ACADEMIC CURRICULA

POSTGRADUATE DEGREE PROGRAMME

MASTER OF SCIENCE IN BIOTECHNOLOGY

(M.Sc.)

Two Years (Full-Time)

Learning Outcome-Based Education

Choice Based Flexible Credit System

Academic Year

2021- 2022

SRM INSTITUTE OF SCIENCE AND TECHNOLOGY

(Deemed to be University u/s 3 of UGC Act, 1956)

Kattankulathur, Kancheepuram District 603203, Tamil Nadu, India

DEPARTMENT OF BIOTECHNOLOGY

1.	Department Vision Statement
Stmt - 1	*Creating the most conducive environment for imparting quality education in Biotechnology*
Stmt - 2	*Contributing effectively to produce globally competent quality professionals in the field of life science*
Stmt - 3	*Contributing towards preparing young minds to serve the community*

2.	Department Mission Statement
Stmt - 1	*Impart student's essential knowledge and skills required for a successful career in life science*
Stmt - 2	*Instill confidence in the students to take up new challenges by grooming them appropriately*
Stmt - 3	*Inculcate in the students a sense of commitment to professional ethics, moral values with an emphasis on teamwork and leadership qualities*
Stmt - 4	*Instill the students with a clear awareness of environmental issues and their relevance to their profession*
Stmt - 5	*Impress upon the students the impact of their work on the nation's economic and social progress*

3.	Program Education Objectives (PEO)
PEO - 1	Graduates will have the skills and knowledge to excel in their professional careers in Biotechnology and related disciplines
PEO - 2	Graduates will contribute and communicate effectively within the team to grow into leaders
PEO - 3	Graduates will practice lifelong learning for continuing professional development
PEO - 4	Graduates will have the capability to continue their formal education and complete an advanced degree
PEO - 5	Graduates will contribute to the growth of the nation and society by applying the acquired knowledge in technical, computing, and managerial skills.

4. Consistency of PEO's with Mission of the Department

	Mission Stmt. - 1	Mission Stmt. - 2	Mission Stmt. - 3	Mission Stmt. - 4	Mission Stmt. - 5
PEO - 1	H	H	M	H	M
PEO - 2	H	M	H	H	H
PEO - 3	M	H	M	H	H
PEO - 4	H	H	H	L	M
PEO - 5	L	H	M	H	H

H – High Correlation, M – Medium Correlation, L – Low Correlation

5. Consistency of PEO's with Program Learning Outcomes (PLO)

	Program Learning Outcomes (PLO)														
	1. Disciplinary Knowledge	2. Critical Thinking	3. Problem Solving	4. Analytical Reasoning	5. Research Skills	6. Team Work	7. Scientific Reasoning	8. Reflective Thinking	9. Self-Directed Learning	10. Multicultural Competence	11. Ethical Reasoning	12. Community Engagement	13. ICT Skills	14. Leadership Skills	15. Life Long Learning
PEO - 1	H	H	H	H	H	L	M	L	M	M	H	H	M	H	H
PEO - 2	H	H	H	H	H	L	M	L	M	H	M	M	H	H	M
PEO - 3	H	H	H	H	H	M	H	M	M	M	H	H	H	M	M
PEO - 4	H	M	M	H	H	H	M	H	H	H	H	L	M	M	H
PEO - 5	M	M	H	H	M	H	M	H	H	H	M	M	H	M	M

H – High Correlation, M – Medium Correlation, L – Low Correlation

6. POST GRADUATION: Program Structure (Total Credits:80)

1. Professional Core Courses (C) (8 COURSES)

Course Code	Course Title	Hours/ Week			
		L	T	P	C
PBT21101J	Biochemistry	4	0	4	6
PBT21102J	Microbiology	4	0	4	6
PBT21201J	Molecular Biology	4	0	4	6
PBT21202J	Plant biotechnology	4	0	4	6
PBT21203J	Genetic Engineering	4	0	4	6
PBT21301J	Immunotechnology	4	0	4	6
PBT21302J	Animal biotechnology	4	0	4	6
Total Learning Credits					42

2. Discipline Elective Courses (D) (6 COURSES)

Course Code	Course Title	Hours/ Week			
		L	T	P	C
PBT21D01T	Enzyme technology	3	0	0	3
PBT21D02J	Genomics and Proteomics	3	0	2	4
PBT21D03T	Biophysics	4	0	0	4
PMS21D01T	Statistics for biosciences				
PBT21D04T	Regenerative medicine	2	0	0	2
PBT21D05T	Nanobiotechnology				
PBT21D06J	Industrial biotechnology	2	0	2	3
Total Learning Credits					16

3. Generic Elective Courses (G)

Course Code	Course Title	Hours/ Week			
		L	T	P	C
PBT21G01T	Research Methodology	2	0	0	2
Total Learning Credits					2

4. Skill Enhancement Courses(S)

Course Code	Course Title	Hours/ Week			
		L	T	P	C
PBT21S01T	Mathematical Calculations in Biology	2	0	0	2
PBT21S02T	Structural Bioinformatics				
PBT21S03T	Forensic Science	1	0	0	1
PBT21S04T	Clinical Trials				
Total Learning Credits					3

5. Project Work, Internship In Industry / Higher Technical Institutions(P)

Course Code	Course Title	Hours/ Week			
		L	T	P	C
PBT21P01L	Internship/MOOC	0	0	0	0
PBT21P02L	Project Work	0	0	24	12
Total Learning Credits					12

6. Ability Enhancement Courses (AE) (4 Courses)

Course Code	Course Title	Hours/ Week			
		L	T	P	C
PBT21AE1T	Entrepreneurship In Life Science	2	0	0	2
PCD21AE1T	Professional Skills and Problem Solving	1	0	0	1
PCD21AE2T	General Aptitude for Competitive Examinations	1	0	0	1
PCD21AE3T	Employability Skills	1	0	0	1
Total Learning Credits					5

Semester	Professional Core Courses (PCC)	Discipline Electives Courses (DEC)	Generic Elective Course (GEC)	Skill Enhancement Course (SEC)	Ability Enhancement Course (AEC)	Project Work, Internship (P)	Total Credits	Total Hours
COURSE STRUCTURE								
Sem I	PCC-1 PCC-2	DEC-1		SEC 1	AEC 1 AEC 2		20	24
Sem II	PCC-3 PCC-4 PCC-5	DEC-2			AEC3		23	30
Sem III	PCC-6 PCC-7	DEC-3 DEC-4 DEC-5		SEC2	AEC4	P/internship/MOOC	23	28
Sem IV			GEC			P	14	26
Total Credits	42	16	2	3	5	12	80	108

7. IMPLEMENTATION PLAN

Semester – I

COURSE CODE	COURSE TITLE	L	T	P	C
		HOURS/ WEEK			
PBT21101J	Biochemistry	4	0	4	6
PBT21102J	Microbiology	4	0	4	6
PBT21D01T	Enzyme Technology	3	0	0	3
PBT21S01T	Mathematical Calculations in Biology	2	0	0	2
PBT21S02T	Structural Bioinformatics				
PBT21A01T	Entrepreneurship In Life Science	2	0	0	2
PCD21AE1T	Professional Skills and Problem Solving	1	0	0	1
	Total Learning Credits				**20**

Semester - II

COURSE CODE	COURSE TITLE	L	T	P	C
		Hours/ Week			
PBT21201J	Molecular Biology	4	0	4	6
PBT21202J	Plant Biotechnology	4	0	4	6
PBT21203J	Genetic Engineering	4	0	4	6
PBT21D02J	Genomics and Proteomics	3	0	2	4
PCD21AE2T	General Aptitude for Competitive Examinations	1	0	0	1
	Total Learning Credits				**23**

Semester – III

COURSE CODE	COURSE TITLE	L	T	P	C
		Hours/ Week			
PBT21301J	Immunotechnology	4	0	4	6
PBT21302J	Animal Biotechnology	4	0	4	6
PBT21D03T	Biophysics	4	0	0	4
PMS21D01T	Statistics for Biosciences				
PBT21D04T	Regenerative Medicine	2	0	0	2
PBT21D05T	Nanobiotechnology				
PBT21D06J	Industrial Biotechnology	2	0	2	3
PBT21S03T	Forensic Science	1	0	0	1
PBT21S04T	Clinical Trials				
PCD21AE3T	Employability Skills	1	0	0	1
PBT21P01L	Internship/MOOC	0	0	0	0
	Total Learning Credits				**23**

Semester - IV

COURSE CODE	COURSE TITLE	L	T	P	C
		Hours/ Week			
PBT21G01T	Research Methodology	2	0	0	2
PBT21P02L	Project Work	0	0	24	12
	Total Learning Credits				**14**

Total Learning Credits:80

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Course Code	Course Name	Disciplinary Knowledge	Critical Thinking	Problem Solving	Analytical Reasoning	Research Skills	Team Work	Scientific Reasoning	Reflective Thinking	Self-Directed Learning	Multicultural Competence	Ethical Reasoning	Community Engagement	ICT Skills	Leadership Skills	Life Long Learning
	8. Program Articulation Matrix															
PBT21101J	Biochemistry	H	H	H	H	H	L	M	L	M	M	H	H	M	H	H
PBT21102J	Microbiology	H	H	H	H	H	L	M	L	M	M	H	H	M	H	H
PBT21201J	Molecular Biology	H	H	H	H	H	L	M	L	M	M	H	H	M	H	H
PBT21202J	Plant Biotechnology	H	H	H	H	H	L	M	L	M	M	H	H	M	H	H
PBT21203J	Genetic Engineering	H	H	H	H	H	L	M	L	M	M	H	H	M	H	H
PBT21301J	Immunotechnology	H	H	H	H	H	L	M	L	M	M	H	H	M	H	H
PBT21302J	Animal Biotechnology	H	H	H	H	H	L	M	L	M	M	H	H	M	H	H
PBT21D01T	Enzyme Technology	H	H	H	H	H	L	M	L	M	M	H	H	M	H	H
PBT21D02J	Genomics and Proteomics	H	H	H	H	H	M	H	M	M	M	H	H	H	M	M
PBT21D03T	Biophysics	H	H	H	H	H	M	H	M	M	M	H	H	H	M	M
PMS21D01T	Statistics for Biosciences	H	H	H	H	H	M	H	M	M	M	H	H	H	M	M
PBT21D04T	Regenerative Medicine	H	H	H	H	H	M	H	M	M	M	H	H	H	M	M
PBT21D05T	Nanobiotechnology	H	H	H	H	H	M	H	M	M	M	H	H	H	M	M
PBT21D06J	Industrial Biotechnology	H	H	H	H	H	M	H	M	M	M	H	H	H	M	M
PBT21S01T	Mathematical Calculations in Biology	H	H	H	H	H	L	M	L	M	H	M	M	H	H	M
PBT21S02T	Structural Bioinformatics	H	H	H	H	H	L	M	L	M	H	M	M	H	H	M
PBT21S03T	Forensic Science	H	H	H	H	H	L	M	L	M	M	H	H	M	H	H
PBT21S04T	Clinical Trials	H	H	H	H	H	L	M	L	M	H	M	M	H	H	M
PBT21AE1T	Entrepreneurship In Life Science	M	M	H	H	M	H	M	H	H	H	M	M	H	M	M
PCD21AE1T	Professional Skills and Problem Solving	H	H	H	H	H	L	M	L	M	M	M	H	M	H	H
PCD21AE2T	General Aptitude for Competitive Examinations	H	H	H	H	H	M	H	M	M	M	H	H	H	M	M
PCD21AE3T	Employability Skills	H	H	H	H	H	M	H	M	M	M	H	H	H	M	M
PBT21P01L	Internship/MOOC	H	H	H	H	H	M	H	M	M	M	H	H	H	M	M
PBT21P02L	Project Work	H	H	H	H	H	M	H	M	M	M	H	H	H	M	M
	Program Average	H	H	H	H	H	M	M	M	M	M	M	H	H	H	H

H – High Correlation, M – Medium Correlation, L – Low Correlation

Course Code	PBT21101J	Course Name	BIOCHEMISTRY			Course Category	C	Professional Core Course	L	T	P	C
									4	0	4	6

Pre-requisite Courses	Nil	Co-requisite Courses	NIL	Progressive Courses	NIL
Course Offering Department		BIOTECHNOLOGY	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
CLR-1 :	Understanding the classification and properties of biomolecules.																		
CLR-2 :	Understanding biomolecule metabolism.																		
CLR-3 :	Knowledge of vitamins and their importance.																		
CLR-4 :	Knowledge of the energetics of oxidative pathway.																		
CLR-5 :	Understanding the location of a metabolic pathway.																		
CLR-6 :	Knowledge of the importance of all metabolic pathways.																		

Column headers: Level of Thinking (Bloom); Expected Proficiency (%); Expected Attainment (%); Scientific 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; PSO – 1; PSO – 2; PSO – 3

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Scientific 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	PSO-1	PSO-2	PSO-3
CLO-1 :	Students understand the fundamentals of biomolecules.	3	80	80	H	-	-	H	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	Students gain knowledge about the energetics of the catabolic pathway.	3	80	80	H	H	H	H	H	-	-	-	-	-	-	--	-	-	-
CLO-3 :	Students understand the difference between anabolic and catabolic pathways.	3	90	80	H	-	-	H	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	Students acquire knowledge on the importance of essential biomolecules.	3	90	80	H	-	-	H	-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	Students understand the exact metabolism of biomolecules.	3	90	90	H	H	H	H	H	-	-	-	-	-	-	-	-	-	-
CLO-6 :	Students understand the importance and functions of minerals.	3	86	82	H	H	H	H	H	-	-	-	-	-	-	-	-	-	-

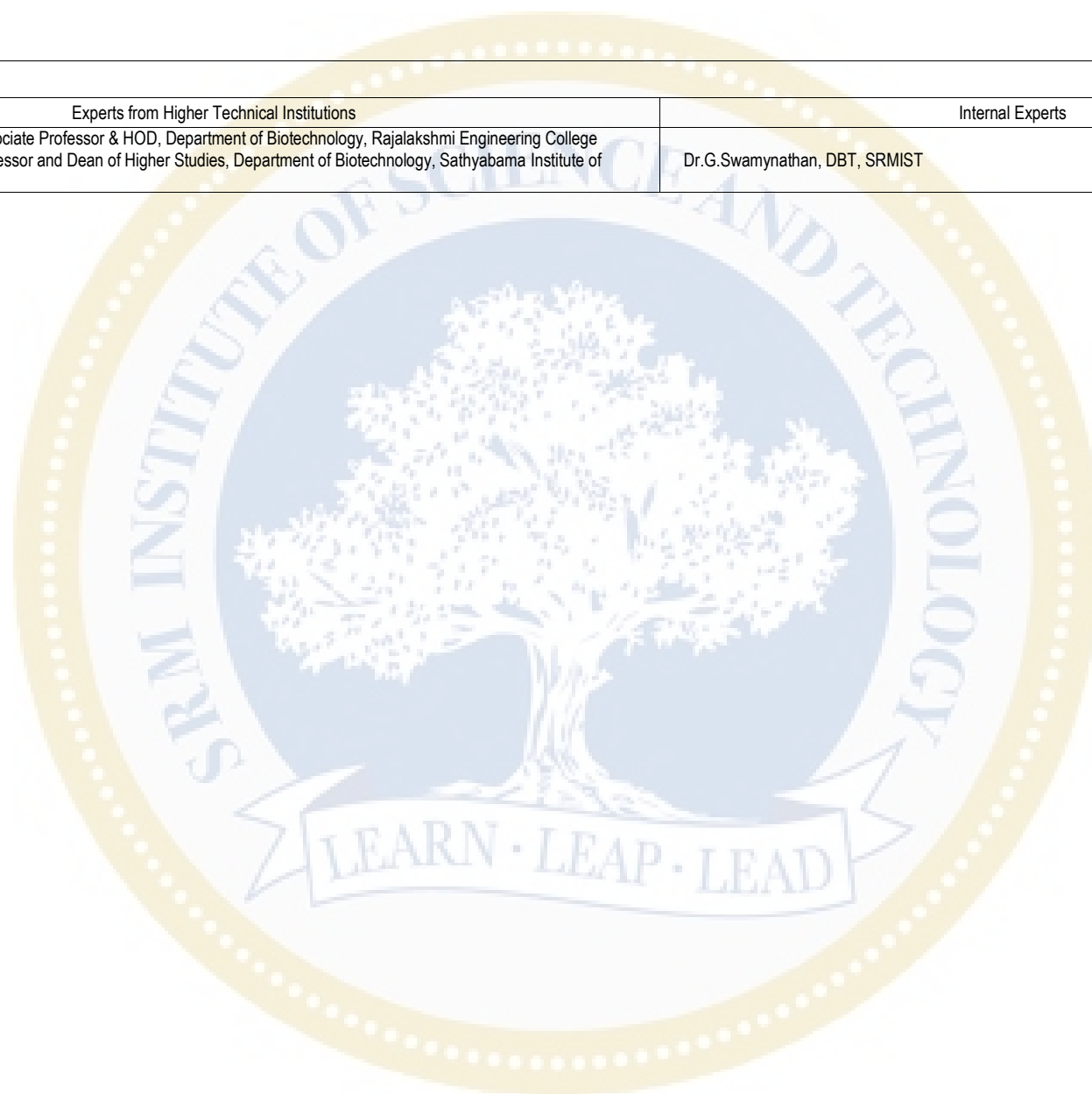| Duration (hour)		24	24	24	24	24
S-1	SLO-1	Classification, structure, properties and function - Carbohydrates	Vitamins – Types and functions.	Oxidation – α, β of fatty acids.	Biosynthesis of non- essential amino acids	Metabolism of purines
S-2	SLO-1	Classification, structure, properties and function - Carbohydrates	Vitamins – Types and functions.	Oxidation – α, β of fatty acids	Biosynthesis of non- essential amino acids	Metabolism of pyrimidines
S-3	SLO-1	Classification, structure, properties and function - Carbohydrates	Glycolysis	ω of fatty acids.	Biosynthesis of non- essential amino acids	Metabolism of pyrimidines
S-4	SLO-1	Classification, structure, properties and function - Lipid	Glycolysis	synthesis of fatty acids.	Biosynthesis of non- essential amino acids	Metabolism of pyrimidines
S 5-8	SLO-1 SLO-2	Estimation of glucose by orthotoludine method.	TLC separation of Amino acids	Estimation of DNA by diphenyl amine method.	Qualitative analyses of carbohydrates.	Isolation & Characterization of casein from milk.

