ACADEMIC CURRICULA

UNDERGRADUATE DEGREE PROGRAMMES

Bachelor of Technology

(B.Tech. - Four Years)

in

ARTIFICIAL INTELLIGENCE

(Choice Based Flexible Credit System)

Regulations 2018

CURRICULUM and SYLLABUS

SRM INSTITUTE OF SCIENCE AND TECHNOLOGY

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

Kattankulathur, Chengalpattu District 603203, Tamil Nadu, India

B.Tech. in Artificial Intelligence

1. Department Vision Statement	
Stmt - 1	To produce students with a comprehensive understanding of the essentials of the theory and application of Artificial Intelligence
Stmt - 2	To enable students to become leaders in the industry and academia nationally and internationally.
Stmt - 3	To meet the persistent demands in the area of Artificial Intelligence.

2. Department Mission Statement	
Stmt - 1	To develop, test, iterate and demonstrate how Artificial Intelligence can be used to tackle the problems in divergent domains that serves the nation and humanity.
Stmt - 2	To collaborate with other disciplines that includes but not limited to Engineering and Technology, Science, Humanities, Medicines, Agriculture, Management, Law, etc.
Stmt - 3	To advance the research collaboration with communities for a healthy, and sustainable world.
Stmt - 4	To impart societal, safety, cultural, environmental and ethical responsibilities in the professional activities.
Stmt - 5	To produce successful Artificial Intelligence graduates with the ability to work in multidisciplinary teams and commitment to lifelong learning.

3. Program Education Objectives (PEO)	
PEO - 1	Graduates will be able to analyze the problems by applying the principles of computer science, mathematics, and scientific investigation and to design and implement industry accepted solutions using latest AI technologies
PEO - 2	Graduates will be able to develop a basic understanding of the building blocks of AI in terms of intelligent agents like Search, Knowledge representation, inference, logic, and learning
PEO - 3	Graduates will be able to aid computers perform intellectual tasks such as decision making, problem solving, perception, understanding human communication in any language, and translate among them
PEO - 4	Graduates will be able to be work productively in supportive, leadership and entrepreneurial roles with multidisciplinary teams through effective communication and high regard to legal and ethical responsibilities.
PEO - 5	Successfully pursue higher education in reputed institutions
PEO - 6	Be able to embrace lifelong learning to meet ever changing developments in computer science

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	H	M	M
PEO - 2	H	H	H	M	M
PEO - 3	H	H	M	M	H
PEO - 4	H	H	M	H	H
PEO - 5	H	H	H	H	H
PEO - 6	H	H	H	H	H

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

	Program Learning Outcomes (PLO)														
	1. Scientific Knowledge	2. Problem Analysis	3. Design & Development	4. Analysis, Design, Research	5. Modern Tool Usage	6. Society & Culture	7. Environment & Sustainability	8. Ethical Reasoning	9. Individual & Team Work	10. Communication	11. Project Mgt. & Finance	12. Life Long Learning	13. Critical Thinking	14. Reflective Thinking	15. Scientific Reasoning
PEO - 1	H	H	H	M	H	L	H	L	H	L	L	H	H	H	H
PEO - 2	H	H	H	M	H	L	M	L	H	L	L	H	H	H	H
PEO - 3	H	H	H	M	H	M	M	L	H	L	L	H	H	H	H
PEO - 4	M	M	M	H	L	L	H	H	H	H	M	L	L	L	L
PEO - 5	M	M	M	H	M	L	M	L	H	L	L	H	H	H	H
PEO - 6	H	M	M	M	L	L	M	L	L	L	L	H	L	L	L

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

PSO – Program Specific Outcomes (PSO)

PSO-1	Ability to learn Artificial Intelligence and its relative fields
PSO-2	Ability to create new techniques, develop algorithms and validate in the field of Artificial Intelligence
PSO-3	Ability to develop systems using techniques and tools in the field of Artificial Intelligence

Program Structure: B.Tech. In Artificial Intelligence

1. Humanities & Social Sciences including Management Courses (H)					
Course Code	Course Title	Hours/week			C
		L	T	P	
18LEH101J	English	2	0	2	3
18LEH102J	Chinese	2	0	2	3
18LEH103J	French				
18LEH104J	German				
18LEH105J	Japanese				
18LEH106J	Korean				
18PDH101T	General Aptitude	0	0	2	1
18AIH201T	Professional Ethics of Artificial Intelligence	2	0	0	2
18PDH201T	Employability Skills and Practices	0	0	2	0
Total Learning Credits					9

2. Basic Science Courses (B)					
Course Code	Course Title	Hours/week			C
		L	T	P	
18MAB101T	Calculus and Linear Algebra	3	1	0	4
18MAB102T	Advanced Calculus and Complex Analysis	3	1	0	4
18PCB101J	Engineering Physics, Chemistry and Biology	3	1	2	5
18MAB201T	Transforms and Boundary Value Problems	3	1	0	4
18MAB206T	Numerical Methods and Analysis	3	1	0	4
18MAB304T	Probability and Applied Statistics	3	1	0	4
18MAB302T	Discrete Mathematics for Engineers	3	1	0	4
Total Learning Credits					29

