	**Learning Unit / Module 4**	**Learning Unit / Module 5**
Duration (hour)		**30**	**30**	**30**	**40**	**30**
S-1	SLO-1	*Practical 1: identification of product, analyzing the existing status*	*Practical 4: Preparation of RTS*	*Practical 7: Processing of canned products*	*Practical 10: fermented beverages*	*Practical 13: Identifying suitable packaging material for the developed product*
	SLO-2					
S-2	SLO-1	*Practical 2: Preparation of jam and jelly*	*Practical 5: Processing of dehydrated fruits*	*Practical 8: Preparation of toffee and fruit bars*	*Practical 11: Analysis of sensory evaluation*	*Practical 14: Designing layout of food processing industry*
	SLO-2					
S-3	SLO-1	*Practical 3: Preparation of marmalade and squash*	*Practical 6: Processing of dehydrated vegetables*	*Practical 9: Preparation of pickles and sauces*	*Practical 12: evaluation of cost analysis*	*Practical 15: Quality assessment and maintenance of production records Food safety standards*
	SLO-2					
S-4	SLO-1	-	-	-	-	*Practical 16: Pilot scale production*
	SLO-2					

Learning Resources	1. *Khader, V. (2001). Text book of Food Science and Technology. Directorate of Information and Publications of Agriculture, ICAR, KrishiAnusandhanBhawan, Pusa, New Delhi* 2. *Sudheer, K.P and V.Indira. (2007). Post Harvest Technology of Horticultural Crops. New India Publishing Agency, PitamPura, New Delhi*

	Level of Thinking	Final internal Examination (100%)
Level 1	Remember Understand	*20 %*
Level 2	Apply Analyze	*40 %*
Level 3	Evaluate **Create**	*40 %*
	Total	*100 %*

Course Designers		
Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
Mr. Elangovan, *Avvai Foods Enterprise, No.92, Puliyankudi, Kokkeri vai,* *Papanasam Taluk, Ammapet, Thanjavur - 614402*	*Dr. Selvi J, Assistant Professor, Department of Food Science and Technology,* *Community Science College and Research Institute, TNAU, Madurai- 625104*	*Dr. P.Sheela,* *Assistant Professor*

Practical

Identification of product available in the market, analyzing the existing status, market survey and identifying the target customer. Preparation of jam, jelly, marmalade and RTS. Processing of dehydrated fruits and vegetable products, canned products, toffee and fruit bars. Preparation of pickles and sauces. Processing of fermented beverages. Identifying suitable packaging material for the developed products. Designing and layout of food processing industry and identifying the resources. Project proposal preparation, quality assessment and maintenance of production records and food safety standards and pilot scale production

Text Book

1. James G. Brennan. (2006). Food Processing Handbook. Wiley-VCH Verlag GmbH & Co. KGaA, Weinheim, Germany.
2. M. Shafiur Rahman. (2007). Handbook of Food Preservation, (2nd Ed). CRC Press, Boca Raton, FL, USA.
3. Norman N. Potter and Joseph H. Hotchkiss. (1995). Food Science, (5th Ed). Chapman & Hall, NY, USA.
4. Srilakshmi, B. (2018). Food Science (7th Ed). New Age International Ltd, publishers, New Delhi, India, PP: 1-508
5. Stavros Yanniotis. (2008). Solving Problems in Food Engineering. Springer Science + Business Media, NY, USA.

Reference Books

1. Potter, N. (2005).Food Science, CBS Publishers and Distributors, Delhi
2. Verma, L.R. and V.K. Joshi. (2000). Post Harvest Technology of Fruits and Vegetables. Vol. 1 and 2. Indus Publishing Company. New Delhi.
3. Vijaya Khader. (2001). Textbook of Food Science and Technology, Indian Council of Agricultural Research, New Delhi.