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S-9	SLO-1	Classification, structure, properties and function - Lipids	Tricarboxylic acid cycle	synthesis of fatty acids.	Biosynthesis of non- essential amino acids	Minerals – Types and Functions
S-10	SLO-1	Classification, structure, properties and function - Lipids	Tricarboxylic acid cycle	Cholesterol synthesis	Biosynthesis of non- essential amino acids	Minerals – Types and Functions
S-11	SLO-1	Classification, structure, properties and function - Amino acids	Electron transport chain.	Cholesterol synthesis	Biosynthesis of non- essential amino acids	Minerals – Types and Functions
S-12	SLO-1	Classification, structure, properties and function - Amino acids	Electron transport chain.	Hormone synthesis – oesterogen and testosterone	Urea cycle.	Minerals – Types and Functions
S 13-16	SLO-1 SLO-2	Estimation of protein by Folin Lowry method.	TLC separation of Sugars	Qualitative analyses of carbohydrates.	Qualitative analyses of carbohydrates	Isolation and characterization of starch from potato.
S-17	SLO-1	Classification, structure, properties and function - Nucleic Acids	HMP Shunt, Pentose phosphate pathway	Hormone synthesis – oesterogen and testosterone.	Urea cycle.	Minerals – Types and Functions
S-18	SLO-1	Classification, structure, properties and function - Nucleic Acids	Cori cycle; Gluconeogenesis	Heam metabolism	Metabolism of purines	Minerals – Types and Functions
S-19	SLO-1	Classification, structure, properties and function - Nucleic Acids	glycogenesis and glycogenolysis	Heam metabolism	Metabolism of purines	Revision
S-20	SLO-1	Vitamins – Types and functions.	Cycle test-1	Heam metabolism	Cycle test-2	Model exam
S 21-24	SLO-1	Estimation of aminoacids by formal titration method.	Estimation of RNA by Orcinol method.	Qualitative analyses of carbohydrates.	Qualitative analyses of amino acids.	Model Practical

Learning Resources	Theory: 1. Nelson & Cox [2017], Lehninger's "Principles of Biochemistry", 7th Edition, W.H.Freeman& Company 2. Harper's (2015), "Illustrated Biochemistry" 30th Edition, Lange Medical Books 3. LubertStryer [2015], "Bio chemistry", 8th Edition, Freeman &Co.Voet&Voet [2012], "Fundamentals of Biochemistry", 4th Edition, John Willey & Sons.

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (10%)		CLA – 3 (20%)		CLA – 4 (10%)			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	20%	20%	15%	15%	15%	15%	15%	15%	15%	15%
	Understand										
Level 2	Apply	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
	Analyze										
Level 3	Evaluate	10%	10%	15%	15%	15%	15%	15%	15%	15%	15%
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers	
Experts from Higher Technical Institutions	Internal Experts
1. Dr.P. Rajasekaran, Associate Professor & HOD, Department of Biotechnology, Rajalakshmi Engineering College 2. Dr. Y.Swarnalatha, Professor and Dean of Higher Studies, Department of Biotechnology, Sathyabama Institute of Science and Technology	Dr.G.Swamynathan, DBT, SRMIST

Course Code	PBT21102J		Course Name	MICROBIOLOGY		Course Category	C	Professional Core Course	L	T	P	C
									4	0	4	6

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

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

- CLR-1 : Understanding the taxonomic classification of microorganisms based on convention
- CLR-2 : understanding the techniques used for visualizing and identifying the microorganism
- CLR-3 : Knowledge of structure and organization of bacteria
- CLR-4 : Knowledge of structure and organization of viruses and fungi
- CLR-5 : Learning techniques on preparation and sterilization of media
- CLR-6 : Candidates understanding of the fundamentals of microbiology is useful for industry and academia

Course Learning Outcomes (CLO): At the end of this course, learners will be able to:

		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	13	14	15	PSO-1	PSO-2	PSO-3
CLO-1 :	To identify the microorganism based on taxonomical rules	3	80	70	H	-	-	H	-	-	-	-	H	H	-	-				M	H	H
CLO-2 :	Application of techniques for identifying microorganisms using technologies	3	85	75	H	H	H	H	H	-	M	-	H	H	-	-				M	H	H
CLO-3 :	Applying knowledge to identify bacteria based on structure and functional organelles	3	75	70	H	-	-	H	-	-	M	-	H	H	-	-				M	H	H
CLO-4 :	Applying knowledge to identify viruses and fungi based on structure and functional organelles	3	85	80	H	-	-	H	-	-	-	-	H	M	-	-				M	H	H
CLO-5 :	Knowing media preparation and sterilization in microbiology	3	85	75	H	H	H	H	H	M	M	-	H	H	-	M				M	H	H
CLO-6 :	Overall understanding and application of microbiological concepts in the progress of industry and academics	3	80	70	H	H	H	H	H	-	-	-	H	H	-	-				M	H	H

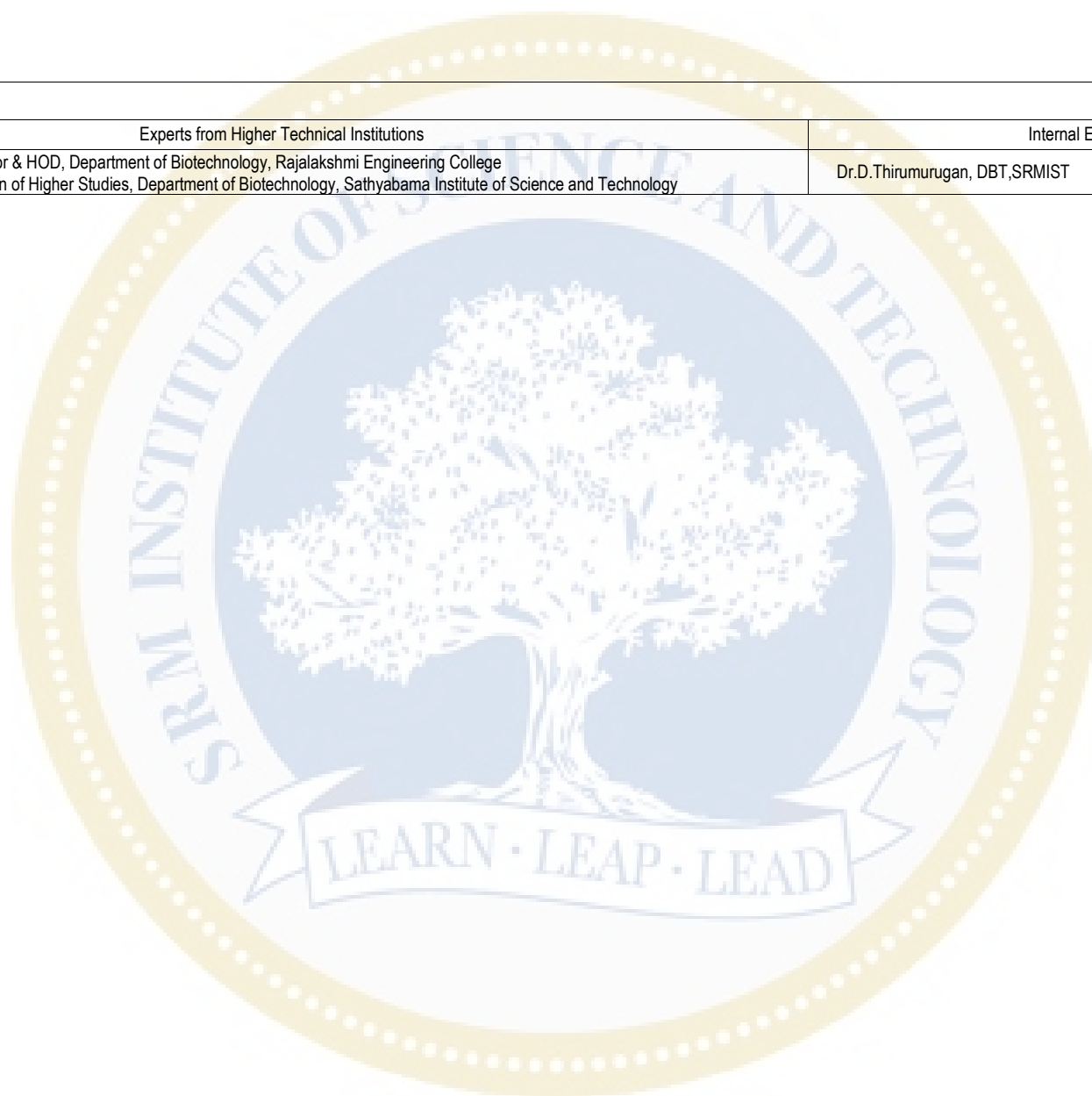| Duration (hour)		24	24	24	24	24
S-1	SLO-1	Microbiology- Introduction	Morphological types of Bacteria - Introduction	Structure and organization of viruses	General characteristics and distribution of fungi	Role of microorganisms in ecosystem
S-2	SLO-1	Scope of microbiology	Cell structure, size, shape and arrangement.	General property of viruses	fungal cell ultra- structure and thallus organization	Economic importance of bacteria in Agriculture: Biofertilizers
S-3	SLO-1	Microbial Taxonomy: Definition and systematics	Cell walls of Gram negative and Gram positive bacteria	Viral Replication -I	fungal cell wall structure and synthesis	Biological N_2 fixation
S-4	SLO-1	Microbial Taxonomy: Definition and systematics	Cell walls of archaebacteria	Viral Replication -II	Reproduction- sexual reproduction	N_2 fixation - genes and regulations in Rhizobium
S 5-8	SLO-1 / SLO-2	Lab1 : Cleaning of Glassware and laboratory rules	Lab 4: Smear preparation and simple staining	Lab 7: capsular staining technique	Lab 10: Enumeration of Bacteria- Serial dilution, Pour plate and Spread plate method	Lab 13: Biochemical tests- TSI

S-9	SLO-1	Classical approach - Numerical taxonomy	Cell wall synthesis	Ultra structure–Bacteriophages	Reproduction- Asexual reproduction	Biopesticides - (Bacillus thurengiensis)
S-10	SLO-1	Chemical taxonomy	Capsule types, composition, function	Lytic and lysogenic cycle	Nutritional types of fungi	Importance of bacteria in environment-Bioremediation
S-11	SLO-1	Genetic taxonomy	Cell membranes and periplamicspace-function	Sub-viral particles: Virusoids	Symbiotic fungi	Sewage treatment method
S-12	SLO-1	Nomenclatural rules and identification	Structure, function and arrangement of flagella	Sub-viral particles: Prions	Symbiotic fungi	Importance of bacteria in Industry-Beer production
S 13-16	SLO-1 SLO-2	Lab2: Principles and method of sterilization– Heat, Filtration and Radiation	Lab 5- Gram's staining technique	Lab 8: Staining of Fungi – LPCB	Lab 11: Pure culture technique-Streak plate method and study of colony morphology.	Lab 14: Antibiotics sensitivity test- Disk diffusion-Kirby Bauer method
S-17	SLO-1	Classification – Five kingdoms and Three kingdoms.	Structure and function of cilia and pili	Sub-viral particles: Virusoids	Lichens	Wine production
S-18	SLO-1	Woese domain system	Internal membrane systems	Viruses of Algae	Economic Importance of fungi in food, Agriculture	Probiotics
S-19	SLO-1	Classification of salient features of bacteria according to Bergey's Manual of systemic Bacteriology	Mycoplasma	Viruses of Fungi and Cyanobacteria	Economic Importance of fungi in medicine and environment	Antibiotics (Penicillin production)
S-20	SLO-1	Classification of salient features of bacteria according to Bergey's Manual of systemic Bacteriology.	Endospore-Structure & Function	Revision	Revision	Revision
S 21-24	SLO-1 SLO-2	Lab 3- Preparation of media (Solid, Semi solid and Liquid)	Lab 6: Spore staining technique	Lab 9: Demonstration of motility by hanging drop method	Lab 12: Biochemical tests- IMViC	Lab 15: Antibiotics sensitivity test- Disk diffusion-Kirby Bauer method

Learning Resources	Text Books: 1. M.J. Pelezar, E.C.S. Chan and N.R. Krieg "Microbiology"– Krieg Tata McGraw Hill Publications, 2007. 2. Prescott, Harley and Klein, "Microbiology", McGraw Hill publications, Fifth edition, 2003.	Reference: 1. Jacquelyn G.Black, "Microbiology -Principles and Explorations" Wiley publications 2008. 2. Sherris Medical Microbiology: An introduction to infectious diseases (2010) Kenneth

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (10%)		CLA – 3 (20%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	20%	20%	15%	15%	15%	15%	15%	15%	15%	15%
	Understand										
Level 2	Apply	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
	Analyze										
Level 3	Evaluate	10%	10%	15%	15%	15%	15%	15%	15%	15%	15%
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Higher Technical Institutions		Internal Experts
Dr.P. Rajasekaran, Associate Professor & HOD, Department of Biotechnology, Rajalakshmi Engineering College Dr. Y.Swarnalatha, Professor and Dean of Higher Studies, Department of Biotechnology, Sathyabama Institute of Science and Technology		Dr.D.Thirumurugan, DBT,SRMIST

Course Code	PBT21D01T	Course Name	ENZYME TECHNOLOGY	Course Category	C	Professional Core Course	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	NIL	Progressive Courses		NIL
Course Offering Department	Biotechnology	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
CLR-1 :	Understanding the classification of enzymes & properties																		
CLR-2 :	Understanding the techniques used for purification of enzymes																		
CLR-3 :	Knowledge on enzyme involvement in lowering activation energy																		
CLR-4 :	Knowledge on different inhibitors and its role																		
CLR-5 :	Understanding the importance of coenzymes																		
CLR-6 :	Candidates acquire knowledge about the enzyme role and its importance																		

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Scientific 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	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	Students understand the fundamentals of enzymes.	3	80	80	H	-	-	H	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	Students gain knowledge about the kinetics of enzyme activity.	3	80	80	H	H	H	H	H	-	-	-	-	-	--	-	-	-	-
CLO-3 :	Students understand the difference between various inhibitors.	3	90	80	H	-	-	H	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	Students acquire knowledge on industrial applications of enzymes.	3	90	80	H	-	-	H	-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	Students understand the mechanism of enzyme action.	3	90	90	H	H	H	H	H	-	-	-	-	-	-	-	-	-	-
CLO-6 :	Students understand the importance of enzymes in medical field.	3	80	80	H	H	H	H	H	-	-	-	-	-	-	-	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Definition, IUB enzyme classification.	Collision and transition state theory	Kinetics- steady state kinetics	Isoenzymes-LDH	Immobilisation - methods & Importance of enzyme immobilization
S-2	SLO-1	IUB enzyme classification	Collision and transition state theory	Michalies-Menten equation	Creatine kinase	Immobilisation - methods & Importance of enzyme immobilization
S-3	SLO-1	enzyme activity	Lock and key - induced fit model of enzyme-substrate interactions.	Michalies-Menten equation	Coenzymes introduction	Properties and application of immobilized enzymes.
S-4	SLO-1	Enzyme turnover number, specific activity.	Lock and key - induced fit model of enzyme-substrate interactions.	LB plot, Eadie – Hofstee equation.	NAD, NADP	Properties and application of immobilized enzymes.
S-5	SLO-1	Concept of enzyme-substrate complex	Acid-base catalysis	Enzyme inhibition – competitive - non-competitive, uncompetitive. Allosteric inhibition.	FAD, FMN	Industrial uses of enzymes
S-6	SLO-1	Concept of enzyme-substrate complex	nucleophilic catalysis	Enzyme inhibition – competitive	Thiamine Pyrophosphate, Pyridoxal Phosphate	Industrial uses of enzymes
S-7	SLO-1	activation energy	Mechanism of chymotrypsin	Enzyme inhibition –non-competitive	Lipoic Acid - Tetrahydro folate & Vitamin B12.	Industrial uses of enzymes

S-8	SLO-1	factors affecting enzyme activity.	Mechanism of lysozyme.	Enzyme inhibition- un competitive	Immobilisation - methods & Importance of enzyme immobilization.	Medical applications of enzymes
S-9	SLO-1	factors affecting enzyme activity.	Cycle test -1	Allosteric inhibition.	Cycle test-2	Model exam

Learning Resources	Theory: 1. Nicholas C. Price and Lewis Stevens, *"Fundamentals of Enzymology"*, Oxford University Press, 2003. 2. Trevor Palmer and Philip Bonner, Enzymes –*"Biochemistry, Biotechnology, Clinical chemistry*, 2nd edition, East-West Press Pvt. Ltd, 2004. 3. Lehninger, Nelson and Cox, *"Principles of Biochemistry*, 6th edition, W.H. Freeman & Company, 2013. 4. Prakash M.,DigmartiBhaskaraRao,Jena T, *"Enzyme Biotechnology"*, 1st edition, Discovery Publication, 2010.