3. Engineering Science Courses (S)					
Course Code	Course Title	Hours/week			C
		L	T	P	
18AIS101J	Introduction to MATLAB for Artificial Intelligence	1	0	4	3
18EES101J	Basic Electrical and Electronics Engineering	3	1	2	5
18CSS101J	Programming for Problem Solving	3	0	4	5
18AIS102J	Smart Manufacturing	1	0	4	3
18AIS201T	Linear Systems and Signal Processing	3	0	0	3
18AIS202T	Digital Logic and Computer Architecture	3	0	0	3
18AIS203J	Computer Networks and Communications	2	0	2	3
Total Learning Credits					25

4. Professional Core Courses (C)					
Course Code	Course Title	Hours/week			C
		L	T	P	
18AIC101J	Foundation of Data Analysis	3	0	2	4
18AIC201J	Foundation of Artificial Intelligence	2	0	2	3
18AIC202J	Data Structure and its Applications	3	0	2	4
18AIC203J	Object Oriented Design and Programming	3	0	2	4
18AIC204T	Software Engineering Principles	3	0	0	3
18AIC205J	Neural Networks and Machine Learning	3	0	2	4
18AIC206J	Analysis and Design of Algorithms	3	0	2	4
18AIC207J	Database Management Systems for Artificial Intelligence	2	0	2	3
18AIC208J	Operating System Design	2	0	2	3
18AIC209T	Foundation of Metric Spaces	1	0	0	1
18AIC301J	Deep Learning Techniques	3	0	2	4
18AIC302J	Web Programming for Artificial Intelligence	3	0	2	4
18AIC303T	Formal Language and Automata Theory	3	0	0	3
18AIC304J	Reinforcement Learning Techniques	2	0	2	3
18AIC305T	Inferential Statistics and Predictive Analytics	2	0	0	2
18AIC306J	Design of Artificial Intelligence Products	2	0	2	3
18CSC208L	Competitive Professional Skills - I	0	0	2	1
18CSC306L	Competitive Professional Skills-II	0	0	2	1
18CSC307L	Competitive Professional Skills – III	0	0	2	1
18CSC350T	Comprehension	0	1	0	1
Total Learning Credits					56

5. Professional Elective Courses (E) (Any 6 Elective Courses)					
Course Code	Course Title	Hours/week			C
		L	T	P	
18AIE321T	Optimization Techniques	3	0	0	3
18AIE322T	Stochastic Decision Making	3	0	0	3
18AIE323T	Information Theory and Coding	3	0	0	3
18AIE324T	Cognitive Science & Analytics	3	0	0	3
18AIE325T	Internet of Things Architecture and Protocols	3	0	0	3
18AIE326T	Intelligent Autonomous Systems	3	0	0	3
18AIE327T	Intelligence of Biological Systems	3	0	0	3
18AIE328T	Marketing Analytics	3	0	0	3
18AIE329T	Information Retrieval	3	0	0	3
18AIE330T	Text Processing	3	0	0	3
18AIE331T	Advanced Social, Text and Media Analytics	3	0	0	3
18AIE332T	Image and Video processing	3	0	0	3
18AIE333T	Biometrics	3	0	0	3
18AIE334T	Pattern Recognition Techniques	3	0	0	3
18AIE335T	Surveillance Video Analytics	3	0	0	3
18AIE336T	Medical Signal Processing	3	0	0	3
18AIE337T	Speech Recognition and Understanding	3	0	0	3
18AIE338T	Logic and Knowledge Representation	3	0	0	3
18AIE339T	Matrix theory for Artificial Intelligence	3	0	0	3
18AIE421T	Soft Computing and its Applications	3	0	0	3
18AIE422T	Artificial Intelligence and High-Performance Computing	3	0	0	3
18AIE423T	Business Intelligence and Analytics	3	0	0	3
18AIE424T	Artificial Intelligence and Internet of Things	3	0	0	3
18AIE425T	Compiler Design	3	0	0	3
18AIE426T	Virtual Reality and Augmented Reality	3	0	0	3
18AIE427T	Data Mining and Analytics	3	0	0	3
18AIE428T	Time Series Analysis	3	0	0	3
18AIE429T	Cloud Computing	3	0	0	3

6. Open Elective Courses (O) offered to B Tech Artificial Intelligence Students (Any 3 Open Elective Courses)					
Smart Health care					
Course Code	Course Title	Hours/Week			
		L	T	P	C
18BT0101T	Human Health and diseases	3	0	0	3
18BT0106T	Waste to Wealth to Wheels	3	0	0	3
18BT0107T	Fundamental Neurobiology	3	0	0	3
18EC0122T	Health Information systems	3	0	0	3
18BM0124T	Rehabilation Engineering	3	0	0	3
18EC0125T	Quality control for Biomedical devices	3	0	0	3
18BM0126T	Bio Mechanics of Human Movement	3	0	0	3
18NT0305T	Medical Nanotechnology	3	0	0	3
Infrastructure					
Course Code	Course Title	Hours/Week			
		L	T	P	C
18CE0305T	Environmental Impact Assessment	3	0	0	3
18CE0307T	Disaster Mitigation and Management	3	0	0	3
18CE0406T	Global warming and climate change	3	0	0	3
18CE0407T	Application of Remote sensing and GIS	3	0	0	3
18CE0405T	Water pollution and its Management	3	0	0	3