Web-References

1. http://www.ifis.org
2. http://www.fao.org/infoods/index_en.stm
3. https://fstjournal.org
4. www.foodnetbase.com
5. www.cfs.purdue.edu/class

Journals

1. Trends in Foods Science and Technology
2. Annual Reviews of Food Science and Technology
3. Food Research International
4. Indian Food Industry
5. Indian food packer

Course Nature: Only Practical			
Total Marks (100)			
S.No.	**Category**	**Assessment Tools**	**Marks**
1	Practical-Internal	*Purely internal based on the participation, involvement and contribution of students in the activities pertaining to the course*	
		Continuous evaluation of routine activities	*30*
		Execution skill and Product generation/ Competence	*20*
		Written test	*20*
		Record and Observation Note	*20*
		Viva-Voce	*05*
		Attendance	*05*
		Grand Total	***100***

Course Code	STR19814	Course Name	POULTRY PRODUCTION TECHNOLOGY	Course Category	E	*Student Ready-Experimental Learning Programme*	L	T	P	C
							0	0	10	10

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Animal Husbandary	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	*To Understand the importance of Poultry sector*			
CLR-2 :	*Acquire Knowledge on different poultry species and their utilities*			
CLR-3 :	*Learn different types of breeds, strains of broilers and layers*			
CLR-4 :	*Obtain skill for chicken rearing*			
CLR-5 :	*Learn about different egg products preparation*			
CLR-6 :	*Develop skills for business entrepreneurships*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	*To Understand the importance of Poultry sector*	*1*	95	80
CLO-2 :	*Acquire Knowledge on different poultry species and their utilities*	*2*	90	85
CLO-3 :	*Learn different types of breeds, strains of broilers and layers*	*2*	85	70
CLO-4 :	*Obtain skill for chicken rearing*	*1*	80	75
CLO-5 :	*Learn about different egg products preparation*	*2*	75	60
CLO-6 :	*Develop skills for business entrepreneurships*	*3*	75	65

Program Learning Outcomes (PLO)															
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
Agriculture Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	Ability to solve scientific problems	Ability to implement knowledge gained in the applied field of Business Management	Ability to understand social and ethical responsibilities	
M			L					M	H		H	L	H	H	
M	L		M					L	H		H	L	H	H	
M	L							L	H		H	M	H	H	
M	M							M	H		H	L	H	H	
L		M						M	H		H	M	H	H	
L	L	M		L		H		M	H		H	L	H	H	

		Learning Unit / Module 1	Learning Unit / Module 2	Learning Unit / Module 3	Learning Unit / Module 4	Learning Unit / Module 5
Duration (Weeks)		3	3	4	3	3
S-1	SLO-1	*Week 1-Introduction to poultry sector*	*Week 5- Summer and winter management of broilers*	*Week 8- Egg products and additive supplementation*	*Week11- Quail rearing and medication, vaccination techniques*	*Week 14- Exposure visit to commercial layer, broiler farm*
	SLO-2					
S-2	SLO-1	*Week 2- Different types of breeds and strains of broilers and layers*	*Week 6- collection and handling of eggs and Egg quality determination*	*Week 9- Broiler rearing – dressing and cut-up parts*	*Week 12- Artificial insemination - postmortem examination and dead bird disposal*	*Week 15- Economics of broiler and layer farming*
	SLO-2					
S-3	SLO-1	*Week 3- Preparation of Poultry house – Farm equipment's*	*Week 7- Egg candling and preservation*	*Week 10 – Termites, azolla production and feeding*	*Week 13- Waste management and Bio security measures*	*Week 16. – Exposure visit to hatchery unit, feed mill and processing unit*
	SLO-2					
S-4	SLO-1	*Week 4- Litter material selection and management - Brooding*	-	-	-	-
	SLO-2					