Learning Assessment

Level	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (10%)		CLA – 3 (20%)		CLA – 4 (10%) #			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	30%	-	30%	-	30%	-	30%	-	30%	-
	Understand										
Level 2	Apply	40%	-	40%	-	40%	-	40%	-	40%	-
	Analyze										
Level 3	Evaluate	30%	-	30%	-	30%	-	30%	-	30%	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

Course Designers	
Experts from Higher Technical Institutions	Internal Experts
1. Dr.P. Rajasekaran, Associate Professor & HOD, Department of Biotechnology, Rajalakshmi Engineering College 2. Dr. Y.Swarnalatha, Professor and Dean of Higher Studies, Department of Biotechnology, Sathyabama Institute of Science and Technology	Dr. S.VijayaBharathi, DBT, SRMIST

COURSE CODE	PBT21S01T	COURSE NAME	MATHEMATICAL CALCULATIONS IN BIOLOGY	COURSE CATEGORY	S	SKILL ENHANCEMENT COURSES	L	T	P	C
							2	0	0	2

Pre-requisite Courses	Nil	Co-requisite Courses	NIL	Progressive Courses	NIL
Course Offering Department	Biotechnology	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
CLR-1 :	Knowledge on GLP and significant digits	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Scientific 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	PSO - 1	PSO - 2	PSO – 3
CLR-2 :	Knowledge onsolution and mixtures																		
CLR-3 :	Knowledge on growth kinetics																		
CLR-4 :	Knowledge on nucluiec acid quantification																		
CLR-5 :	Knowledge on protein quantification																		
CLR-6 :	Overall Knowledge On Using Mathematics In Biotechnology																		

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																		
CLO-1 :	Learning on GLP and digits	3	85	80	L	L	L	M	L	-	-	-	L	M	H	M	-	-	-
CLO-2 :	Learning on calculation in solution and mixtures	3	80	75	M	H	M	M	M	-	-	-	M	M	H	M	-	-	-
CLO-3 :	Calculation on growth kinetics	3	85	80	H	H	M	H	M	-	-	-	M	M	H	H	-	-	-
CLO-4 :	Learning calculations on nucleic acids and DNA	3	85	80	M	H	M	H	M	-	-	-	M	M	H	H	-	-	-
CLO-5 :	Learning calculations on proteins	3	85	80	H	H	M	H	H	-	-	-	M	M	H	M	-	-	-
CLO-6 :	Learning basic calculations used on a daily basis in biotechnology laboratories	3	75	80	H	H	M	H	M	-	-	-	M	M	H	M	-	-	-

	Duration (hour)	6	6	6	6	6
S-1	SLO-1	Introduction to mathematics in biology	concentrations by factor of X	manipulating cell concentration	Determination of concentration of dsDNA	Protein concentration Bradford assay
	SLO-2	History of GLP	percent solutions	calculating generation time	Determination of concentration of dsDNA	Protein quantification by absorbance A280
S-2	SLO-1	Definition of GLP	Diluting percent solutions	calculating generation time	Determination of concentration of ssDNA	Protein quantification by absorbance A205
	SLO-2	Significant digits	Moles and molecular weight	plotting OD vs time on a graph	Determination of concentration of RNA	absorbance coefficient
S-3	SLO-1	Significant digits	Molarity, Gram equivalents	Measuring cell concentration on a hemocytometer	purity of DNA	absorbance coefficient
	SLO-2	converting numbers from scientific to decimal notations	Diluting molar solutions	Measuring cell concentration on a hemocytometer	oligonucleotide quantification	extinction coefficient

S-4	SLO-1	*converting numbers from scientific to decimal notations*	*conversion of molarity to percent solutions*	*Measuring cell concentration on a hemocytometer*	*determination of molecular weight*	*importance of extinction coefficient*
	SLO-2	*conversion factors*	*conversion of % solutions to molarity*	*Multiplicity of phage infection*	*Molarity of DNA*	*specific activity of enzyme*
S -5	SLO-1	*Canceling terms*	Normality	*Measuring phage titer*	*nucleic acid length*	*specific activity of enzyme*
	SLO-2	*Discussion on overall notations and clarifications*	*pH & pOH*	*Diluting bacteriophage*	*Problem solving questions*	*Problem solving questions*
S-6	SLO-1	Calculating dilutions	*Problem solving questions*	*Problem solving questions*	*Discussion of problems*	*Discussion on problems solved*
	SLO-2	*concentrations by factor of X*	*Discussion of problems*	*Discussion on problems solved*	*Discussion of problems*	*Discussion on problems solved*

Learning Resources	Theory:
	1. Calculations for Molecular Biology and Biotechnology- A guide to mathematics in the laboratory". by Frank H. Stephenson. Academic Press- 2nd Edition (2014)

Learning Assessment

Level	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (10%)		CLA – 3 (20%)		CLA – 4 (10%) #			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	30%	-	30%	-	30%	-	30%	-	30%	-
	Understand										
Level 2	Apply	40%	-	40%	-	40%	-	40%	-	40%	-
	Analyze										
Level 3	Evaluate	30%	-	30%	-	30%	-	30%	-	30%	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.

Course Designers	
Experts from Higher Technical Institutions	Internal Experts
1. Dr.P. Rajasekaran, Associate Professor & HOD, Department of Biotechnology, Rajalakshmi Engineering College 2. Dr. Y.Swarnalatha, Professor and Dean of Higher Studies, Department of Biotechnology,Sathyabama Institute of Science and Technology	Dr.N.Prasanth Bhatt,DBT,SRMIST

COURSE CODE	PBT21S02T	COURSE NAME	STRUCTURAL BIOINFORMATICS	COURSE CATEGORY	S	SKILL ENHANCEMENT COURSE	L	T	P	C
							2	0	0	2

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

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

CLR-1 :	Understand the overview about biological macromolecular structures
CLR-2 :	Understand the protein structure prediction methods.
CLR-3 :	Learn about protein folding and its significance
CLR-4 :	Knowledge on computational methods, tools and algorithms employed for Biological Data Interpretation
CLR-5 :	Various computational methods and tools used for protein secondary structure prediction and genome analysis
CLR-6 :	Introduction to the concept of molecular modelling

Course Learning Outcomes (CLO): At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Scientific 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	PSO - 1	PSO - 2	PSO – 3
CLO-1 : Knowledge about conformations of protein and its significance	3	80	70	M	M	M	-	M	H	M	-	-	H	H	H	M	H	H
CLO-2 : Understanding the basics of protein structure alignment	3	80	70	M	M	M	-	M	H	M	-	-	H	H	H	M	H	H
CLO-3 : various approaches in protein three dimensional structure prediction	3	85	75	M	M	M	-	M	H	M	-	-	H	H	H	M	H	H
CLO-4 : Understand the network motifs in protein structure	3	85	75	M	M	M	-	M	H	M	-	-	H	H	H	M	H	H
CLO-5 : knowledge about various concepts employed in drug discovery and its applications	3	85	75	M	M	M	-	M	H	M	-	-	H	H	H	M	H	H
CLO-6 : Overview about biological macromolecular structures and structure prediction methods.	3	80	70	M	M	M	-	M	H	M	-	-	H	H	H	M	H	H

Duration (hour)		6	6	6	6	6
S-1	SLO-1	Overview of structural bioinformatics	Protein structure	Globular proteins	3D structure prediction	macromolecular interactions
	SLO-2	understanding structural basis for biological phenomena	Conformational Analysis of proteins	Prediction of secondary structure	Homology Modeling	Protein protein interactions
S-2	SLO-1	Biological database	Primary and secondary structure	Chou Fasman	Steps in homology modeling	Protein protein interactions
	SLO-2	Types of Database	Tertiary and Quaternary structure	GOR methods	Swiss model	Protein DNA interactions
S-3	SLO-1	Structure Databases	Forces that determine protein structure	HMM	Fold Recognition Methods	Protein ligand interactions
	SLO-2	PDB	polypeptide chain geometries	NN	Ab initio methods	interactions databases
S-4	SLO-1	NDB	Ramachandran Map	Transmembrane proteins	Rosetta	BIND

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	SLO-2	CCD	potential energy calculations	transmembrane structure prediction	CASP	ProNIT
S-5	SLO-1	Structural Classification	observed values for rotation angles	solvent accessibility	Cycle test 2	Molecular Docking
	SLO-2	SCOP	structure comparison and alignment	HMM	Predicted structure quality assessment	Docking - principles and methods
S-6	SLO-1	CATH	Cycle test 1	NN	WHATIF	Applications of molecular docking
	SLO-2	FSSP	structure alignment	calculations and prediction	Interactomes	Molecular docking tools

Learning Resources	Theory 1. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins byAndreas D. Baxevanis and B.F. Francis Ouellette 2. Introduction to Bioinformatics by Arthur Lesk

Learning Assessment

Level	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (10%)		CLA – 3 (20%)		CLA – 4 (10%) #			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	30%	-	30%	-	30%	-	30%	-	30%	-
	Understand										
Level 2	Apply	40%	-	40%	-	40%	-	40%	-	40%	-
	Analyze										
Level 3	Evaluate	30%	-	30%	-	30%	-	30%	-	30%	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

\# CLA-1, CLA-2 and CLA-3 can be from any combination of these: Online Aptitude Tests, Classroom Activities, Case Studies, Poster Presentations, Power-point Presentations, Mini Talks, Group Discussions, Mock interviews, etc.
\#\# CLA – 4 can be from any combination of these: Assignments, Seminars, Short Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers	
Experts from Higher Technical Institutions	Internal Experts
1. Dr.P. Rajasekaran, Associate Professor & HOD, Department of Biotechnology, Rajalakshmi Engineering College 2. Dr. Y.Swarnalatha, Professor and Dean of Higher Studies, Department of Biotechnology, Sathyabama Institute of Science and Technology	DR. V.G.VIDHYA, DBT,SRMIST

COURSE CODE	PBT21AE1T	COURSE NAME	ENTREPRENEURSHIP IN LIFE SCIENCES	COURSE CATEGORY	A	ABILITY ENHANCEMENT COURSE	L	T	P	C
							2	0	0	2

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

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

- CLR-1 : Understand about managerial functions
- CLR-2 : Learn about the traits of an entrepreneur
- CLR-3 : Learn about IPR, Patents and Copyright laws
- CLR-4 : Understand about bio-entrepreneurship
- CLR-5 : Learn about generating business ideas
- CLR-6 : Develop the qualities of becoming an entrepreneur

Course Learning Outcomes (CLO): At the end of this course, learners will be able to:

CLO	Description	Level of Thinking	Expected Proficiency (%)	Expected Attainment (%)	1 Fundamental 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 PSO-1	14 PSO-2	15 PSO-3
CLO-1	Understand the principles of management	2	70	65	H	H	M	M	L	-	L	-	L	-	L	H	-	-	-
CLO-2	Analyze the ways of entrepreneurial development	2	80	75	H	H	H	M	L	-	L	-	L	-	M	H	-	-	-
CLO-3	Learn about setting up of business organization	2	75	65	H	M	H	M	H	-	L	-	H	-	H	H	-	-	-
CLO-4	Acquire knowledge about business opportunities in life sciences	2	75	70	H	M	H	H	H	-	L	-	H	-	H	H	-	-	-
CLO-5	Learn about how to commercialize biotechnology products	2	75	70	H	H	H	H	H	-	M	-	H	-	H	H	-	-	-
CLO-6	Analyze and understand about running a business model	2	70	65	H	H	H	H	M	-	M	-	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	SLO-1	Principles of Management	Entrepreneurship	Types of business organizations	Business opportunities in life sciences	Business Idea generation
S-2	SLO-1	Managerial functions	Scope and Importance of Entrepreneurship	Business models	Agro-based industries	Product commercialization
S-3	SLO-1	Planning, Organizing	Entrepreneur	Setting up of start-ups	Food processing industries	Packaging
S-4	SLO-1	Staffing, Directing and Controlling	Entrepreneurial traits	Funding agencies promoting business set up	Pharmaceutical industries	Pricing strategies
S-5	SLO-1	Sales Management	Entrepreneurial development	Intellectual Property Rights	Dairy industry	International marketing
S-6	SLO-1	Marketing and Advertising	Training and government institutions promoting entrepreneurship	Patents, Trademarks and Copyrights	Waste management	Case studies

Learning Resources	Text Books: 1. Craig Shimasaki. "Biotechnology Entrepreneurship: Starting, Managing, and Leading Biotech Companies". Academic Press, 2014. 2. David H. Holt. "Entrepreneurship: New Venture Creation" Prentice-Hall, 1991.	References: 1. Jack M. Kaplan. "Getting started in Entrepreneurship". John Wiley & Sons, 2001. 2. H. Koontz, H. Weihrich. "Essentials of Management". McGraw Hill Education, 1990.

Learning Assessment											
Level	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (10%)		CLA – 3 (20%)		CLA – 4 (10%) #			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	30%	-	30%	-	30%	-	30%	-	30%	-
	Understand										
Level 2	Apply	40%	-	40%	-	40%	-	40%	-	40%	-
	Analyze										
Level 3	Evaluate	30%	-	30%	-	30%	-	30%	-	30%	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers	
Experts from Higher Technical Institutions	Internal Experts
1. Dr.P. Rajasekaran, Associate Professor & HOD, Department of Biotechnology, Rajalakshmi Engineering College 2. Dr. Y.Swarnalatha, Professor and Dean of Higher Studies, Department of Biotechnology, Sathyabama Institute of Science and Technology	Dr.G.Swamynathan ,DBT,SRMIST

Course Code	PCD21AE1T	Course Name	Professional Skills and Problem Solving	Course Category	A	Ability Enhancement Course	L	T	P	C
							1	0	0	1

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Career Development Centre			Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1:	utilise success habits to enhance professionalism
CLR-2:	enable to solve problems and to crack competitive exams.
CLR-3:	understand and master the mathematical concepts to solve types of problem
CLR-4:	Identify a logically sound and well-reasoned argument
CLR-5:	expertise in communication and problem-solving skills
CLR-6:	develop problem solving skills with appropriate strategies

Course Learning Outcomes (CLO): At the end of this course, learners will be able to:

CLO	Description	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Disciplinary Knowledge	Critical Thinking	Problem Solving	Analytical Reasoning	Research Skills	Team Work	Scientific Reasoning	Reflective Thinking	Self-Directed Learning	Multicultural Competence	ICT Skills	Life Long Learning	PSO-1	PSO-2	PSO-3
CLO-1	identify success habits and inculcate professional skills	2	80	75	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
CLO-2	grasp the approaches and strategies to solve problems with speed and accuracy	2	80	70	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
CLO-3	collectively solve problems in teams and groups	2	75	70	H	H	H	H	H	H	H	M	H	H	M	H	H	H	H
CLO-4	construe and solve an argument through critical thinking	2	80	75	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
CLO-5	acquire communication and problem- solving skills	2	80	70	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
CLO-6	apply problem solving techniques and skills	2	80	75	H	H	H	H	H	H	H	H	H	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)		3	3	3	3	3
S-1	SLO-1	Personal profiling	Creative problem solving method	Case study analysis	Emotional Intelligence	Communication skills
	SLO-2	USP& Personal branding	Techniques	Case study analysis	Personal & social competence	Communication skills
S-2	SLO-1	Assumption and strengthening of an argument	Weakening and Inference of an argument	Conclusion and paradox of an argument	Main idea and structure of a passage	Tone and Style of a passage
	SLO-2	Assumption and strengthening of an argument	Weakening and Inference of an argument	Conclusion and paradox of an argument	Main idea and structure of a passage	Tone and Style of a passage
S-3	SLO-1	Arithmetic: Simple equations	Profit, Loss & Discount	Average	Percentage	Mixtures & alligation
	SLO-2	Equation 1 and equation 2	Interest calculation	Average	Percentage	Mixtures & alligation

Learning Resources	1.Arun Sharma-Quantitative aptitude for CAT, Tata McGraw Hill 2.Dinesh Khattar-The Pearson Guide to QUANTITATIVE APTITUDE for competitive examinations.	3.Manhatten Prep - GRE Reading Comprehension and Essays 4. Seven habits of highly effective people- Steven Covey 5. Manhattan Prep – Critical Reasoning Skills and Techniques

Learning Assessment												
	Bloom's Level of Thinking	**Continuous Learning Assessment (50% weightage)**									**Final Examination (50% weightage)**	
		CLA – 1 (10%)		CLA – 2 (10%)		CLA – 3 (20%)		CLA – 4 (10%)#				
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		Theory	Practice
Level 1	Remember	30 %	-	30 %	-	30 %	-	30 %	-		30 %	-
	Understand											
Level 2	Apply	40 %	-	40 %	-	40 %	-	40 %	-		40 %	-
	Analyze											
Level 3	Evaluate	30 %	-	30 %	-	30 %	-	30 %	-		30 %	-
	Create											
	Total	100 %		100 %		100 %		100 %			100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Scientific Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications etc.,

Course Designers	
Experts from Industry	Internal Experts
1.Mr Ajay Zenne, Career Launcher, ajay.z@careerlauncher.com	*Mr. P Priyanand, SRMIST*
	Mrs. Kavitha Srisarann, SRMIST
2. Mr.Pratap Iyer, Study Abroad Mentors, Mumbai, pratap.iyer30@gmail.com	*Mr. Harinarayana Rao, SRMIST*
	Dr. A Clement, SRMIST

Course Code	PBT21201J	Course Name	MOLECULAR BIOLOGY	Course Category	C	Professional Core Course	L	T	P	C
							4	0	4	6

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department		BIOTECHNOLOGY		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
CLR-1 :	Understanding the basics of Central dogma																		
CLR-2 :	Understanding the properties and functions of DNA																		
CLR-3 :	Understanding the importance of DNA replication and repair																		
CLR-4 :	Knowledge about Transcription																		
CLR-5 :	Knowledge on translation																		
CLR-6 :	Understanding gene regulation																		