18AIE430T	Distributed Systems	3	0	0	3
18AIE431T	Big Data Analytics: Hadoop, Spark and NoSQL	3	0	0	3
18AIE432T	Brain Machine Interface	3	0	0	3
18AIE433T	Nature Inspired Computing	3	0	0	3
18AIE434T	Bio Informatics	3	0	0	3
18AIE435T	Theoretical and Computational Neuroscience	3	0	0	3
18AIE436T	Autonomous Navigation and Vehicles	3	0	0	3
18AIE437T	Mobile Game Development	3	0	0	3
Total Learning Credits					**18**

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

Course Code	Course Title	Hours/week			C
		L	T	P	
18AIP101L/ 18AIP102L/18AIP103L	MOOC / Industrial Training 1 / Seminar 1	0	0	2	1
18AIP104L/18AIP105L /18AIP106L	MOOC / Industrial Training 2 / Seminar 2	0	0	2	1
18AIP107L/ 18AIP108L	Project (Phase-I) Internship (4-6weeks)	0	0	6	3
18AIP109L/ 18AIP110L	Project (Phase-II) / Semester Internship	0	0	20	10
Total Learning Credits					**15**

8. Mandatory Courses (M)

Course Code	Course Title	Hours/week			C
		L	T	P	
18PDM 101L	Professional Skills & Practices	0	0	2	0
18LEM101T	Constitution of India	1	0	0	0
18GNM101L	Physical and Mental Health using Yoga	0	0	2	0
18LEM102J	Value Education	1	0	1	0
18GNM10XL	NCC / NSS / NSO	0	0	2	0
18PDM201L	Competencies in Social Skills	0	0	2	0
18PDM203L	Entrepreneurial Skill Development	0	0	2	0
18PDM202L	Critical and Creative Thinking Skills	0	0	2	0
18PDM204L	Business Basics for Entrepreneurs	0	0	2	0
18CYM101T	Environmental Science	1	0	0	0
18PDM301L	Analytical and Logical Thinking Skills	0	0	2	0
18PDM302L	Entrepreneurship Management	0	0	2	0
18LEM109T	Indian Traditional Knowledge	1	0	0	0
18LEM110L	Indian Art Form	0	0	2	0
Total Learning Credits					**0**

Business Analytics

Course Code	Course Title	Hours/Week			
		L	T	P	C
18CS0161T	Behavioral Economics	3	0	0	3
18CS0162T	Computational Finance and Modelling	3	0	0	3
18CS0163T	Psychology	3	0	0	3
18MB0404T	Entrepreneur and Intellectual Property Rights	3	0	0	3
18MB0406T	B2B Marketing	3	0	0	3
18MB009T	Finance for Engineers	3	0	0	3

Robotics

Course Code	Course Title	Hours/Week			
		L	T	P	C
18MH0103T	Introduction to Robotics	3	0	0	3
18EC0134T	Industrial Automata	3	0	0	3
18EC0182T	Telehealth Technology	3	0	0	3
18EC0187T	Integrated Product Development	3	0	0	3
18ME0108T	Automatic Control Systems	3	0	0	3
18ME0101T	Robotics Engineering and Application	3	0	0	3
18NT0307T	Nano Computing	3	0	0	3
18NT0308T	Smart Sensor Systems	3	0	0	3

9. Open Elective Courses (O) Offered to other branches

Course Code	Course Title	Hours/ Week			C
		L	T	P	
18AIO351T	Introduction to Artificial Intelligence	3	0	0	3
18AIO352T	Machine Learning	3	0	0	3
18AIO353J	Python for Data Analytics	2	0	2	3
18AIO354T	Soft Computing	3	0	0	3
Total Learning Credits					**12**

B.Tech. in ARTIFICIAL INTELLIGENCE (4 years)
Curriculum – Regulations 2018

Semester - I

Code	Course Title	Hours/ Week L	T	P	C
18LEH101J	English	2	0	2	3
18MAB101T	Calculus and Linear Algebra	3	1	0	4
18AIS101J	Introduction to MATLAB for Artificial Intelligence	1	0	4	3
18EES101J	Basic Electrical and Electronics Engineering	3	1	2	5
18CSS101J	Programming for Problem Solving	3	0	4	5
18PDM 101L	Professional Skills & Practices	0	0	2	0
18LEM101T	Constitution of India	1	0	0	0
18GNM101L	Physical and Mental Health using Yoga	0	0	2	0
	Total Learning Credits				20

Semester - II

Code	Course Title	Hours/ Week L	T	P	C
18LEH102J/ 18LEH103J/ 18LEH104J/ 18LEH105J/ 18LEH106J	Chinese / French / German / Japanese/ Korean	2	0	2	3
18MAB102T	Advanced Calculus and Complex Analysis	3	1	0	4
18AIC101J	Foundation of Data Analysis	3	0	2	4
18PCB101J	Engineering Physics, Chemistry and Biology	3	1	2	5
18AIS102J	Smart Manufacturing	1	0	4	3
18PDH101T	General Aptitude	0	0	2	1
18LEM102J	Value Education	1	0	1	0
18GNM10XL	NCC / NSS / NSO	0	0	2	0
	Total Learning Credits				20