Learning Resources	Text Books:	Reference Book:
	1. *Sreenivasaiah, P.V.(2006). Scientific Poultry Production (3rd ed). Lucknow: International Book Distributing Co. pp-1-1487* 2. *R.A.Singh (1990) .A Text Book of Poultry production (3rd ed) .Ludhiana: Kalyani publishers ,rajender nagar.pp-1-315.*	1. *D.Narahari (1997). Commercial Broiler production, (2nd ed): Delhi. ,Emkay Publication pp-1-153*

	Level of Thinking	Final Internal Evaluation (15%)
Level 1	Remember	*20%*
	Understand	
Level 2	Apply	*40%*
	Analyze	
Level 3	Evaluate	*40%*
	Create	
	Total	*100%*

Course Designers		
Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
Dr. B. George Stephenson *Manager -Technical* *Novas international Pvt.Ltd* *Mobile: 9500107918*	*Dr.T.Vasanthakumar* *Assistant Professor* *Livestock farm complex* *Veterinary college and research institute, Orathanadu* *Thanjavur (Dt)* *Mobile:9025250970*	*Dr. G. Prabakar,* ***Assistant Professor***

Practical

Poultry Industry in India - Current status of broiler and layer industry – Scope of broiler and layer production in India - Introduction to Broilers and Layers – Commercial strains of broilers and layers. Housing management – Location and layout of commercial broiler and layer farm- Farm equipment's -Preparation of poultry house- Litter material selection and management - Summer management of broiler -Winter management of broiler – Lighting management- collection and handling of eggs-Determination of internal and external egg qualities- Hatchery management – egg handling – egg preservation – egg products - broiler rearing – dressing of broilers – different cut-up-parts – Additive and supplementation of additives- Termite production – Azolla feeding – Quail rearing -Medication and Vaccination techniques – Artificial insemination technique - Postmortem inspection - Disposal of dead birds - Waste management - Biosecurity measures- Economics of broiler and layers farming- Visit to commercial broiler farm, layer farm, feed plant, hatchery unit and processing plant.

Text Books

1. P.V. Sreenivasaiah (2006). *Scientific Poultry Production* (3rded): Lucknow: International Book Distributing Co. pp. 1-1487.
2. Gopalakrishnan, C.A., and Lal, D.M.M (1992). *Livestock and Poultry Enterprises for Rural Development*. Ghaziabad, Uttar Pradesh: Vikas Publications Private Limited. pp. 1- 1096.
3. Sastry, N.S.R and Thomas, C.K. (2005). *Livestock Production Management (*3rd ed). Ludhiana: Kalyani Publishers. pp. 1-850.

Reference Books

1. D.Narahari (1997). *Commercial Broiler production*. (2nd ed). Delhi: Emkay Publication.pp-1-153.
2. Robert.J.Etches (2000) *Reproduction in Poultry* :UK:CABI publishing,pp-1-318
3. A.K.Biswas and P.K.Mandal (2014.)Text book of Poultry, egg and Fish Processing Technology. New Delhi: Studium press (india) Pvt. Ltd.

Web-References

1. https://www.youtube.com/watch?v=uwU6-_mK4II
2. https://www.youtube.com/watch?v=nRWRYvLsudw
3. https://www.youtube.com/watch?v=EgFQQdVvJME&t=70s
4. https://www.youtube.com/watch?v=_UyyLRqah3E
5. https://www.youtube.com/watch?v=TJIXePc7MgQ

Journals

1. Indian Journal of Poultry Science
2. British Poultry Science
3. World Poultry Science
4. Poultry Science
5. Indian Journal of Animal science

Course Nature: Only Practical			
Total Marks (100)			
S.No.	**Category**	**Assessment Tools**	**Marks**
1	Practical-Internal	*Purely internal based on the participation, involvement and contribution of students in the activities pertaining to the course*	
		Continuous evaluation of routine activities	*30*
		Execution skill and Product generation/ Competence	*20*
		Written test	*20*
		Record and Observation Note	*20*
		Viva-Voce	*05*
		Attendance	*05*
		Grand Total	***100***