Course Learning Outcomes (CLO)	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Fundamental 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	PSO – 1	PSO – 2	PSO – 3
CLO-1 :	Acquired basic Knowledge on DNA RNA and gene regulation	2	85	80	L	H	H	H	H	-	-	M	M	L	-	H	-	-	-
CLO-2 :	Basic Knowledge on DNA replication and DNA repair	3	85	80	L	H	H	H	H	-	-	M	M	L	-	H	-	-	-
CLO-3 :	Strong basis for understanding the transcription in pro and Eukaryotes	3	85	80	L	H	H	H	H	-	-	M	M	L	-	H	-	-	-
CLO-4 :	Gaining knowledge on molecular boiology concepts	3	85	80	L	H	H	H	H	-	-	M	M	L	-	H	-	-	-
CLO-5 :	Better knowledge gained Signal transductin	3	85	80	L	H	H	H	H	-	-	M	M	L	-	H	-	-	-
CLO-6 :	Overall understanding transition of DNA to protein/Enzyme	3	85	80	L	H	H	H	H	-	-	M	M	L	-	H	-	-	-

Duration (hour)		24	24	24	24	24
S-1	SLO-1	Structure of DNA	DNA Replication	Transcription	Translation	Gene Regulation
S-2	SLO-1	Watson and Crick Model	Mechanism of Replication	Mechanism of Transcription in prokaryotes	Genetic code	Operons
S-3	SLO-1	Forms of DNA	Rolling circle replication	Mechanism of Transcription in eukaryotes	Prokaryotic and eukaryotic ribosomes	Cis-acting regulatory elements
S-4	SLO-1	RNA – Structure, types and functions	Theta replication, D-Loop	RNA Polymerases	Prokaryotic translation	Trans-regulatory elements
S 5-8	SLO-1	Isolation of DNA from animal or plant or microbial sources.	DNA quantification using a spectrophotometer.	Isolation of plasmid DNA from bacterial culture	Restriction Digestion (single and double) -	Southern Blotting
S-9	SLO-1	Unusual structures of DNA & RNA	DNA damage	Transcription factors	Eukaryotic translation	Gene regulation in prokaryotes
S-10	SLO-1	Prokaryotic &Eukaryotic genome	Mutation & its types	Regulatory elements	Initiation factors	Transcriptional regulation
S-11	SLO-1	Genome organization in Prokaryotes	Mutagenesis	Post-transcriptional modifications	Elongation factors	Riboswitches

S-12	SLO-1	Genome organization in Eukaryotes	Types of mutagens	Processing at 5' end	Regulation of translation	Lac Operon
S 13-16	SLO-1	Agarose gel electrophoresis	RNA quantification using a spectrophotometer.	PCR	Restriction Digestion (single and double)	Western blotting.
S-17	SLO-1	Mitochondrial DNA, Chloroplast DNA	DNA Repair mechanisms	Processing at 3' end	Protein folding	Trp Operon
S-18	SLO-1	Chromosome types and functions	Base Excision Repair, Nucleotide Excision Repair	Splicing	Post- translational modifications	Gene regulation in eukaryotes
S-19	SLO-1	Fine structure of gene	Recombination Repair	Alternative splicing	Epigenetic modifications	Chromatin remodeling
S-20	SLO-1	Types of genes	SOS Repair	mRNA transport	Protein sorting	Epigenetic gene regulation
S 21-24	SLO-1	Isolation of RNA from animal or plant or microbial source.	Isolation of plasmid DNA from bacterial culture	PCR	Ligation technique	Northern Blotting

Learning Resources	1. DavidFreifelder. "Essnetials of Molecualr Biology", 4th edition, 2015. 2. Cooper "The Cell – A molecular approach", 7th Edition, 2015. 3. Lewin's "Genes" – 12th Edition, 2017.

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (10%)		CLA – 3 (20%)		CLA – 4 (10%)			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	20%	20%	20%	10%	15%	15%	10%	10%	15%	15%
	Understand										
Level 2	Apply	20%	20%	30%	20%	20%	20%	20%	30%	20%	20%
	Analyze										
Level 3	Evaluate	10%	10%	10%	10%	15%	15%	10%	10%	15%	15%
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

 # CLA – 4 can be from any combination of these: Assignments, Seminars, Short Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers	
Experts from Higher Technical Institutions	Internal Experts
1. Dr.P. Rajasekaran, Associate Professor & HOD, Department of Biotechnology, Rajalakshmi Engineering College 2. Dr. Y.Swarnalatha, Professor and Dean of Higher Studies, Department of Biotechnology,Sathyabama Institute of Science and Technology	Dr.V.G.Vidhya ,DBT,SRMIST

Course Code	PBT21202J	Course Name	PLANT BIOTECHNOLOGY	Course Category	C	Professional Core Course	L	T	P	C
							4	0	4	6

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1 :	Understand about Plant Genome
CLR-2 :	Study about the plant tissue culture
CLR-3 :	Gain knowledge on the gene transfer methods
CLR-4 :	Learn about the vectors
CLR-5 :	Learn about Single-cell proteins
CLR-6 :	Understand the scope and commercialization of Plant biotechnology

Course Learning Outcomes (CLO): At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	PSO - 1	PSO - 2	PSO - 3
CLO-1 : Understand the basic concepts of plant and organelle genome	3	80	70	H	M	H	H	M	L	L	L	L	L	-	M	-	-	-
CLO-2 : Understand the concepts of tissue culture techniques	3	85	75	H	H	H	H	H	H	H	H	M	M	-	H	-	-	-
CLO-3 : Gain knowledge on genetic engineering of plants	3	75	70	M	H	H	H	H	H	M	M	M	L	-	H	-	-	-
CLO-4 : Apply knowledge vectors and protoplast isolation methods	3	85	80	M	H	H	H	H	H	M	M	M	L	-	H	-	-	-
CLO-5 : Have overall understanding of applications of plant biotechnology	3	85	75	M	H	H	H	H	H	M	M	M	L	-	H	-	-	-
CLO-6 : Apply knowledge on plant tissue culture and genetic engineering of plants	3	80	70	M	H	H	H	H	H	M	M	M	L	-	H	-	-	-

Duration (hour)		24	24	24	24	24
S-1	SLO-1	Introduction of plant genome	Plant biotechnology – overview	Genetic engineering in plants - Introduction	Selectable markers	Commercialization of plant biotechnology
S-2	SLO-1	Structural organization nuclear genome	History of plant biotechnology	methods of gene transfer	reporter genes	improvement of SCP
S-3	SLO-1	Chloroplast genome	Achievements in plant biotechnology	Physical methods	promoters used in vectors	Algal source
S-4	SLO-1	Chloroplast genome	Media Components	Gene Gun	Transposons in transgenic plants	Fungal source
S 5-8	SLO-1	Isolation of plant genomic DNA	Isolation of total RNA from sprouting seeds	Shoot/ Root induction - organogenesis	Protoplast isolation – enzymatic method	Gus assay/ GFP cloning
	SLO-2					
S-9	SLO-1	CMS in Maize	Hormones and Sterilization	Electroporation	GURT	Hydrophonics
S-10	SLO-1	Mitochondrial genome	Micropropagation	Chemical methods	Gene silencing	Aquaphonics

S-11	SLO-1	Mitochondrial genome	Caulogenesis,	biological methods	crop improvement	plant cell bioreactors
S-12	SLO-1	Symbiotic associations	Organogenesis	Argrobacterium mediated Transformation	crop improvement	plant cell as bioreactors
S 13-16	SLO-1 SLO-2	Isolation of plant genomic DNA	Preparation of Plant tissue culture media and Stock solutions	Haploid production – Anther & ovule culture	Protoplast fusion by PEG	Isolation of Rhizobium from root nodules
S-17	SLO-1	molecular biology of N2 fixation	Embryogenesis	Agrobacterium Technology	Production of transgenic plants	therapeutic vaccines
S-18	SLO-1	molecular biology of N2 fixation	Somatic Embryogenesis	Chloroplast engineering	Molecular farming	therapeutic proteins
S-19	SLO-1	Genome Analysis - Arabidopsis	Protoplast technology	Chloroplast engineering	GM crops	Biosafety of GM plants
S-20	SLO-1	Genome Analysis - Arabidopsis	Protoplast technology	Transposons in Maize	GM seeds	ELSI
S 21-24	SLO-1 SLO-2	Isolation of total RNA from sprouting seeds	Germination of seed	Somatic embryogenesis	Agrobacterium mediated transformation	Model Exam

Learning Resources	Text Books: 3. DoodsD.H.,"Plant Genetic Engineering" Scientific American Books NY 2002. 4. LycettG.W.and Grierson D.,, "Genetic Engineering of crop plants" Butterworth-Heinemann, USA, 2007	Reference: 1. ChrispeelsM.J.andSadavaJhones D.F., "Plants, genes and agriculture", ASPP Press, 2009. 2. A. Hammond Mcgarvey and Yusibov,, "Plant biotechnology new products and application", Published by Springer, New Delhi, 2009

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (10%)		CLA – 3 (20%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	20%	20%	20%	20%	15%	15%	15%	15%	20%	20%
	Understand										
Level 2	Apply	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
	Analyze										
Level 3	Evaluate	10%	10%	10%	10%	15%	15%	15%	15%	10%	10%
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers	
Experts from Higher Technical Institutions	Internal Experts
1. Dr.P. Rajasekaran, Associate Professor & HOD, Department of Biotechnology, Rajalakshmi Engineering College 2. Dr. Y.Swarnalatha, Professor and Dean of Higher Studies, Department of Biotechnology, Sathyabama Institute of Science and Technology	Dr.Infant Santhosh ,DBT,SRMIST

Course Code	PBT21203J	Course Name	GENETIC ENGINEERING	Course Category	C	Professional Core Course	L	T	P	C
							4	0	4	6

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning			Program Learning Outcomes (PLO)															
CLR-1 :	Understanding the basics of chromosome	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-2 :	Understanding the properties and functions of restriction enzymes																		
CLR-3 :	Understanding the importance of vectors																		
CLR-4 :	Understanding the DNA amplication techniques																		
CLR-5 :	Knowledge on screening methods																		
CLR-6 :	Understanding gene editing and its importance																		

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	Acquire basic Knowledge on gene and inheritance	2	85	80	L	H	H	H	H	-	-	M	M	L	-	H	-	-	-
CLO-2 :	Basic Knowledge on restriction enzyme role in genetic engineering	3	85	80	L	H	H	H	H	-	-	M	M	L	-	H	-	-	-
CLO-3 :	Understanding the vectors types	3	85	80	L	H	H	H	H	-	-	M	M	L	-	H	-	-	-
CLO-4 :	Gain knowledge on PCR techniques	3	85	80	L	H	H	H	H	-	-	M	M	L	-	H	-	-	-
CLO-5 :	Gain knowledge on gene transfer methods	3	85	80	L	H	H	H	H	-	-	M	M	L	-	H	-	-	-
CLO-6 :	Overall understanding of gene editing technique	3	85	80	L	H	H	H	H	-	-	M	M	L	-	H	-	-	-

Duration (hour)		24	24	24	24	24
S-1	SLO-1	Impact of genetic engineering in modern society	Introduction to cloning vectors	Cloning strategy and Screening methods	Real-time PCR	siRNA technology
	SLO-2					
S-2	SLO-1	Restriction enzymes- introduction and types	Vectors: Prokaryotic Vectors: Plasmids	Screening methods	Real-time PCR	siRNA technology
	SLO-2					
S-3	SLO-1	Restriction enzymes- introduction and types	Phagmid	Gene transfer techniques: Bacterial Conjugation, Transformation	touchdown PCR, hot-start PCR	Micro RNA
	SLO-2					
S-4	SLO-1	Star activity of restriction enzymes	artificial chromosomes, Yeast vectors	Gene transfer techniques: Bacterial Conjugation, Transformation	touchdown PCR, hot-start PCR	construction of siRNA vectors
	SLO-2					
S 5-8	SLO-1	Isolation of plasmid DNA from bacterial cultur	Ligation technique	Preparation of competent cell and transform the competent in into EcoKI bacteria	Isolation of RNA	PCR
	SLO-2					
S-9	SLO-1	DNA modifying enzymes	artificial chromosomes, Yeast vectors	Transduction, Microinjection	colony PCR, asymmetric PCR, Cloning of PCR products	principle and application of gene silencing
	SLO-2					

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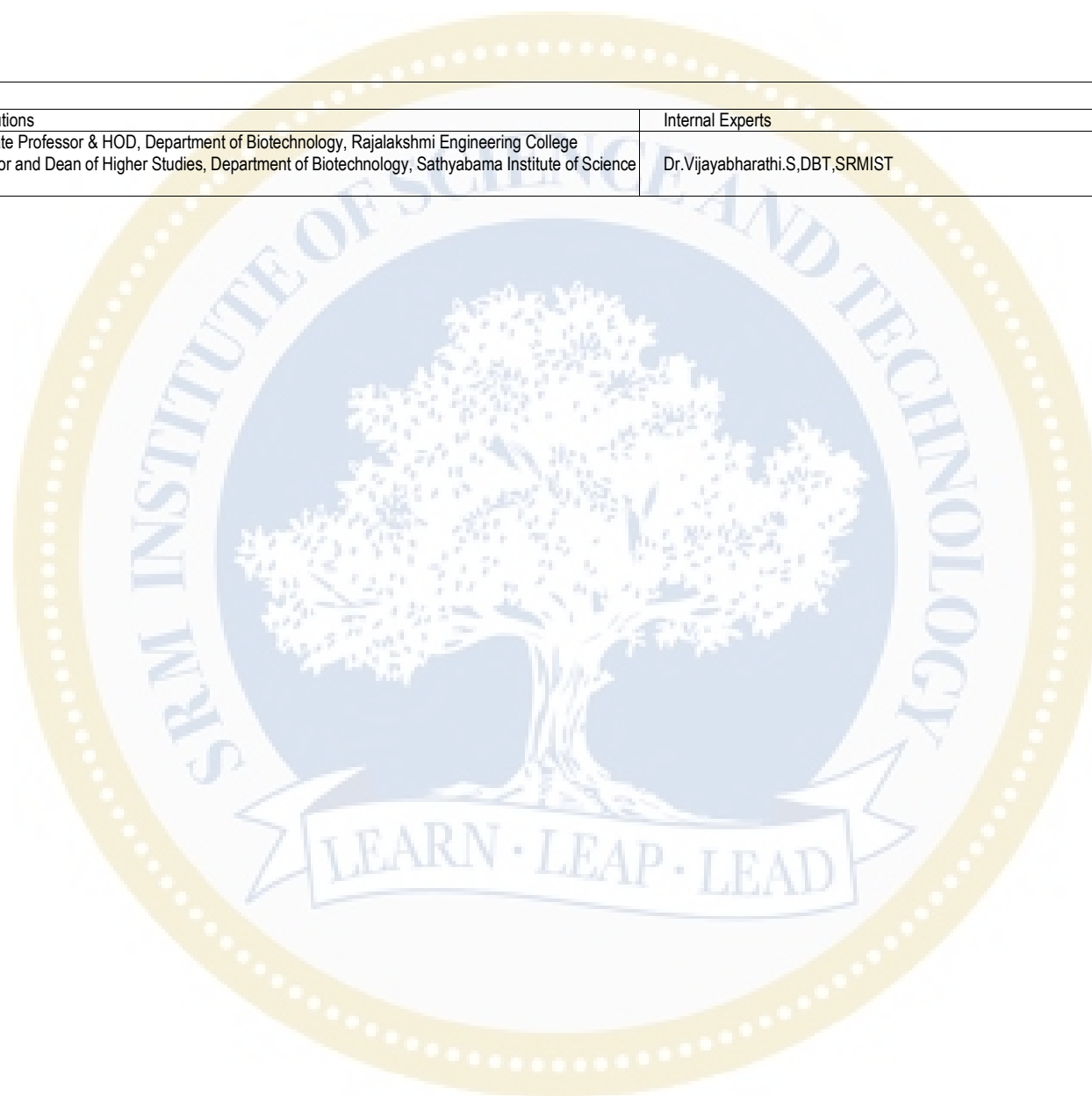|						
S-10	SLO-1	DNA modifying enzymes	Plant vectors	Transduction, Microinjection	colony PCR, asymmetric PCR, Cloning of PCR products	principle and application of gene silencing
	SLO-2					
S-11	SLO-1	Linkers and adapters	Plant Vectors	Electroporation, Microprojectile, Shot Gun method, Ultrasonication, Liposome fusion	DNA fingerprinting	gene knockouts and gene therapy
	SLO-2					
S-12	SLO-1	Homopolymer tailing	Animal viral vectors	Electroporation, Microprojectile, Shot Gun method, Ultrasonication, Liposome fusion	DNA fingerprinting	gene knockouts and gene therapy
	SLO-2					
S 13-16	SLO-1	Isolation, purification, and identification of protein	Ligation technique	Identification of recombinants – antibiotic markers, Blue-white colony selection	Quantification of DNA and RNA by spectrophotometer	Blotting technique
	SLO-2					
S-17	SLO-1	RNases-RNaseI, RNaseA, RNaseH -	Animal viral vectors	PCR – technique, designing of primers	DNA-protein interactions and analysis	CRISPR-CAS
	SLO-2					
S-18	SLO-1	Nucleases – RNase free DNAse- Exonuclease I,	Expression vectors	PCR – technique, designing of primers	DNA-protein interactions and analysis	CRISPR-CAS
	SLO-2					
S-19	SLO-1	Exonucelase III, Mung Bean	shuttle vectors	types of PCR – multiplex, nested; reverse-transcription PCR	Gene silencing techniques; introduction to siRNA	Revision
	SLO-2					
S-20	SLO-1	Nuclease. Kinases - T4 polynucleotide kinase. PhosphatasesTopoisomerase	plasmid vectors (high copy and low copy), phage vectors, cosmid vectors,	types of PCR – multiplex, nested; reverse-transcription PCR	Gene silencing techniques; introduction to siRNA	Revision
	SLO-2					
S 21-24	SLO-1	Restriction Digestion	Preparation of competent cell and transform the competent in to EcoKI bacteria	Identification of recombinants – antibiotic markers, Blue-white colony selection	PCR	MODEL EXAM
	SLO-2					

Learning Resources	1. Old, R. W., Primrose, S. B., & Twyman, R. M. (2001). Principles of Gene Manipulation: an Introduction to Genetic Engineering. Oxford: Blackwell Scientific 2. Lewin's "Genes" – 12th Edition, 2017. 3. Brown, T. A. (2006). Genomes (3rd ed.). New York: Garland Science Pub.