Semester - III

Code	Course Title	Hours/ Week L	T	P	C
18MAB201T	Transforms and Boundary Value Problems	3	1	0	4
18AIC201J	Foundation of Artificial Intelligence	2	0	2	3
18AIC202J	Data Structure and its Applications	3	0	2	4
18AIC203J	Object Oriented Design and Programming	3	0	2	4
18AIC204T	Software Engineering Principles	3	0	0	3
18AIS201T	Linear Systems and Signal Processing	3	0	0	3
18AIS202T	Digital Logic and Computer Architecture	3	0	0	3
18PDM201L	Competencies in Social Skills	0	0	2	0
18PDM203L	Entrepreneurial Skill Development				
	Total Learning Credits				24

Semester - IV

Code	Course Title	Hours/ Week L	T	P	C
18MAB206T	Numerical Methods and Analysis	3	1	0	4
18AIC205J	Neural Networks and Machine Learning	3	0	2	4
18AIC206J	Analysis and Design of Algorithms	3	0	2	4
18AIC207J	Database Management Systems for Artificial Intelligence	2	0	2	3
18AIC208J	Operating System Design	2	0	2	3
18AIS203J	Computer Networks and Communications	2	0	2	3
18AIC209T	Foundation of Metric Spaces	1	0	0	1
18AIH201T	Professional Ethics of Artificial Intelligence	2	0	0	2
18CSC208L	Competitive Professional Skills - I	0	0	2	1
18PDM202L	Critical and Creative Thinking Skills	0	0	2	0
18PDM204L	Business Basics for Entrepreneurs				
18CYM101T	Environmental Science	1	0	0	0
	Total Learning Credits				25

Semester - V

Code	Course Title	Hours/ Week L	T	P	C
18MAB304T	Probability and Applied Statistics	3	1	0	4
18AIC301J	Deep Learning Techniques	3	0	2	4
18AIC302J	Web Programming for Artificial Intelligence	3	0	2	4
18AIC303T	Formal Language and Automata Theory	3	0	0	3
18CSC306L	Competitive Professional Skills-II	0	0	2	1
E	Professional Elective – 1	3	0	0	3
E	Professional Elective – 2	3	0	0	3
O	Open Elective – 1	3	0	0	3
18AIP101L/ 18AIP102L/ 18AIP103L	MOOC 1 / Industrial Training 1/ Seminar 1	0	0	2	1
18PDM301L	Analytical and Logical Thinking Skills	0	0	2	0
18PDM302L	Entrepreneurship Management				
18LEM109T	Indian Traditional Knowledge	1	0	0	0
	Total Learning Credits				26

Semester - VI

Code	Course Title	Hours/ Week L	T	P	C
18MAB302T	Discrete Mathematics for Engineers	3	1	0	4
18AIC304J	Reinforcement Learning Techniques	2	0	2	3
18AIC305T	Inferential Statistics and Predictive Analytics	2	0	0	2
18AIC306J	Design of Artificial Intelligence Products	2	0	2	3
18CSC307L	Competitive Professional Skills – III	0	0	2	1
18AIC350T	Comprehension	0	1	0	1
E	Professional Elective – 3	3	0	0	3
E	Professional Elective – 4	3	0	0	3
O	Open Elective – 2	3	0	0	3
18AIP104L/ 18AIP105L/ 18AIP106L	MOOC 2 / Industrial Training 2 / Seminar 2	0	0	2	1
18PDH201T	Employability Skills and Practices	0	0	2	0
18LEM110L	Indian Art Form				
	Total Learning Credits				24

Semester - VII

Code	Course Title	Hours/ Week L	T	P	C
E	Professional Elective –5	3	0	0	3
E	Professional Elective – 6	3	0	0	3
O	Open Elective – 3	3	0	0	3
18AIP107L/ 18AIP108L	Project (Phase-I) Internship (4-6weeks)	0	0	6	3
	Total Learning Credits				12

Semester – VIII

Code	Course Title	Hours/ Week L	T	P	C
18AIP109L / 18AIP110L	Project (Phase-II) / Semester Internship	0	0	20	10
	Total Learning Credits				10

Category of Courses and Credits Table

Category	Credits per semester I	II	III	IV	V	VI	VII	VIII	Total credits
Humanities & Social Sciences / Management (H)	3	4	-	2	-	-	-	-	09
Basic Sciences (B)	4	9	4	4	4	4	-	-	29
Engineering Sciences (S)	13	3	6	3	-	-	-	-	25
Professional Core (C)	-	4	14	16	12	10	-	-	56
Professional Elective (E)	-	-	-	-	6	6	6	-	18
Open Elective (O)	-	-	-	-	3	3	3	-	09
Project / Seminar / Internship (P)	-	-	-	-	1	1	3	10	15

Total Credits	*20*	*20*	*24*	*25*	*26*	*24*	*12*	*10*	*161*

Professional Electives

Category I – Core AI & ML

S. No.	Course Name	Hours/ Week			C
		L	T	P	
18AIE321T	*Optimization Techniques*	3	0	0	3
18AIE322T	*Stochastic Decision Making*	3	0	0	3
18AIE323T	*Information Theory and Coding*	3	0	0	3
18AIE324T	*Cognitive Science & Analytics*	3	0	0	3
18AIE325T	*Internet of Things Architecture and Protocols*	3	0	0	3
18AIE326T	*Intelligent Autonomous Systems*	3	0	0	3
18AIE327T	*Intelligence of Biological Systems*	3	0	0	3
18AIE338T	*Logic and Knowledge Representation*	3	0	0	3
18AIE339T	*Matrix theory for Artificial Intelligence*	3	0	0	3
18AIE421T	*Soft Computing and its Applications*	3	0	0	3
18AIE422T	*Artificial Intelligence and High-Performance Computing*	3	0	0	3
18AIE423T	*Business Intelligence and Analytics*	3	0	0	3
18AIE424T	*Artificial Intelligence and Internet of Things*	3	0	0	3
18AIE425T	*Compiler Design*	3	0	0	3
18AIE426T	*Virtual Reality and Augmented Reality*	3	0	0	3
18AIE436T	*Autonomous Navigation and Vehicles*	*3*	*0*	*0*	3
18AIE437T	*Mobile Game Development*				