Learning Assessment												
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)		
		CLA – 1 (10%)		CLA – 2 (10%)		CLA – 3 (20%)		CLA – 4 (10%)				
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	
Level 1	Remember	20%	20%	20%	10%	15%	15%	10%	10%	15%	15%	
	Understand											
Level 2	Apply	20%	20%	30%	20%	20%	20%	20%	30%	20%	20%	
	Analyze											
Level 3	Evaluate	10%	10%	10%	10%	15%	15%	10%	10%	15%	15%	
	Create											
	Total	100 %		100 %		100 %		100 %		100 %		

CLA – 4 can be from any combination of these: Assignments, Seminars, Short Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers	
Experts from Higher Technical Institutions	Internal Experts
1. Dr.P. Rajasekaran, Associate Professor & HOD, Department of Biotechnology, Rajalakshmi Engineering College 2. Dr. Y.Swarnalatha, Professor and Dean of Higher Studies, Department of Biotechnology, Sathyabama Institute of Science and Technology	Dr.Vijayabharathi.S,DBT,SRMIST

Course Code	PBT21D02J	Course Name	GENOMICS AND PROTEOMICS	Course Category	D	DISCIPLINE ELECTIVE COURSE	L	T	P	C
							3	0	2	4

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department		BIOTECHNOLOGY	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
CLR-1 :	Understanding the methodologies used for database searching, and determining the accuracies of database search.																		
CLR-2 :	Knowledge on Basic algorithms used in Pair wise and Multiple alignments																		
CLR-3 :	Learning about Prediction of structure from sequence and subsequently testing the accuracy of predicted structures.																		
CLR-4 :	Determining the protein function from sequence through analyzing data																		
CLR-5 :	Application of probabilistic model to determine important patterns.																		
CLR-6 :	Learn various bioinformatics tools of genomic data analysis																		

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	PSO – 1	PSO – 2	PSO – 3
CLO-1 :	Understanding the existing software effectively to extract information from large databases	2	85	80	L	H	H	H	H	-	-	M	M	L	-	H	-	-	-
CLO-2 :	Candidates understanding on computer modeling	3	85	80	L	H	H	H	H	-	-	M	M	L	-	H	-	-	-
CLO-3 :	Develop problem-solving skills, including the ability to develop new algorithms and analysis methods	3	85	80	L	H	H	H	H	-	-	M	M	L	-	H	-	-	-
CLO-4 :	Analysis and development of models for better interpretation of biological data	3	85	80	L	H	H	H	H	-	-	M	M	L	-	H	-	-	-
CLO-5 :	Understanding the structural and functional relationships, and molecular evolution.	3	85	80	L	H	H	H	H	-	-	M	M	L	-	H	-	-	-
CLO-6 :	Applying basic principles of biology, computer science and mathematics to address complex biological problems	3	85	80	L	H	H	H	H	-	-	M	M	L	-	H	-	-	-

Duration (hour)		15	15	15	15	15
S-1	SLO-1	Biological Databases	Bootstrapping strategies.	regulatory elements in eukaryotes	Drug – characteristics	DNA Microarray -methods
S-2	SLO-1	Sequence alignment	Gene prediction in prokaryotes	Protein secondary structure prediction	Drug Designing	DNA Microarray - Applications
S-3	SLO-1	Pairwise alignment methods;	ORF prediction	Chou fasman, GOR	Drug discovery pipeline	Microarray analysis
S4-5	SLO-1	NCBI	PDB	Clustal X - NJ	RASMOL	Molecualr docking
S-6	SLO-1	multiple sequence alignment methods	HMM, NN	transmembrane proteins prediction	Cycle test 2	Image processing

S - 7	SLO-1	Evolutionary analysis: distances	Gene prediction in eukaryotes.	Coiled coil prediction.	Target identification & validation	Normalization
S- 8	SLO-1	clustering methods	HMM, NN	Protein tertiary structure prediction	Lead compound identification	Cluster analysis – k means
S9-10	SLO-1	EMBL, DDBJ	BLAST	Clustal X - NJ	RASMOL	Molecualr docking
S - 11	SLO-1	rooted and unrooted tree representation	Prediction Algorithms.	homology modelling	Serendipity	Self-organizing maps
S - 12	SLO-1	Substitution matrices	Cycle test 1	Threading and fold recognition	ADME Prediction	CHIP-on-chip arrays
S-13	SLO-1	PAM & BLOSUM	regulatory elements in prokaryotes	ab initio protein	QSAR method	Protein Microarray
S14-15	SLO-1	UNIPROT	Global & Local alignment	Swiss model	Chemsketch	Model Practical

Learning Assessment												
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)										Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (10%)		CLA – 3 (20%)		CLA – 4 (10%)					
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice			Theory	Practice
Level 1	Remember	20%	20%	15%	15%	15%	15%	15%	15%			15%	15%
	Understand												
Level 2	Apply	20%	20%	20%	20%	20%	20%	20%	20%			20%	20%
	Analyze												
Level 3	Evaluate	10%	10%	15%	15%	15%	15%	15%	15%			15%	15%
	Create												
	Total	100 %		100 %		100 %		100 %				100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers	
Experts from Higher Technical Institutions	Internal Experts
1. Dr.P. Rajasekaran, Associate Professor & HOD, Department of Biotechnology, Rajalakshmi Engineering College 2. Dr. Y.Swarnalatha, Professor and Dean of Higher Studies, Department of Biotechnology, Sathyabama Institute of Science and Technology	Dr.V.G.Vidhya ,DBT,SRMIST

Course Code	PCD21AE2T	Course Name	GENERAL APTITUDE FOR COMPETITIVE EXAMINATIONS	Course Category	A	ABILITY ENHANCEMENT COURSE	L	T	P	C
							1	0	0	1

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

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

		Learning			Program Learning Outcomes (PLO)
CLR-1:	recapitulate fundamental mathematical concepts and skills	1	2	3	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
CLR-2:	provide context - based vocabulary enhancement				
CLR-3:	sharpen logical reasoning through skilful conceptualization				
CLR-4:	familiarize with basic grammatical and syntactical rules				
CLR-5:	enable to solve problems and to crack competitive exams				
CLR-6:	develop new strategies to enhance reading comprehension				

Course Learning Outcomes (CLO): At the end of this course, learners will be able to:

		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Disciplinary Knowledge	Critical Thinking	Problem Solving	Analytical Reasoning	Research Skills	Team Work	Scientific Reasoning	Reflective Thinking	Self-Directed Learning	Multicultural Competence	ICT Skills	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CLO-1:	build a strong base in the fundamental mathematical concepts	2	80	75	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
CLO-2:	acquire strategies to build vocabulary	2	80	70	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
CLO-3:	apply the learn conditions towards solving problems analytically	2	75	70	H	H	H	H	H	H	H	H	M	H	M	H	H	H	H
CLO-4:	learn grammatical and syntactical rules	2	80	75	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
CLO-5:	grasp the approaches and strategies to solve problems with speed and accuracy	2	80	70	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
CLO-6:	improve reading comprehension strategies	2	80	75	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H

Duration (hour)	15	15	15	15	15
S-1	SLO-1	Logical Reasoning I	Vocabulary from inference to meaning	Numbers - I	Error Identification - I	Data Sufficiency
S-2	SLO-1	Solving Problems	Vocabulary from inference to meaning	Numbers - I	Error Identification - I	Data sufficiency
S-3	SLO-1	Logical Reasoning - I	Cloze passage	Numbers - II	Error Identification - II	Data Interpretation
S4-5	SLO-1	Solving Problems	Cloze passage	Numbers - II	Error Identification - II	Data Interpretation
S-6	SLO-1	Logical Reasoning - I	Sentence Completion	Numbers - III	Sentence Correction - I	Sentence Correction - II
S - 7	SLO-1	Solving problems	Sentence Completion	Numbers - III	Sentence Correction - I	Sentence Correction - II

Learning Resources	1. Quantitative aptitude – r s agarwal
	2. Quantitative aptitude – ARUN SARMA
	3. ManhattanPrepGMAT Sentence Correction Guide–Avi Gutman
	4. GRE Contextual.Vocabulary–Ken Springer

Learning Assessment										
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (10%)		CLA – 3 (20%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	30 %	-	30 %	-	30 %	-	30 %	-	30 %	-
	Understand										
Level 2	Apply	40 %	-	40 %	-	40 %	-	40 %	-	40 %	-
	Analyze										
Level 3	Evaluate	30 %	-	30 %	-	30 %	-	30 %	-	30 %	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

\# CLA – 4 can be from any combination of these: Assignments, Seminars, Scientific Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications etc.,

Course Designers		
Experts from Industry	Internal Experts	
1. Mr Nishith Sinha, dueNorth India Academics LLP, Dehradun,nsinha.alexander@gmail.com	1. Dr.P.Madhusoodhanan SRMIST	3. Dr. A Clement, SRMIST
2.Mr Ajay Zenner, Career Launcher, ajay.z@careerlauncher.com	2. Dr.M.Snehalatha SRMIST	4. Dr. J Jayapragash, SRMIST

Course Code	PBT21301J	Course Name	IMMUNOTECHNOLOGY	Course Category	C	Professional Core Course	L	T	P	C
							4	0	4	6

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department		BIOTECHNOLOGY	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
CLR-1 :	Understanding the basics of immune reactions																		
CLR-2 :	Understanding the properties of antigens and function of immunoglobulins																		
CLR-3 :	Understanding the importance antigrnantibogy interaction in defense action																		
CLR-4 :	Knowledge on B & T cell response																		
CLR-5 :	Knowledge on immunological basis of AIDS, transplantation																		
CLR-6 :	Understanding the response of immune system																		

Column headers (PLO): Level of Thinking (Bloom); Expected Proficiency (%); Expected Attainment (%); Fundamental 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; PSO - 1; PSO - 2; PSO - 3

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	L.o.T	E.P	E.A	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLO-1 :	Acquired basic Knowledge on immune cells, organs	2	85	80	L	H	H	H	H	-	-	M	M	L	-	H	-	-	-
CLO-2 :	Basic Knowledge on antigen, immunoglobulins	3	85	80	L	H	H	H	H	-	-	M	M	L	-	H	-	-	-
CLO-3 :	Strong basis for understanding the interactions of antigen & antibody	3	85	80	L	H	H	H	H	-	-	M	M	L	-	H	-	-	-
CLO-4 :	Better knowledge gained about immune response	3	85	80	L	H	H	H	H	-	-	M	M	L	-	H	-	-	-
CLO-5 :	Better knowledge gained about immune response in disease	3	85	80	L	H	H	H	H	-	-	M	M	L	-	H	-	-	-
CLO-6 :	Overall understanding of immune system in response reactions	3	85	80	L	H	H	H	H	-	-	M	M	L	-	H	-	-	-

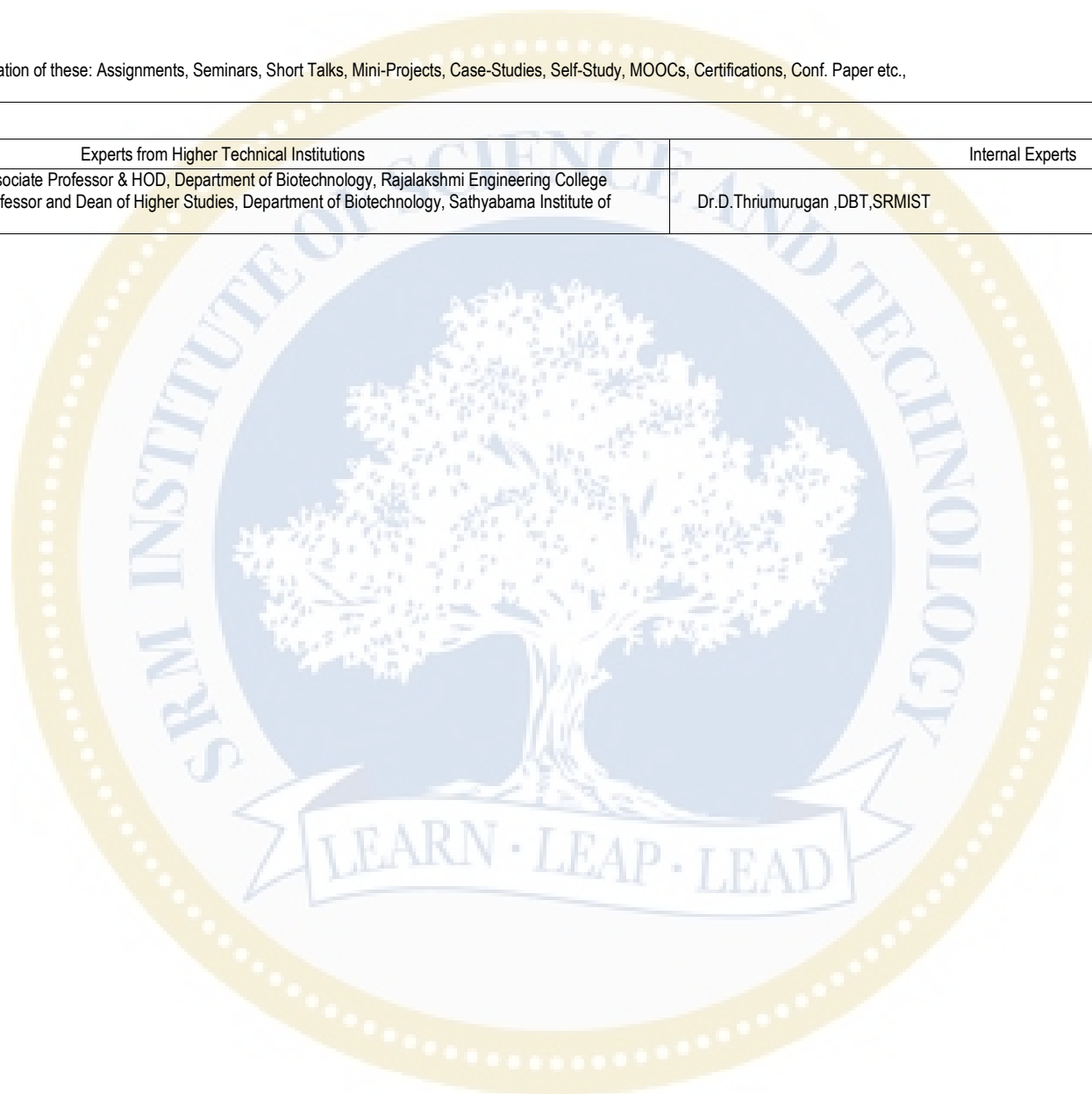| Duration (hour)	24	24	24	24	24
S-1 SLO-1	Immunology- Introduction and History.	Immunoglobulin – structure	Kinetics of primary and secondary immune responses	role of MHC antigens in immune responses	Immunoprophylaxis and immunotherapy
S-1 SLO-2	Scope of Immunology	Function			
S-2 SLO-1	Types of immunity-innate	Different classes of Immunogolbulins	complement activation and its biological consequences,	MHC antigens in transplantation.	Production of polyclonal and monoclonal antibodies
S-2 SLO-2					
S-3 SLO-1	Types of immunity- Acquired	Different classes of Immunogolbulins	Complement System - Pathway	Hypersensitivity-I and II	Production of polyclonal and monoclonal antibodies
S-3 SLO-2					
S-4 SLO-1	Cells of Immune System- Introduction	Side chain and colonal selection theory	Complement System - Pathway	Hypersensitivity-III IV	Production of polyclonal and monoclonal antibodies
S-4 SLO-2					
S 5-8 SLO-1	Lab safety rules	Separation of mononuclear cells from peripheral blood	Ouchterlony double immunodiffusion	Counter current immunoelectrophorosis	DOT ELISA
S 5-8 SLO-2					
S-9 SLO-1	Cells of immune system- Lymphocytes	Antibody diversity –gene rearrangement and somatic recombination	Complement System - Pathway	Autoimmunity	Immunoprecipitation, RIA,
S-9 SLO-2					

S-10	SLO-1	Antigen presenting Cells and Lymphocytic traffic	Class switching- Revision of Antigen and Antibody	Immuno diagnosis	Immunodeficiency diseases	ELISA,
	SLO-2					
S-11	SLO-1	Lymphoid organs	Immune Response: Introduction	Immuno diagnosis	Immunodeficiency diseases	fluorescent immunoassay,
	SLO-2					
S-12	SLO-1	Lymphoid organs – Revision	B –cell Maturation and Activation	cytokines and co-stimulatory molecules	Tumour Immunology	avidin-biotin mediated assay, immunohistochemistry,
	SLO-2					
S 13-16	SLO-1	Agglutination: ABO Blood grouping	Single Radial immunodiffusion	Ouchterlony double immunodiffusion	Rocket immunoelectrophorosis	DOT ELISA
	SLO-2					
S-17	SLO-1	Antigen and Immunogen	B –cell Maturation and Activation	cytokines and co-stimulatory molecules	Vaccines - killed attenuated organisms, toxoid,	limmunoelectrophoresis,
	SLO-2					
S-18	SLO-1	Antigen – Types	T cell Maturation and Activation	cytokines and co-stimulatory molecules	recombinant vaccines, subunit vaccines	immunoelectrophoresis,
	SLO-2					
S-19	SLO-1	Antigen -properties Affinity and Avidity	T cell Maturation and Activation	Major histocompatibility complex (MHC) genes and products	DNA vaccines, synthetic peptide vaccines	immunoblotting.
	SLO-2					
S-20	SLO-1	Adjuvant and Hapten	Kinetics of primary and secondary immune responses	Major histocompatibility complex (MHC) genes and products	antiidiotypic vaccines	Complement fixation test.
	SLO-2					
S 21-24	SLO-1	Pregnancy test	Single Radial immunodiffusion	Counter current immunoelectrophorosis	Rocket immunoelectrophorosis	Model exam
	SLO-2					