Category II – Language Technologies

S. No.	Course Name	Hours/ Week			C
		L	T	P	
18AIE328T	*Marketing Analytics*	*3*	*0*	*0*	*3*
18AIE329T	*Information Retrieval*	*3*	*0*	*0*	*3*
18AIE330T	*Text Processing*	*3*	*0*	*0*	*3*
18AIE331T	*Advanced Social, Text and Media Analytics*	*3*	*0*	*0*	*3*

Category III – Speech & Vision

S. No.	Course Name	Hours/ Week			C
		L	T	P	
18AIE332T	*Image and Video processing*	*3*	*0*	*0*	*3*
18AIE333T	*Biometrics*	*3*	*0*	*0*	*3*
18AIE334T	*Pattern Recognition Techniques*	*3*	*0*	*0*	*3*
18AIE335T	*Surveillance Video Analytics*	*3*	*0*	*0*	*3*
18AIE336T	*Medical Signal Processing*	*3*	*0*	*0*	*3*
18AIE337T	*Speech Recognition and Understanding*	*3*	*0*	*0*	*3*

Category IV– Data Science

S. No.	Course Name	Hours/ Week			C
		L	T	P	
18AIE427T	*Data Mining and Analytics*	*3*	*0*	*0*	*3*
18AIE428T	*Time Series Analysis*	*3*	*0*	*0*	*3*
18AIE429T	*Cloud Computing*	*3*	*0*	*0*	*3*
18AIE430T	*Distributed Systems*	*3*	*0*	*0*	*3*
18AIE431T	*Big Data Analytics: Hadoop, Spark and NoSQL*	*3*	*0*	*0*	*3*

Category V– Neuro Science and Natural Intelligence

S. No.	Course Name	Hours/ Week			C
		L	T	P	
18AIE432T	*Brain Machine Interface*	*3*	*0*	*0*	*3*
18AIE433T	*Nature Inspired Computing*	*3*	*0*	*0*	*3*
18AIE434T	*Bio Informatics*	*3*	*0*	*0*	*3*
18AIE435T	*Theoretical and Computational Neuroscience*	*3*	*0*	*0*	*3*

Note:

1. *Students should choose III year Professional Elective courses from 300 series in category I, II & III.*
2. *Students should choose Professional Elective courses for VII semester from 400 series in category I, IV & V.*

List will be expanded

Open Elective Courses

Smart Health care

Course Code	Course Title	Hours/Week			
		L	T	P	C
18BT0101T	Human Health and diseases	3	0	0	3
18BT0106T	Waste to Wealth to Wheels	3	0	0	3
18BT0107T	Fundamental Neurobiology	3	0	0	3
18EC0122T	Health Information systems	3	0	0	3
18BM0124T	Rehabilation Engineering	3	0	0	3
18EC0125T	Quality control for Biomedical devices	3	0	0	3
18BM0126T	Bio Mechanics of Human Movement	3	0	0	3
18NT0305T	Medical Nanotechnology	3	0	0	3

Infrastructure

Course Code	Course Title	Hours/Week			
		L	T	P	C
18CE0305T	Environmental Impact Assessment	3	0	0	3
18CE0307T	Disaster Mitigation and Management	3	0	0	3
18CE0406T	Global warming and climate change	3	0	0	3
18CE0407T	Application of Remote sensing and GIS	3	0	0	3
18CE0405T	Water pollution and its Management	3	0	0	3

Business Analytics

Course Code	Course Title	Hours/Week			
		L	T	P	C
18CS0161T	Behavioral Economics	3	0	0	3
18CS0162T	Computational Finance and Modelling	3	0	0	3
18CS0163T	Psychology	3	0	0	3
18MB0404T	Entrepreneur and Intellectual Property Rights	3	0	0	3
18MB0406T	B2B Marketing	3	0	0	3
18MB009T	Finance for Engineers	3	0	0	3

Robotics

Course Code	Course Title	Hours/Week			
		L	T	P	C
18MH0103T	Introduction to Robotics	3	0	0	3
18EC0134T	Industrial Automata	3	0	0	3
18EC0182T	Telehealth Technology	3	0	0	3
18EC0187T	Integrated Product Development	3	0	0	3
18ME0108T	Automatic Control Systems	3	0	0	3
18ME0101T	Robotics Engineering and Application	3	0	0	3
18NT0307T	Nano Computing	3	0	0	3
18NT0308T	Smart Sensor Systems	3	0	0	3

Note:

1. ***Students should choose their open electives only from the list given above.***
2. ***Students are advised to choose their all 3 open elective from any one of the domain given above.***