Learning Resources	Richard A. Goldsby "Immunology" Barbara, A. Osborne, Janis KubyImmunology", 5th Edition, W. H. Freeman & Company, 2006 Ivan Roitt. Element of Immunology. Wiley Blackwell publication, 13th edition, 2017

Learrning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (10%)		CLA – 3 (20%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	20%	20%	20%	10%	15%	15%	10%	10%	15%	15%
	Understand										
Level 2	Apply	20%	20%	30%	20%	20%	20%	20%	30%	20%	20%
	Analyze										
Level 3	Evaluate	10%	10%	10%	10%	15%	15%	10%	10%	15%	15%
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

\# CLA – 4 can be from any combination of these: Assignments, Seminars, Short Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers	
Experts from Higher Technical Institutions	Internal Experts
1. Dr.P. Rajasekaran, Associate Professor & HOD, Department of Biotechnology, Rajalakshmi Engineering College 2. Dr. Y.Swarnalatha, Professor and Dean of Higher Studies, Department of Biotechnology, Sathyabama Institute of Science and Technology	Dr.D.Thriumurugan ,DBT,SRMIST

Course Code	PBT21302J	Course Name	ANIMAL BIOTECHNOLOGY	Course Category	C	Professional Core Course	L	T	P	C
							4	0	4	6

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

Course Learning Rationale (CLR): The purpose of learning this course is to,

Learning **Program Learning Outcomes (PLO)**

CLR-1 :	Understand the basics of animal cell culture
CLR-2 :	Understand the development of transgenic animals
CLR-3 :	Gain knowledge on assisted reproductive techniques
CLR-4 :	Develop an understanding on the applications of animal biotechnology
CLR-5 :	Learn the recent techniques in animal biotechnology
CLR-6 :	Provide a basic understanding on the advancements in animal biotechnology and its applications

Course Learning Outcomes (CLO): At the end of this course, learners will be able to:

		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Fundamental 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	PSO – 1	PSO – 2	PSO – 3
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLO-1 :	Learn about the culturing of animal cells	3	80	75	H	-	-	H	-	L	-	-	-	-	-	L	-	-	-
CLO-2 :	Acquire knowledge on gene transfer methods	3	85	80	H	-	-	H	-	M	-	-	-	-	-	L	-	-	-
CLO-3 :	Apply knowledge on the development of transgenic animals	3	75	70	H	H	M	M	H	H	-	M	-	-	-	H	-	-	-
CLO-4 :	Apply knowledge on the use of animal models for human genetic disorders	3	80	75	H	H	H	M	H	H	-	M	-	-	-	H	-	-	-
CLO-5 :	Gain knowledge on gene therapy and its applications	3	80	75	H	M	H	H	H	H	-	M	-	-	-	H	-	-	-
CLO-6 :	Understand the applications of animal biotechnology in medical and industrial sectors	3	80	75	H	H	H	H	H	H	-	M	-	-	-	H	-	-	-

Duration (hour)			24	24	24	24	24
S-1	SLO-1		Animal Cell Culture - Introduction	Transgenic animals - Introduction	Assisted reproductive techniques	Hybridoma Technique	Culturing animal cells in Fluidized bed reactors
S-2	SLO-1		Setup of cell culture laboratory	Transgenic animals - Development	Assisted reproductive techniques	Hybridoma Technique	Anchored fusion proteins
S-3	SLO-1		Growth in serum & serum-free media	Transgenic mice and transgenic fish	Cryopreservation	Probes for diagnosis of Animal diseases	Harvesting GPI-Anchored proteins from CHO cells
S-4	SLO-1		Viral evaluation of animal cell lines used in Biotechnology	Transgenic animals - Uses	Pregnancy diagnosis	Probes for diagnosis of Animal diseases	Gene therapy
S 5-8	SLO-1 SLO-2		Introduction to Animal Biotechnology Laboratory - Lab Safety discussion	Filter sterilization of animal cell culture media.	Subculturing / passaging	Cell viability test	Human lymphocyte culture
S-9	SLO-1		Optimizing gene expression in mammalian cells	Methods of gene transfer	Pregnancy diagnosis	Modern biotechnology Oriented Vaccines	Gene therapy
S-10	SLO-1		Recombinant cells	Methods of gene transfer	In utero testing of foetus for genetic defects	DNA Vaccines in Animal Disease	Molecular markers in clinical diagnosis
S-11	SLO-1		Recombinant cells	Baculoviruses and transgenic silkworm	Gene knockout technology	Animal system as bioreactors	Molecular markers in tissue typing

S-12	SLO-1	Cell Bank preparation	Cloning for conservation of endangered species	Gene knockin technology	Animal cells for transplantation	Human genome project
S 13-16	SLO-1	Isolation of human genomic DNA	Development of cell culture and cell lines	Subculturing / passaging	Differential counting of WBC	Chick embryo fibroblast
	SLO-2					
S-17	SLO-1	DNA fingerprinting	In situ preservation of germplasm	Gene knockdown technology	Animal biotechnology- Medical applications	Human genome project - applications
S-18	SLO-1	DNA fingerprinting	Ex situ preservation of germplasm	Animal models for human genetic disorders	Animal biotechnology- Medical applications	Human cloning
S-19	SLO-1	Characterization of animal cells	Aquafarming	Animal models for human genetic disorders	Animal biotechnology- Industrial applications	Human cloning – ethical limits
S-20	SLO-1	Viability measurements	Aquafarming	Animal models for human genetic disorders	Animal biotechnology- Industrial applications	Human cloning – regulations and issues
S 21-24	SLO-1	Preparation of animal cell culture media	Development of cell culture and cell lines	Quantitation of animal cells using hemocytometer	Human lymphocyte culture	Model Exam
	SLO-2					

Learning Resources	Animal Biotechnology: Recent Concepts and Developments. P Ramadass. MJP Publications, 2015. Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications, 6th Edition. Ian Freshney. John Wiley & Sons, 2010. Animal Cell Biotechnology: Methods and Protocols (Methods in Biotechnology). Nigel Jenkins. Totowa, N.J. : Humana Press, 1999.

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (10%)		CLA – 3 (20%)		CLA – 4 (10%)			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	20%	20%	15%	15%	15%	15%	15%	15%	15%	15%
	Understand										
Level 2	Apply	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
	Analyze										
Level 3	Evaluate	10%	10%	15%	15%	15%	15%	15%	15%	15%	15%
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers	
Experts from Industry/Higher Technical Institutions	Internal Experts
1.Dr.P. Rajasekaran, Associate Professor & HOD, Department of Biotechnology, Rajalakshmi Engineering College 2. Dr. Y.Swarnalatha, Professor and Dean of Higher Studies, Department of Biotechnology, Sathyabama Institute of Science and Technology	DR.SWAMYNATHAN,DBT,SRMIST

Course Code	PBT21D03T	Course Name	BIOPHYSICS	Course Category	D	DISCIPLINE SPECIFIC ELECTIVE	L	T	P	C
							4	0	0	4

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

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

CLR-1 :	Understanding the basics of biomolecule structure
CLR-2 :	Understand the principle of various instruments
CLR-3 :	Understanding the physics involved in human physiology
CLR-4 :	To understand the concept of Membrane potential
CLR-5 :	To know about the radiobiology
CLR-6 :	Understanding the basics of biomolecule structure

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Fundamental 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	PSO - 1	PSO – 2	PSO – 3
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLO-1 :	Knowledge on biomolecule structure	2	85	80	H	H	H	H	H	H	M	M	M	L	-	H	-	-	-
CLO-2 :	Knowledge on working of instruments	3	85	80	L	H	H	H	H	H	M	M	M	L	-	H	-	-	-
CLO-3 :	Knowledge about the human physiology	3	85	80	L	H	H	H	H	H	M	M	M	L	-	H	-	-	-
CLO-4 :	Knowledge on propagation of signals among cells	3	85	80	L	H	H	H	H	H	M	M	M	L	-	H	-	-	-
CLO-5 :	Knowledge on radiobiology and its usage in imaging	3	85	80	L	H	H	H	H	H	M	M	M	L	-	H	-	-	-
CLO-6 :	Overall knowledge on principles and application of physics in Biology	3	85	80	L	H	H	H	H	H	M	M	M	L	-	H	-	-	-

Duration (hour)		12	12	12	12	12
S-1	SLO-1	Introduction to biophysics	Bravais lattices, Braggs Law	Physics behind ventilation	Membrane potential of cell	Concept of radiobiology
S-2	SLO-1	Structure of Amino acids	Millers indices, X-Ray diffraction	pressure changes in ventilation	Development of Membrane potential	ionizing radiation and types
S-3	SLO-1	Structural significance of Amino acids	Light scattering	pressure volume interrelationship	Diffusion potential	Direct and indirect effects
S-4	SLO-1	Peptide bond and its structural importance	Neutron scattering	air flow resistance	Magnitude of resting Membrane potential	Tumour radiotherapy
S-5	SLO-1	Torsional angles, its importance in secondary structure formation	Principle of NMR	Ficks Law	Action potential	RadioImaging techniques
S-6	SLO-1	Ramachandran plot	Principle of NMR	Diffusion capacity	Development of Action potential	X-Ray
S-7	SLO-1	Ramachandran plot	Application of NMR	Diffusion capacity	Development of Action potential	X-Ray
S-8	SLO-1	Stretching of macromolecules	Application of NMR	Hemodynamics	Sodium pump	PET scan
S-9	SLO-1	Protein folding, Helix coil transition	Principle & Applications of Circular Dichroism	Excitation contraction coupling	Calcium pump	MRI
S-10	SLO-1	Protein folding, Helix coil transition	Principle & Applications of Circular Dichroism	Excitation contraction coupling	Calcium pump	MRI

S-11	SLO-1	Nucleic acids Watson and crick model polymorphism in DNA	Principle of LC-MS Application of LC-MS	Electrical properties of heart muscles Work done by heart clinical electrocardiography	Propagation of AP Synaptic potential and End plate potential Voltage gated channel	Ultrasonography GIMG
S-12	SLO-1	Nucleic acids Watson and crick model polymorphism in DNA	Principle of LC-MS Application of LC-MS	Electrical properties of heart muscles Work done by heart clinical electrocardiography	Propagation of AP Synaptic potential and End plate potential Voltage gated channel	Ultrasonography GIMG

Learning Resources	1. Principles and techniques of Biochemistry and Molecular biology, Wilson and Walker, 2013	1. Lehninger Principles of Biochemistry, W. H. Freeman, 2005

Learning Assessment						
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)				Final Examination (50% weightage)
		CLA – 1 (10%)	CLA – 2 (10%)	CLA – 3 (20%)	CLA – 4 (10%)	
		Theory	Theory	Theory	Theory	Theory
Level 1	Remember	40%	30%	30%	30%	30%
	Understand					
Level 2	Apply	40%	40%	40%	40%	40%
	Analyze					
Level 3	Evaluate	20%	30%	30%	30%	30%
	Create					
	Total	100 %	100 %	100 %	100 %	100 %

\# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.

Course Designers	
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1. Dr.P. Rajasekaran, Associate Professor & HOD, Department of Biotechnology, Rajalakshmi Engineering College 2. Dr. Y.Swarnalatha, Professor and Dean of Higher Studies, Department of Biotechnology, Sathyabama Institute of Science and Technology	Dr.N.Prashant Bhatt ,DBT,SRMIST

Course Code	PMS21D01T	Course Name	STATISTICS FOR BIOSCIENCES	Course Category	D	DISCIPLINE ELECTIVE	L	T	P	C
							4	0	0	4

Pre-requisite Courses	Nil		Co-requisite Courses	Nil		Progressive Courses	Nil
Course Offering Department		BIOTECHNOLOGY		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
CLR-1 :	To provide foundations in Data Collection, Classification, and Presentation of Data																		
CLR-2 :	To understand the Concepts of Measures of Tendency and Measures of Dispersion																		
CLR-3 :	To learn and apply the Probability Theory and Distributions in the Biological field																		
CLR-4 :	To acquire the knowledge of Correlation and Regression Analysis																		
CLR-5 :	To gain the knowledge of various sampling techniques and concept of point and interval estimation																		
CLR-6 :	To understand and interpret data using Testing of Hypothesis based on large and small sample.																		

Course Learning Outcomes (CLO): At the end of this course, learners will be able to:

Column headers: Level of Thinking (Bloom), Expected Proficiency (%), Expected Attainment (%) | Scientific 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, PSO-1, PSO-2, PSO-3

		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Scientific 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	PSO - 1	PSO - 2	PSO - 3
CLO-1 :	To acquire the knowledge of data, classification and presentation commonly used in Health and Medical Sciences	3	85	80	L	L	-	L	M	-	-	-	M	M	-	M	-	-	-
CLO-2 :	To collect data relating to variable/variables which will be examined and calculate descriptive statistics from these data.	3	80	75	M	M	-	H	L	-	-	-	M	M	-	H	-	-	-
CLO-3 :	To identify distribution form relating to the variable/variables.	3	85	80	M	H	M	H	M	-	-	-	M	M	-	M	-	-	-
CLO-4 :	To acquire the skill of analysing the relationship between the independent and dependent variables	3	85	80	M	H	H	H	-	-	-	-	M	M	-	H	-	-	-
CLO-5 :	To apply different methods of sampling methods in Biological sciences	3	85	80	H	H	H	M	M	-	-	-	M	M	-	H	-	-	-
CLO-6 :	To apply hypothesis testing via some of the statistical distributions and interpret the results	3	85	80	M	M	H	M	L	-	-	-	L	M	-	H	-	-	-

Duration (hour)		12	12	12	12	12
S-1	SLO-1	Definition of Primary and secondary data with examples	Random experiment, types of events with examples	Definition of Bi-variate distribution, Definition of correlation, types and application	Definition of sampling, types of sampling techniques	Large sample test – Z test using single sample mean
	SLO-2	Source of primary and secondary data	Definition of probability, addition and multiplication law	Definition of scatter diagram	Advantages and disadvantages	Z test using single sample mean
S-2	SLO-1	Classification of data with examples	Problems based on addition and multiplication law	Methods of Measures of correlation coefficient- Karl Pearson's formula	Simple random Sampling –concept, uses and limitation	Large sample test – Z test using two sample mean
	SLO-2	Discrete and continuous data with examples	Conditional probability - formula	Correlation coefficient using Karl Pearson's method	Examples of Simple random sampling	Z test using two sample mean
S-3	SLO-1	Discrete and continuous data with examples	Problems on conditional probability	Correlation coefficient using Karl Pearson's method	Stratified Sampling –concept, uses and limitation	Z test using two sample mean
	SLO-2	Tabulation- parts of the table	Definition of Baye's theorem	Correlation coefficient using Karl Pearson's method	Examples of Stratified sampling	Z test using two sample mean

S 4	SLO-1	Diagrammatic presentation- simple, percentage bar diagram	Problems on Baye's theroem	Correlation coefficient using Karl Pearson's method	Systematic sampling – Concepts, uses, limitations	Small sample test :student t-test with single sample mean
	SLO-2	Sub-divided bar and multiple bar diagram	Definition of probability distribution and its Type	Correlation coefficient using Karl Pearson's method	Examples of systematic sampling	student t-test with single sample mean
S-5	SLO-1	Graphical presentation – histogram, frequency polygon	Definition of Binomial distribution and its applications	Correlation coefficient using Spearman's rank method	Non-random sampling-concepts	t-test with comparison of two sample means
	SLO-2	Frequency cure, ogives	Problems on Binomial distribution	Correlation coefficient using Spearman's rank method	Convenient sampling- concept, uses, limitations	t-test with comparison of two sample means
S -6	SLO-1	Using Ogives locate the median	Problems on Binomial distribution	Correlation coefficient using Spearman's rank method – repeated rank	Convenient sampling- concept, uses, limitations	Paired t-test for dependent samples
	SLO-2	Mean, median and mode – individual and discrete series	Problems on Binomial distribution	Correlation coefficient using Spearman's rank method – repeated rank	Judgment sampling- concept, uses, limitations	Paired t-test for dependent samples
S- 7	SLO-1	Mean, median and mode –Discrete series	Definition of Poisson distribution and its application	Concepts of regression and simple linear regression models	Concepts of sampling and non-sampling errors	F-test: equality of two sample variances
	SLO-2	Mean, median and mode –Continuous series	Problems on Poisson distribution	Problems on regression lines	Central limit theorem- statement	F-test: equality of two sample variances
S -8	SLO-1	Mean, median and mode –Continuous series	Problems on Poisson distribution	Problems on regression lines	Uses of central limit theorem	Chi-square test: Goodness of fit
	SLO-2	Range, quartile deviation, - individual and discrete series	Problems on Poisson distribution	Problems on regression lines	Definition of hypothesis testing, level of significance, type – I error, type-II error	Chi-square test: Goodness of fit
S -9	SLO-1	Mean deviation – Individual and discrete series	Problems on Poisson distribution	Solve the two regression lines are given in the problem	Concepts of One tailed test and two tailed test	Chi-square test: independence of attributes
	SLO-2	Range, Quartile deviation – Continuous series	Definition of normal distribution, characteristics	Properties of regression coefficients	Point estimation – sample statistics, mean variance, and standard deviation	Chi-square test: independence of attributes
S -10	SLO-1	Mean deviation – Continuous series	Importance of normal distribution	Concept of Simple regression lines using Least square method	Point estimation – sample statistics, mean variance and standard deviation	Chi-square test: independence of attributes
	SLO-2	Standard deviation, co-efficient of variation – Individual and discrete series	Definition of Standard Normal distribution	Regression lines using least square method	Point estimation – sample statistics, mean variance and standard deviation	Analysis of variance: concepts, One-way ANOVA table
S-11	SLO-1	Standard deviation, co-efficient of variation-continuous series	Problems on normal distribution	Regression lines using least square method	Point estimation – sample statistics, mean variance and standard deviation	One-way ANOVA table- formula and problem
	SLO-2	Standard deviation, co-efficient of variation – continuous series	Problems on normal distribution	Regression lines using least square method	Interval estimation with 95% los	One-way ANOVA table- formula and problem
S-12	SLO-1	Skewness, Bowleys coefficient of skewness- discrete series	Problems on normal distribution	Regression lines using least square method	Interval estimation with 95% los	Two-way ANOVA table- formula and problem
	SLO-2	Skewness, Bowleys coefficient of skewness- continuous series	Problems on normal distribution	Regression lines using least square method	Interval estimation with 99% los	Two-way ANOVA table- formula and problem
		Bowleys coefficient of skewness – Continuous series	Problems on normal distribution	Probable error	Interval estimation with 99% los	Two-way ANOVA table- formula and problem