Open Elective Courses (O) Offered to other branches

Course Code	Course Title	Hours/ Week			C
		L	T	P	
18AIO351T	*Introduction to Artificial Intelligence*	*3*	*0*	*0*	*3*
18AIO352T	*Machine Learning*	*3*	*0*	*0*	*3*
18AIO353J	*Python for Data Analytics*	*2*	*0*	*2*	*3*
18AIO354T	*Soft Computing*	*3*	*0*	*0*	*3*
Total Learning Credits					**12**

Course Code	18PCB101J	Course Name	Engineering Physics, Chemistry and Biology	Course Category	B	Basic Science	L	T	P	C
							3	1	2	5

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

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

			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)		Engineering 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-1 :	Utilize the knowledge on Mechanics, optics and its applications in AI		1	2	3		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-2 :	Utilize the knowledge on Electric filed on materials, Quantum Mechanics and its applications in AI																				
CLR-3 :	Discuss the concepts of organic and inorganic chemistry																				
CLR-4 :	Understand the Microbial diseases, Immunity and vaccines																				
CLR-5 :	Illustrate the applications of stem cells, vaccines and environmental studies																				
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																				
CLO-1 :	Identify the principle of mechanics and Optics		2	85	75		H	M	L												
CLO-2 :	Analyze electromagnetic induction and Apply quantum mechanics to basic physical problems		2	75	70		H	M	L												
CLO-3 :	Understand the uses of organic and inorganic chemistry		2	80	75			M				H	L								
CLO-4 :	Study the Microbial diseases, Immunity and vaccines		2	75	70		M	M	L												
CLO-5 :	Analyse the applications of stem cells, vaccines and environmental pollution management		2	80	70					M		H	H								

Duration (hour)		Physics	Physics	Chemistry	Biology	Biology
S-1	SLO-1	Introduction to Physics	Introduction to Electrostatics	Quantum Mechanical Model of Atom	Introduction to Biology	Introduction to Animal Biotechnology
	SLO-2	Scope of Physics - Macroscopic & Microscopic domain	Introduction to Magneto statics		Taxonomy and classification	Types of breeding
S-2	SLO-1	Introduction to Artificial Intelligence	Maxwell's I & II Equation	Periodic table of Elements	Introduction to Microbiology	Artificial Insemination
	SLO-2	Role of Physics in AI	Maxwell's III & IV Equation	Classification of elements	Infections: Acute / Chronic, Treatment and cure	Super Ovulation
S-3	SLO-1	Mechanics - Kinematics	Electromagnetic Induction & Faraday's Law	Chemical Bonds- Ionic and Covalent bonds	Bacterial Diseases: Cholera	Cloning
	SLO-2	Dynamics	Laser-Introduction and Applications	Hydrogen and Vandervalk's forces	Vibrio-Cholerea	Case Study: Dolly (Goat)
S-4	SLO-1	Problem Solving	Problem Solving	Ideal and real gases - Introduction	Viral Diseases: AIDS	Transgenic Animals

	SLO-2			*Vander Waals equation of state - Derivation*	*HIV*	*Case Study: Fish*
S 5-6 (LAB)	SLO-1	*Basics of Experimentation (Lab I)*	*Determination of Particle Size using Laser (Lab 4)*	*Determination of strength of an acid using conductometric titration (Lab 7)*	*Identification of Bacteria using Gram-staining Technique (Lab 10)*	*Culturing of Mammalian Cells in vitro (Lab 13)*
	SLO-2					
S-7	SLO-1	*Use of Mechanics in AI -*	*Introduction to Quantum Mechanics*	*Fundamentals of Organic Chemistry*	*Applications of AI in Microbiology*	*Introduction to Stem cells and tissue engineering*
	SLO-2	*Case study: Inspecting Infrastructure with Automated Unmanned Aerial Vehicles*	*Planck's Radiation Law and photoelectric effect*		*GMOs in industrial, medical, food and agricultural applications*	*Properties of stem cells*
S-8	SLO-1	*Fluid Mechanics*	*De Broglie's Wave Hypothesis*	*Introduction to Hydrocarbons*	*Introduction to Immunology*	*Types of stem cells*
	SLO-2	*Hydro dynamics & Aero dynamics*	*Heisenberg's Uncertainty Principle*	*Classification -Long Chain, Short Chain*	*B-cell and T-cell*	*Applications of stem cells in healthcare domain*
S-9	SLO-1	*Applications of AI in fluid dynamics*	*Schrodinger's time independent wave equation*	*Classification -Long Chain, Short Chain*	*Immunity: Active and Passive*	*Introduction to environmental Bio technology*
	SLO-2	*Case Study: Modelling Combustion systems with AI*	*Schrodinger's time Dependent wave equation*	*Alkanes, Alkenes and Alkynes*	*Immune Memory*	*Municipal and Industrial Waste generation - Liquid, solid and gas*
S-10	SLO-1	*Problem Solving*	*Problem Solving*	*Thermodynamics – Introduction*	*Antigens and Antibodies*	*Recovery, reuse and disposal of waste*
	SLO-2			*Gibb's Helmholtz equation - Derivation*	*Monoclonal Antibodies*	*Liquid waste management*
S 11-12 (LAB)	SLO-1	*Introduction to Artificial Neural Networks using Python (Lab 2)*	*Determination of Planck's Constant (Lab 5)*	*Estimation of Fe by using Potentiometric titration (Lab 8)*	*Antigen and antibody interaction- WIDAL Test (Lab 11)*	*Estimation of Chemical Oxygen Demand as an indicator of organic pollutants (Lab 14)*
	SLO-2					
S-13	SLO-1	*Introduction to Optics, Total Internal Reflection*	*Quantum Electro dynamics*	*Electro Chemistry – Introduction*	*Recombinant Antibody production*	*Solid waste management: Land filling, composting and incineration*
	SLO-2	*Fibre Optics - Classification of fibre optics*	*Electron-wave particle*	*Nernst equation - Derivation*	*Antigen target antibody production*	*Alternative Energy-Bio-fuel, bio-gas, hydrogen fuel cells*
S-14	SLO-1	*Numerical aperture and acceptance angle*	*Introduction to X-Rays*	*Electroplating and Electro less plating*	*Types of vaccines*	*Bio pesticides, bio-insectides*
	SLO-2	*Derivation of Numerical aperture and Acceptance angle*	*Production, properties & Applications of X-Rays*	*Batteries, Electro dusting*	*Applications of Human Vaccines*	*Bio-fertilizers*
S-15	SLO-1	*Role of optics in AI Hardware*	*AI Applications using X-Rays*	*Polymers - Introduction and its types*	*AI Integrated Biology*	*New Innovations of Medical Biotechnology: 3D-printing, Artificial Heart, Bones, joints and hips*
	SLO-2	*Ultrasonics Transducers*	*AI Applications using Ultrasonics*	*Composites - Introduction and its types*	*AI for Disease Classification*	
S-16	SLO-1	*Problem Solving*	*Problem Solving*	*Sensors and Biosensors - Introduction*	*Problem Solving*	*AI in Environmental Studies*
	SLO-2			*Nanomaterial, Nanoparticles - Introduction*		*Case study*