Learning Resources	Theory: 1. Gupta S.C and Kapoor V.K, Fundamentals of Mathematical Statistics, Sultan Chand, New Delhi. 2000 2. Wayne W. Daniel, Biostatistics, A Foundation for Analysis in Health Sciences, John Wiley & Sons, 2008 3. Marcello Pagano and Kimberlee Gauvreau: Principles of Biostatistics, Duxbury Printed in India by (Chennai Micro Point Pvt. Ltd, No. 34, Nelson ManickamRoad, Chennai – 29), 2000 4. Veer Bala Rastogi, Fundamentals of Biostatistics, Ane Books Pvt. Ltd, Avarthika Niwas, 1st Floor, 19, Duraisamy Road, T.Nagar, Chennai ,2009

Learning Assessment							
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)					Final Examination (50% weightage)
		CLA – 1 (10%)	CLA – 2 (10%)	CLA – 3 (20%)	CLA – 4 (10%)		
		Theory	Theory	Theory	Theory		Theory
Level 1	Remember	30%	30%	30%	30%		30%
	Understand						
Level 2	Apply	40%	40%	40%	40%		40%
	Analyze						
Level 3	Evaluate	30%	30%	30%	30%		30%
	Create						
	Total	100 %	100 %	100 %	100 %		100 %

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers	
Experts from Academic	Internal Experts
Dr. M.A. Baskar, Professor & Head, Dept. Of Mathematics, Loyola college, Chennai	M.Kalaivani, SRMIST
Dr. P.Dhanvanthan, Professor & Head, Dept. Of Statistics, Pondicherry University	

Course Code	PBT21D04T	Course Name	REGENERATIVE MEDICINE	Course Category	D	DISCIPLINE ELECTIVE COURSE	L	T	P	C
							2	0	0	2

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department		BIOTECHNOLOGY	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
CLR-1 :	understanding the cells																		
CLR-2 :	understanding the tissues																		
CLR-3 :	knowledge on stem cell biology																		
CLR-4 :	knowledge on in vitro and in vivo synthesis of tissues																		
CLR-5 :	learning different vitro and in vivo synthesis of organs																		
CLR-6 :	candidates understanding on stem cell in diseases																		

Column legend (PLO): 1 Level of Thinking (Bloom); 2 Expected Proficiency (%); 3 Expected Attainment (%) | 1 Scientific 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 PSO - 1; 14 PSO - 2; 15 PSO - 3

Course Learning Outcomes (CLO): At the end of this course, learners will be able to:

		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLO-1 :	Overall Understanding the cells	2	85	80	H	H	H	H	H	H	M	M	M	L	-	H	-	-	-
CLO-2 :	Overall Understanding the tissues	3	85	80	L	H	H	H	H	H	M	M	M	L	-	H	-	-	-
CLO-3 :	Overall Knowledge on stem cell biology	3	85	80	L	H	H	H	H	H	M	M	M	L	-	H	-	-	-
CLO-4 :	Knowledge on in vitro and in vivo synthesis of tissues	3	85	80	L	H	H	H	H	H	M	M	M	L	-	H	-	-	-
CLO-5 :	Knowledge on in vitro and in vivo synthesis of organs	3	85	80	L	H	H	H	H	H	M	M	M	L	-	H	-	-	-
CLO-6 :	Candidates understanding on stem cells in diseases	3	85	80	L	H	H	H	H	H	M	M	M	L	-	H	-	-	-

Duration (hour)		6	6	6	6	6
S-1	SLO-1	Cell types, cell-cell interaction	Structure and organization of tissues	Tissue grafting.	Stem cell therpy ,Three-Dimensional Scaffolds	Regeneration of hepatocytes. Bioprinting of Organs and Tissue
S-2	SLO-1	Cell differentiations, cell matrix	Structure and organization of tissues	Stem cells - properties and Classification.	Three-Dimensional Scaffolds	Bioprinting of Organs and Tissue
S-3	SLO-1	Biology of cells in culture	Epithelial, connective	Types of Stem cells - embryonic stem cells	Tissue Engineering and Transplantation Techniques - Immunoisolation Techniques	Stem Cell therapy - Gastrointestinal
S-4	SLO-1	cell culture bioreactors	muscle tissues	Adult stem cells, Hematopoietic Stem Cells	Modes of Cell and Tissue Delivery	Kidney, Heart
S-5	SLO-1	Three-Dimensional organization of Cells in Culture	Artificial organs	Mesenchymal Stem Cells	Breast reconstruction, Regeneration of Bone and Cartilage	Lung disorders
S-6	SLO-1	Organ Culture, Organotypic Culture	Nerve tissues	Isolation, Culture and Characterization protocol	Breast reconstruction, Regeneration of Bone and Cartilage Transplantation and Bioartificial Pancreas	Eye Diseases

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		Robert. P.Lanza, Robert Langer & William L. Chick,, "*Principles of Tissue Engineering*", Academic press, 2008	1.Bernhard Palsson, Sangeeta Bhatia, "*Tissue Engineering*", Pearson Prentice Hall, 2003.
Learning Resources		1. Robert. P.Lanza, Robert Langer & William L. Chick,, "*Principles of Tissue Engineering*", Academic press, 2008 2. Palsson B., Hubbell J.A., PlonseyR.&Bronzino, "*Tissue Engineering*" CRC- Taylor & Francis, 2004.	2.Ian freshney, "*Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications*", 6th edition, John wiley& Sons, Amazon., 2011.

Learning Assessment

	Bloom's Level of Thinking		Continuous Learning Assessment (50% weightage)				Final Examination (50% weightage)
			CLA – 1 (10%)	CLA – 2 (10%)	CLA – 3 (20%)	CLA – 4 (10%)	
			Theory	Theory	Theory	Theory	Theory
Level 1	Remember		40	30%	30%	30%	30%
	Understand						
Level 2	Apply		40%	40%	40%	40%	40%
	Analyze						
Level 3	Evaluate		20%	30%	30%	30%	30%
	Create						
	Total		100 %	100 %	100 %	100 %	100 %

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers

Experts from Higher Technical Institutions	Internal Experts
1. Dr.P. Rajasekaran, Associate Professor & HOD, Department of Biotechnology, Rajalakshmi Engineering College. 2. Dr. Y.Swarnalatha, Professor and Dean of Higher Studies, Department of Biotechnology, Sathyabama Institute of Science and Technology.	Dr.N.Prashant Bhatt ,DBT,SRMIST

COURSE CODE	PBT21D05T	COURSE NAME	NANOBIOTECHNOLOGY	COURSE CATEGORY	DISCIPLINE-SPECIFIC ELECTIVE	L	T	P	C
						2	0	0	2

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

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

CLR-1 :	Exposure to the field of Nanobiotechnology
CLR-2 :	Through Knowledge on nanomaterial's and its wide application on different areas
CLR-3 :	Knowledge on characterization techniques
CLR-4 :	Knowledge on new era of research
CLR-5 :	Wide knowledge on nanomaterial synthesis and its application in science
CLR-6 :	Over all enlighten ideology on the new upcoming field of research

Learning — Program Learning Outcomes (PLO)

Course Learning Outcomes (CLO): At the end of this course, learners will be able to:

CLO	Description	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Scientific 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	PSO - 1	PSO - 2	PSO - 3
CLO-1 :	Understand the Scope / interest on view of new area of research	70	50	50	H	-	-	H	-	H	-	-	-	-	-	-	-	-	-
CLO-2 :	Understand the different types and methods of synthesis of nanomaterial	70	50	50	H	-	-	-	-	-	-	-	-	-	--	-	-	-	-
CLO-3 :	Importance of the machine learning process – characterization techniques	50	50	50	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	A new /advanced research interest was made viable	50	50	50	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	Implementation and research oriented problems from bed to bench is exposed	70	50	50	H	H	H	-	-	-	-	-	-	-	-	-	-	-	-
CLO-6 :	Over all understanding on Nanobiotechnology and its application in the field of science	70	86	82	H	H	H	H	-	-	-	-	-	-	-	-	-	-	-

Duration (hour)	6	6	6	6	6
S-1	SLO-1	Nanobiotechnology- introduction	Nanowires	Bacteriorhodopsin and its potential in technical application	Information driven nanoassembly- Biomolecular sensing.	PLA and PLGA based nanoparticle delivery system
S-2	SLO-1	Nanobiotechnology- scope	Quantum dots and wire	Nanoparticles – Characterization Techniques	Biopolymer: polymer nanofibers,polymer controlled drug delivery	Nanomedicine today- Artificial blood
S-3	SLO-1	Nanobiotechnology- basics	Bionanostructure – in research and role	NMR	electrospinning method and their biomedical applications	Nanomedicine today- Artificial blood
S-4	SLO-1	Nanomaterials – Carbon nanomaterials	Protein based Nanostructures	Mass Spectroscopy	polymer nanocomposite- bone and dental restorations	drug delivery
S-5	SLO-1	Fullerenes	Research paper discussion and problem analyses	X-ray diffraction	polymer nanocomposite- bone and dental restorations	drug delivery

S-6	SLO-1	Nanotube – types	Bacteriorhodopsin and its potential in technical application	Microscopic techniques – TEM SEM and AFM	PLA and PLGA based nanoparticle delivery system	Immmunotoxins are targeted cell killers

Learning Resources	*Text Book:* David S. Goodsell, *"Bionanotechnology"* John Wilsyinc.,Publications, 2004. Shanmugam.S, *"Nanotechnology*, MJP Publishers, 2010	*Reference:* Niemeyer, C.M. Mirking C.A., *"Nanobiotechnology concepts, Applications and Perpectives"* 2004. ManasiKarkare, *"Nanotechnology"*, I.K. International publishing House Pvt.Ltd, 2008.

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (10%)		CLA – 3 (20%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	40%	-	20%	-	30%	-	40%	-	30%	-
	Understand										
Level 2	Apply	40%	-	60%	-	40%	-	20%	-	40%	-
	Analyze										
Level 3	Evaluate	20%	-	20%	-	30%	-	40%	-	30%	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers	
Experts from Higher Technical Institutions	Internal Experts
1. Dr.P. Rajasekaran, Associate Professor & HOD, Department of Biotechnology, Rajalakshmi Engineering College 2. Dr. Y.Swarnalatha, Professor and Dean of Higher Studies, Department of Biotechnology,Sathyabama Institute of Science and Technology	Dr.T.G.Nithya, HOD,DBT,SRMIST

Course Code	PBT21D06J	Course Name	INDUSTRIAL BIOTECHNOLOGY	Course Category	D	DISCIPLINE-SPECIFIC ELECTIVE	L	T	P	C
							2	0	2	3

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

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

CLR-1 :	Understanding the basics of food processing
CLR-2 :	Understanding the building parts and complex of bioreactor designing
CLR-3 :	Understanding the growth kinetics of microorganism
CLR-4 :	Knowledge both Upstream and downstream process
CLR-5 :	Knowledge on tremendous use of microorganism in drug and food production
CLR-6 :	Understanding about the difficulties and pathways byproduct and their effective use in industries

Course Learning Outcomes (CLO): At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Fundamental 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	PSO – 1	PSO – 2	PSO – 3
	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLO-1 : Importance and role and scope of the food production Industries	2	85	80	L	H	H	H	H	-	-	M	M	L	-	H	-	-	-
CLO-2 : Basic Knowledge on design and engineering of bioreactors	3	85	80	L	H	H	H	H	-	-	M	M	L	-	H	-	-	-
CLO-3 : Strong basis for understanding the growth kinetics alteread rate andphase for different products	3	85	80	L	H	H	H	H	-	-	M	M	L	-	H	-	-	-
CLO-4 : Better knowledge gained about process levels and importance of industrial biotechnologist role	3	85	80	L	H	H	H	H	-	-	M	M	L	-	H	-	-	-
CLO-5 : Better knowledge gained about products of day today life	3	85	80	L	H	H	H	H	-	-	M	M	L	-	H	-	-	-
CLO-6 : Overall understanding of Industrial level of production of products and scope of the subject	3	85	80	L	H	H	H	H	-	-	M	M	L	-	H	-	-	-

Duration (hour)		12	12	12	12	12
S-1	SLO-1	Basic principles of food processing	Microbial growth kinetics	Down stream processing- types	Industrial production of Beer and WIne	Industrial production – Vitamin B12importance and need
S-2	SLO-1	Basic principles of food processing	Isolation of and screening of microbes for bioproduct	Down stream processing- types	Comparison on techniques used to prepare the beer and wine – industries that are pioneer in making the beer and wine discussion	Industrial production- Steroids Benefits and Process
S-3-4	SLO-1	Instrumentation of fermenter Design of various types of fermenters& bioreactors	Production of ethanol & wine from grapes	Bread- making	Immobilization of cells and enzymes using alginate and polyacrylamide	Mushroom cultivation
S-5	SLO-1	Types of fermentation	Preservation of the strain AND Strain improvement	Downstream processing- types/product recovery	Industrial production of Citric acid	Biotransformation process - introduction
S-6	SLO-1	Types of fermentation	Media and sterilization techniques	Immobilization of enzymes – Techniques - industrially important enzymes	Industrial production of Glutamic acid	Fermented dairy products - Cheese, yogurt.

S7-8	SLO-1	Instrumentation of fermenter Design of various types of fermenters& bioreactors	Production of ethanol & wine from grapes	Isolation of amylase-producing microorganisms and determination of the amylase enzyme.	Sauerkraut production	Mushroom cultivation
S-9	SLO-1	Microbial growth kinetics	Media and sterilization techniques	Immobilization of enzymes – Techniques - industrially important enzymes	Industrial production of Penicillin – History	Microbial Foods – Single cell proteins (SCP),SCO
S-10	SLO-1	Microbial growth kinetics	Down stream processing- types	Industrial production of Ethanol	Industrial production of Penicillin – History	Microbial production of PHB
S-11-12	SLO-1	Instrumentation of fermenter Design of various types of fermenters& bioreactors	Bread - making	Immobilization of cells and enzymes using alginate and polyacrylamide	Mushroom cultivation	Mushroom cultivation

Learning Resources	1. Stanbury PF and Whitaker A. Pergamon,*"Principles of Fermentation technology"*, second edition ,Pergamon Press, Oxford, 2005, reprinted 2012 2. PatelA.H.,*"IndustrialMicrobiology"*, Macmillan Publishers India, 2000.

Learning Assessment												
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)		
		CLA – 1 (10%)		CLA – 2 (10%)		CLA – 3 (20%)		CLA – 4 (10%)#				
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	20%	20%	20%	10%	15%	15%	10%	10%	15%	15%
	Understand										
Level 2	Apply	20%	20%	30%	20%	20%	20%	20%	30%	20%	20%
	Analyze										
Level 3	Evaluate	10%	10%	10%	10%	15%	15%	10%	10%	15%	15%
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Short Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Higher Technical Institutions		Internal Experts
1. Dr.P. Rajasekaran, Associate Professor & HOD, Department of Biotechnology, Rajalakshmi Engineering College 2. Dr. Y.Swarnalatha, Professor and Dean of Higher Studies, Department of Biotechnology,Sathyabama Institute of Science and Technology		Dr.R.Nishanthi ,DBT,SRMIST

Course Code	PBT21S03T	Course Name	FORENSIC SCIENCE	Course Category	S	SKILL ENHANCEMENT COURSE	L	T	P	C
							1	0	0	1

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	BIOTECHNOLOGY	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
CLR-1 :	Understanding the scope of Forensic Science																		
CLR-2 :	Understanding the Crime Scene Investigation																		
CLR-3 :	Knowledge on Duties of forensic scientist																		
CLR-4 :	Facilities offered by forensic science laboratory																		
CLR-5 :	Learning different BEOSP																		
CLR-6 :	Candidates understanding on Cyber forensic																		

Column headers (PLO): Level of Thinking (Bloom) | Expected Proficiency (%) | Expected Attainment (%) | Fundamental Knowledge | Application of Concepts | Link with Related Disciplines | Procedural Knowledge | Skills in Specialization | Ability to Utilize Knowledge | Skills in Modeling | Analyze, Interpret Data | Investigative Skills | Problem Solving Skills | Communication Skills | Analytical Skills | PSO - 1 | PSO - 2 | PSO – 3

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking	Exp. Prof. (%)	Exp. Att. (%)	Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	PSO-1	PSO-2	PSO-3
CLO-1 :	Overall Understanding the scope of Forensic Science	2	85	80	H	H	H	H	H	H	M	M	M	L	-	H	-	-	-
CLO-2 :	Overall Understanding the Crime Scene Investigation	3	85	80	L	H	H	H	H	H	M	M	M	L	-	H	-	-	-
CLO-3 :	Overall Knowledge on Duties of forensic scientist	3	85	80	L	H	H	H	H	H	M	M	M	L	-	H	-	-	-
CLO-4 :	Facilities offered by forensic science laboratory	3	85	80	L	H	H	H	H	H	M	M	M	L	-	H	-	-	-
CLO-5 :	Knowledge on different BEOSP	3	85	80	L	H	H	H	H	H	M	M	M	L	-	H	-	-	-
CLO-6 :	Candidates understanding on Cyber forensic	3	85	80	L	H	H	H	H	H	M	M	M	L	-	H	-	-	-

Duration (hour)		3	3	3	3	3
S-1	SLO-1	Definition and scope of Forensic Science.	Crime,Types of crimes,	Duties of forensic scientist	Specialized facilities offered by forensic science laboratory	Brain electrical oscillation signature proficiency (BEOSP)
S-2	SLO-1	History and Development of Forensic Science	Crime Scene procedures - sketching, photography,location,	Various divisions of crime investigation – Toxicology,Biology	Specialized facilities offered by forensic science laboratory	Cyber forensic
S-3	SLO-1	Development of Forensic Science in India and Organizational set up of Forensic ScienceLaboratories	Physical evidence; types,significance and collection and preservation of exhibits/evidences	Serology, Chemistry	DNA fingerprinting, Polygraph.	Tape and video authentication Speaker identification etc.