S 17-18 (LAB)	SLO-1	*Study of Attenuation and propagation characterization of optical fiber (Lab 3)*	*AI Design of Convolution Neural Network capable of analyzing images (Lab 6)*	*Determination of Molecular weight of a Polymer by Viscosity average method (Lab 9)*	*Classification and Prediction in Microbiology (Lab 12)*	*AI Design of Deep Neural Network for Pollution prediction (Lab 15)*
	SLO-2					

Learning Resources	1. *David Jeffery Griffiths, Introduction to Electrodynamics, Revised 3 rd edition, Pearson, 2013* 2. *Ajay Ghatak, Optics, Tata McGraw Hill Education, 5th edition, 2012* 3. *David Halliday, Fundamentals of Physics, 7th edition, John Wiley & Sons Australia, Ltd, 2004* 4. *Eisberg and Resnick, Quantum Physics: Of Atoms, Molecules, Solids, Nuclei and Particles, 2nd Edition, 1985* 5. *"B. R. Puri , Madan S. Pathania , L. R. Sharma , Principles of Physical Chemistry Vishal Publishing Co., 2019"* 6. *ARUN BAHL, A Textbook of Organic Chemistry, S Chand, Edition: 2020* 7. *Katyal Mohan, Soni P.L., Textbook of Inorganic Chemistry, Sultan Chand & Sons, 2017* 8. *R.Ananthanarayanan and Ck. Jayaram Paniker, Textbook of Microbiology, 9th Edition, 2011.* 9. *"Richard Coico, Geoffrey Sunshine, "Immunology: A short course" 6th Edition.Wiley-Blackwell. 2009."* 10. *Kenneth Murphy, "Janeway's Immunobiology," 8th Edition, Garland, 2011* 11. *"Ramadass.P, "Animal Biotechnology: Recent concepts and Developments",MJP Publications, India, 2008."* 12. *"Chatterjee.A.K, "Introducton to Environmental Biotechnology," Prentice-Hall of India, 2004."* 13. *"Russel R. Russo", Neural Networks for Beginners: An Easy Textbook for Machine Learning Fundamentals to Guide You Implementing Neural Networks with Python and Deep Learning (Artificial Intelligence 2), Kindle Edition, 2019.* 14. *"Bhardwaj, Anurag, Wei Di, and Jianing Wei". Deep Learning Essentials: Your hands-on guide to the fundamentals of deep learning and neural network modeling. Packt Publishing Ltd, 2018.*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		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	Experts from Higher Technical Institutions	Internal Experts
Dr. Vinay Kumar Gupta, National Physical Laboratory	Prof .C. Vijayan, IITM, Chennai	Dr. M. Krishnamohan, Physics & Nanotechnology
Dr. S. Sam Gunasekar, General Manager (Environment), Orchid Pharma Ltd., Chennai	Dr.G.Sekaran, Former Chief Scientist, Environmental Technology Division, CSIR- Central Leather Research Institute, Chennai	Dr. K. Ramani, Department of Biotechnology, School of Bio-Engineering
Dr. Sudarshan Mahapatra, Encube Ethicals Pvtt.Ltd	Prof. G. Sekar, IIT Madras	Prof. M. Arthanareeswari, Department of Chemistry
Dr. Shanmukhaprasad Gopi, Dr. Reddy' s Laboratories,	Prof.Vivek Polshettiwar, TIFR Mumbai	Dr. J. Arockia Selvi, Department of Chemistry
Mr. Derick Jose, Co-founder, Flutura Decision Science and Analytics, Bangalore	Dr. E. Sivasankar, Assistant Professor, Department of CSE, NIT, Trichy	Dr. A. Alice Nithya, School of Computing