Learning Resources	1. Introduction to Forensic Science in Crime Investigation –Dr.RukmaniKrishnamurty, *"Selective and Scientific Books"*, 1st edition 2011 2. Richard Saferstein, 2001, Criminalistic: *"An Introduction to Forensic Science"*. 7th editionPrentice-Hall, New Jersey.	1. L.J. Kaplan, 2001. *"A laboratory manual for the introduction to the Crime Lab"*.Williamstown, Massachusetts. 2. Moenseens, A.A., Starrs, J.E., Henderson, C.E. and Inabare, F.E., 1995. ScientificEvidence in Civil and Criminal cases, IV edition, Foundation Press, Westbury, NewYork. 3. Fishes, B.A.J., 2000. *"Techniques of Crime Scene Investigation"*. VI edition CRC Press,Boca Raton, 2000.

Learning Assessment						
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)				Final Examination (50% weightage)
		CLA – 1 (10%)	CLA – 2 (10%)	CLA – 3 (20%)	CLA – 4 (10%)	
		Theory	Theory	Theory	Theory	Theory
Level 1	Remember	40	30%	30%	30%	30%
	Understand					
Level 2	Apply	40%	40%	40%	40%	40%
	Analyze					
Level 3	Evaluate	20%	30%	30%	30%	30%
	Create					
	Total	100 %	100 %	100 %	100 %	100 %

\# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers	
Experts from Higher Technical Institutions	Internal Experts
1. Dr.P. Rajasekaran, Associate Professor & HOD, Department of Biotechnology, Rajalakshmi Engineering College 2. Dr. Y.Swarnalatha, Professor and Dean of Higher Studies, Department of Biotechnology, Sathyabama Institute of Science and Technology	Dr.N.Prashant Bhatt ,DBT,SRMIST

Course Code	PBT21S04T	Course Name	Clinical Trials		Course Category	S	SKILL ENHANCEMENT COURSE	L	T	P	C
								1	0	0	1

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning			Program Learning Outcomes (PLO)														
CLR-1 :	Understanding key concepts in the design of clinical trials	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-2 :	Knowledge on the study designs commonly used																		
CLR-3 :	Understand and Identify key issues in data management for clinical trials																		
CLR-4 :	Understanding the roles of Regulatory Affairs in clinical trials																		
CLR-5 :	Understand and Identify key issues in data management for clinical trials																		
CLR-6 :	Understanding the roles of Regulatory Affairs in clinical trials																		

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	ICT Skills	Professional Behavior	Life Long Learning
CLO-1 :	Understand about the drugs and its discovery	3	80	70	M	M	M	-	M	H	M	-	-	H	H	H	M	H	H
CLO-2 :	Understand about the methods involved in clinical experiments	3	80	70	M	M	M	-	M	H	M	-	-	H	H	H	M	H	H
CLO-3 :	Know the steps involved in clinical research	3	85	75	M	M	M	-	M	H	M	-	-	H	H	H	M	H	H
CLO-4 :	Dynamics of drugs- the clear idea will be obtained	3	85	75	M	M	M	-	M	H	M	-	-	H	H	H	M	H	H
CLO-5 :	Toxicity due to overuse /misuse will be obtained	3	85	75	M	M	M	-	M	H	M	-	-	H	H	H	M	H	H
CLO-6 :	Safety issues on drug will be obtained	3	80	70	M	M	M	-	M	H	M	-	-	H	H	H	M	H	H

Duration (hour)		3	3	3	3	3
S-1	SLO-1	Clinical Trials – Introduction, Who can be in clinical trials? need clinical trials	Randomized Controlled Trial (RCT): what is a randomized controlled trial? Reasons for randomization, Features of RCT	New drug discovery process- purpose, main steps, Timelines, advantages and purposes of each steps	Pharmacodynamics, Pharmacokinetics (ADME)	Preclinical toxicology: General principles, Systemic toxicology (Single dose and repeat dose toxicity studies)
S -2	SLO-1	Terms in clinical Trials: Clinical Research, Healthy Volunteer, Inclusion/Exclusion Criteria, Informed Consent, Patient Volunteer, Phases of Clinical Trials	Who sponsors and runs clinical trials? How should an RCT be designed and conducted?	Ethics in clinical research, Phases of clinical research – I, II, III, IV	Absorption of drugs effects after absorption, allergies	Carcinogenicity, Mutagenicity, Teratogenicity
S-3	SLO-1	Placebo, Protocol, Principal Investigator, Randomization, Single- or Double-Blind, Studies	Random allocation, Allocation concealment, Blinding, Conduct, Outcome ascertainment, Sample size, Power of a study, How should an RCT be reported?	Principles of sampling, Monitoring treatment outcome and Termination of trial	Sensitivity study, product formulation, Regulation and drug safety	Reproductive toxicity, local toxicity, Genotoxicity

Learning Resources	1. Machin and Fayers. Randomized Clinical Trials: Design, Practice and Reporting. Wiley-Blackwell, 2010 2. Piantadosi S. Clinical Trials: A Methodologic Perspective (2nd Edition). New Jersey: John Wiley & Sons, 2005

Learning Assessment							
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)					Final Examination (50% weightage)
		CLA – 1 (10%)	CLA – 2 (10%)	CLA – 3 (20%)	CLA – 4 (10%)		
		Theory	Theory	Theory	Theory		Theory
Level 1	Remember	40	30%	30%	30%		30%
	Understand						
Level 2	Apply	40%	40%	40%	40%		40%
	Analyze						
Level 3	Evaluate	20%	30%	30%	30%		30%
	Create						
	Total	100 %	100 %	100 %	100 %		100 %

\# CLA-1, CLA-2 and CLA-3 can be from any combination of these: Online Aptitude Tests, Classroom Activities, Case Studies, Poster Presentations, Powerpoint Presentations, Mini Talks, Group Discussions, Mock interviews, etc.
\#\# CLA – 4 can be from any combination of these: Assignments, Seminars, Short Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers	
Experts from Higher Technical Institutions	Internal Experts
1. Dr.P. Rajasekaran, Associate Professor & HOD, Department of Biotechnology, Rajalakshmi Engineering College 2. Dr. Y.Swarnalatha, Professor and Dean of Higher Studies, Department of Biotechnology,Sathyabama Institute of Science and Technology	Dr.N.Prashant Bhatt ,DBT,SRMIST

Course Code	PCD21AE3T	Course Name	Employability Skills		Course Category	A	Ability Enhancement Course	L	T	P	C
								1	0	0	1

Pre-requisite Courses	Nil	Co-requisite Courses	Nil		Progressive Courses	Nil
Course Offering Department	Career Development Centre				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

CLR-1: develop contextual approach to acquire new vocabulary
CLR-2: establish clear relationship between words
CLR-3: identify problems
CLR-4: learn the fundamental skills to solve problems
CLR-5: acquire experience of attending group discussion and personal interview
CLR-6: equipping students with necessary employability skills

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Disciplinary Knowledge	Critical Thinking	Problem Solving	Analytical Reasoning	Research Skills	Team Work	Scientific Reasoning	Reflective Thinking	Self-Directed Learning	Multicultural Competence	ICT Skills	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CLO-1:	determine the accurate meanings of words	2	80	75	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
CLO-2:	recognise parallel relationship between words	2	80	70	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
CLO-3:	learn to solve problems	2	75	70	H	H	H	H	H	H	H	H	M	H	H	H	H	H	H
CLO-4:	understand and applies problem solving skills learned.	2	80	75	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
CLO-5:	inculcate professional communication through Interviews & Group Discussions	2	80	70	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
CLO-6:	acquire necessary skills for successful career	2	80	75	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H

Duration (hour)		3	3	3	3	3
S-1	SLO-1	Time & work	Time, speed, distance	Permutation and combination	Probability	Geometry and Mensuration
	SLO-2	Solving problems	Solving problems	Solving problems	Solving problems	Solving problems
S-2	SLO-1	Perspective on Issues	Critical Reasoning	Synonyms	Antonyms	Word Analogy
	SLO-2	Perspective on Issues	Critical Reasoning	Synonyms	Antonyms	Word Analogy
S-3	SLO-1	Resume preparation	Group Discussion	Mock GD	Interview Techniques	Mock PI
	SLO-2	Resume preparation	Group Discussion	Mock GD	Interview Techniques	Mock PI

	Learning Resources	1. Quantitative aptitude by Dinesh Khattar 2. Ramachandran and Karthik, From Campus to Corporate, India, PEARSON Publication, 2016.	3. Verbal Advantage – Ten Easy Steps to a Powerful Vocabulary – Charles Harrington Elster 4. Barron's GRE

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (10%)		CLA – 3 (20%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	30 %	-	30 %	-	30 %	-	30 %	-	30 %	-
	Understand										
Level 2	Apply	40 %	-	40 %	-	40 %	-	40 %	-	40 %	-
	Analyze										
Level 3	Evaluate	30 %	-	30 %	-	30 %	-	30 %	-	30 %	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Scientific Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications etc.,

Course Designers

Experts from Industry	Internal Experts	
1.Mr. Ajay Zenne, Career Launcher,ajay.z@careerlauncher.com	1. Dr.P.Madhusoodhanan, SRMIST	2. Dr. A Clement, SRMIST
	3. Dr.M.Snehalatha, SRMIST	4. Dr.Jayapragash J, SRMIST
2.Mr.Pratap Iyer, Study Abroad Mentors, Mumbai,pratap.iyer30@gmail.com	5. Mr. Harinarayana Rao, SRMIST	6. Mr. P Priyanand, SRMIST
	7. Mrs. Kavitha Srisarann, SRMIST	

Course Code	PBT21P01L	Course Name	INTERNSHIP			Course Category	P	INTERNSHIP	L	T	P	C
									0	0	0	0

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

Course Learning Rationale (CLR):	The purpose of learning this course is to,
CLR-1 :	To test the ability to identify research gap
CLR-2 :	To test the ability to identify the problem
CLR-3 :	To test the ability to devise a plan of study
CLR-4 :	To teach how to determine the methodology
CLR-5 :	To test the practical knowledge
CLR-6 :	To teach how to write a dissertation

Learning

Program Learning Outcomes (PLO)

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Fundamental 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	PSO - 1	PSO - 2	PSO - 3
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLO-1 :	Knowledge on reading the review of literature	2	85	80	H	H	H	H	-	-	-	H	H	-	H	H	H	H	H
CLO-2 :	Knowledge on problem solving methods	3	85	80	H	H	H	H	-	-	-	H	H	-	H	H	H	H	H
CLO-3 :	Knowledge on devising methodologies	3	85	80	H	H	H	H	-	-	-	H	H	-	H	H	H	H	H
CLO-4 :	Hands- on knowledge on various techniques	3	85	80	H	H	H	H	-	-	-	H	H	-	H	H	H	H	H
CLO-5 :	Knowlwdge to interpret the results	3	85	80	H	H	H	H	-	-	-	H	H	-	H	H	H	H	H
CLO-6 :	Understanding the importance of presentation and dissertation	3	85	80	H	H	H	H	-	-	-	H	H	-	H	H	H	H	H

Learning Assessment				
Internship	Continuous Learning Assessment (50% weightage)		Final Evaluation (50% weightage)	
	Review – 1	Review – 2	Project Report	Viva-Voce
	20%	30 %	30 %	20 %

COURSE CODE	PBT21G01T	COURSE NAME	RESEARCH METHODOLOGY	COURSE CATEGORY	G	GENERIC ELECTIVE COURSE	L	T	P	C
							2	0	0	2

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	BIOTECHNOLOGY	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
CLR-1 :	Understanding the aspects of research																		
CLR-2 :	Understanding the methods of framing a research plan																		
CLR-3 :	Understanding the importance of literature survey																		
CLR-4 :	To know the method of writing thesis																		
CLR-5 :	Knowledge on scientific writing																		
CLR-6 :	Knowing the concept of funding agencies																		

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Fundamental 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	PSO – 1	PSO – 2	PSO – 3
CLO-1 :	Acquired basic Knowledge on research and its implications	2	85	80	L	H	H	H	H	-	-	M	M	L	-	H	-	-	-
CLO-2 :	Basic Knowledge on scientific writing	3	85	80	L	H	H	H	H	-	-	M	M	L	-	H	-	-	-
CLO-3 :	Strong basis for understanding variables and data needed for research	3	85	80	L	H	H	H	H	-	-	M	M	L	-	H	-	-	-
CLO-4 :	Better knowledge on choosing a research problem	3	85	80	L	H	H	H	H	-	-	M	M	L	-	H	-	-	-
CLO-5 :	Better knowledge gained about funding agencies	3	85	80	L	H	H	H	H	-	-	M	M	L	-	H	-	-	-
CLO-6 :	Overall understanding of methods in doing a reserach	3	85	80	L	H	H	H	H	-	-	M	M	L	-	H	-	-	-

Duration (hour)		3	3	3	3	3
S-1	SLO-1	Definition and objectives of Research	Literature review	Scientific document: Organization	Tables and graphs of frequency data of one variable	Funding agencies: National and international funding agencies for R & D projects
S -2	SLO-2	Solving problems	Solving problems	Solving problems	Solving problems	Solving problems
S-3	SLO-1	Types of research	Surveying	writing of a research paper	Tables and graphs that show the relationship between two variables	Preparation of R & D projects for funding
S-4	SLO-2	Perspective on Issues	Critical Reasoning	Synonyms	Antonyms	Word Analogy
S-5	SLO-1	Various Steps in Research Process	synthesizing, critical analysis	short communications, review articles	Mean median mode	Organization of a research project,
S-6	SLO-2	Resume preparation	Group Discussion	Mock GD	Interview Techniques	Mock PI

Learning Resources	1. Dr.RajendrakumarC."Research Methodology" APH Publishing corporation, 2008.
	2. Kothari C.R."Research Methodology". New Age International, 2004.
	3. KhanzodeV.V"Research Methodology". APH Publication, 2004.

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (10%)		CLA – 3 (20%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	40%	-	60%	--	30%	-	20%	-	30%	-
	Understand										
Level 2	Apply	40%	-	30%	-	30%	-	40%	-	40%	-
	Analyze										
Level 3	Evaluate	20%	-	10%	-	40%	-	40%	-	30%	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

Course Designers	
Experts from Higher Technical Institutions	Internal Experts
1. Dr.P. Rajasekaran, Associate Professor & HOD, Department of Biotechnology, Rajalakshmi Engineering College 2. Dr. Y.Swarnalatha, Professor and Dean of Higher Studies, Department of Biotechnology,Sathyabama Institute of Science and Technology	Dr.T.G.Nithya, DBT,SRMIST

Course Code	PBT21P02L	Course Name	PROJECT WORK	Course Category	P	PROJECT WORK AND INTERNSHIPS	L	T	P	C
							0	0	24	12

Pre-requisite Courses	Nil		Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department		Biotechnology	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
CLR-1 :	To test the ability to identify research gap																		
CLR-2 :	To test the ability to idetify the problem																		
CLR-3 :	To test the ability to devise a plan of study																		
CLR-4 :	To teach how to determine the methodology																		
CLR-5 :	To test the practical knowledge																		
CLR-6 :	To teach how to write a dissertation																		

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Fundamental 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	PSO - 1	PSO – 2	PSO – 3
CLO-1 :	Knowledge on reading the review of literature	2	85	80	H	H	H	H	-	-	-	H	H	-	H	H	H	H	H
CLO-2 :	Knowledge on problem solving methods	3	85	80	H	H	H	H	-	-	-	H	H	-	H	H	H	H	H
CLO-3 :	Knowledge on devising methodologies	3	85	80	H	H	H	H	-	-	-	H	H	-	H	H	H	H	H
CLO-4 :	Hands- on knowledge on various techniques	3	85	80	H	H	H	H	-	-	-	H	H	-	H	H	H	H	H
CLO-5 :	Knowlwdge to interpret the results	3	85	80	H	H	H	H	-	-	-	H	H	-	H	H	H	H	H
CLO-6 :	Understanding the importance of presentation and dissertation	3	85	80	H	H	H	H	-	-	-	H	H	-	H	H	H	H	H

Learning Assessment					
Project Work / Internship	Continuous Learning Assessment (50% weightage)		Final Evaluation (50% weightage)	
	Review – 1	Review – 2	Project Report	Viva-Voce
	20%	30 %	30 %	20 %