Course Code	18AIC101J	Course Name	FOUNDATION OF DATA ANALYSIS	Course Category	C	*Professional Core Course*	L	T	P	C
							3	0	2	4

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

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

		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	1 Engineering	2 Problem Analysis	3 Design &	4 Analysis, Design,	5 Modern Tool Usage	6 Society & Culture	7 Environment &	8 Ethics	9 Individual & Team	10 Communication	11 Project Mgt. &	12 Life Long Learning	13 PSO - 1	14 PSO - 2	15 PSO – 3
CLR-1 :	*Introduce a range of topics and concepts related to data and data analysis process.*	1	2	3															
CLR-2 :	*Understand the basic data structures involved in python to perform exploratory data analysis*																		
CLR-3 :	*Apply EDA for different file formats.*																		
CLR-4 :	*Understands data visualization using python*																		
CLR-5 :	*Provides an exposure to basic machine learning techniques to solve real world problems*																		
Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*																		
CLO-1 :	*Understand different types of data and starts working in python environment*	2	85	75	H	M	L	-	-	-	-	-	-	-	-	H	H	H	H
CLO-2 :	*Understand various data structures involved in python and perform exploratory data analysis*	2	75	70	H	M	L	-	-	-	-	-	-	-	-	H	H	H	H
CLO-3 :	*Apply the concepts of EDA in various datasets.*	2	80	75		M	-	-	-	H	L	-	-	-	-	H	H	H	H
CLO-4 :	*Formulate and use appropriate visualization techniques for their data*	2	75	70	M	M	L	-	-			-	-	-	-	H	H	H	H
CLO-5 :	*Formulate and use appropriate models of data analysis to solve hidden solutions to business-related challenges*	2	80	70	-	-	-	M	-	H	H	-	-	-	-	H	H	H	H

Duration (hour)		*15*	*15*	*15*	*15*	*15*
S-1	SLO-1	*An Introduction to Data Analysis*	*Numpy Library: Numpy Installation*	*Pandas: Reading data from csv, xml, text and html files*	*Data visualization with matplotlib library*	*Machine Learning with sci-kit learn*
	SLO-2	*Data Analysis*	*Ndarray, Create an array and Types of data*	*Writing data in CSV, Html, Excel, files*	*Matplotlib – Installation and architecture*	*sci-kit learn library*
S-2	SLO-1	*Knowledge domains of Data Analyst: Computer Science, Mathematics and statistics*	*Basic Operations: Arithmetic Operators, Matrix Product, Increment and Decrement Operators*	*Json data*	*Pyplot, plotting window*	*Machine Learning*
	SLO-2	*Machine Learning & AI, Professional fields of Application*	*Universal Functions, Aggregate Functions*	*HDF5 format*	*Using Kwargs and adding elements to the chart*	
S-3	SLO-1	*Introduction to Data*	*Indexing, slicing and iterating*	*Data preparation*	*Saving charts*	*Supervised learning with sci-kit learn*
	SLO-2	*Understanding the nature of Data*	*Conditions and Boolean arrays*	*Concatenating*	*Handling data values*	
S 4-5 (LAB)	SLO-1	***LAB 1: Introduction to Python – Installing Python and Jupyter, Importing Libraries***	***LAB 4: Numpy: Reading and writing array data on files (binary files and tabular data)***	***LAB 7: Reading and writing data***	***LAB 10: Installing matplotlib and implementing line and adding elements to the charts***	***LAB 13: Binary classification using (Logistic Regression)***
	SLO-2					
S-6	SLO-1	*Data – Information; Information - Knowledge*	*Shape and array manipulation*	*Data transformation- Removing duplicates*	*Line charts*	*Linear Regression*
	SLO-2	*Types of Data*	*Vectorization, structured arrays*	*Mapping*		

S-7	SLO-1		*Pandas library: Installation*	*Discretization and binning: Detecting and filtering outliers*	*Bar charts*	*Logistic Regression*
	SLO-2	*Data Analysis Process*	*Introduction to Pandas data structures*	*Permutation – random sampling*		
S-8	SLO-1	*Quantitative Data Analysis*	*Other functionalities on indexes*	*String manipulation*	*Histograms*	*K-Nearest Neighbor classifier*
	SLO-2	*Qualitative Data Analysis*	*Operations between data structures*	*Regular expressions*	*Pie charts*	
S 9-10 (LAB)	SLO-1 SLO-2	***LAB 2: Writing Python Code – Input and Output statements, Mathematical calculations and indentation***	***LAB 5: Implementation of Pandas data structures***	***LAB 8: Data cleaning***	***LAB 11: Implementing bar charts, histogram and pie charts***	***LAB 14: Classification using kNN***
S-11	SLO-1	*Python – The Programming Language*	*Function application and mapping*	*Data Aggregation- Group by*	*Contour plots*	*Support Vector Machines*
	SLO-2	*Python 2 and Python 3*		*Hierarchical grouping*	*Polar charts*	*Support Vector Classification*
S-12	SLO-1	*Python Package Index*	*Sorting and ranking*	*Advanced data aggregation*	*Mplot 3D toolkit: 3D surfaces*	*Nonlinear SVC*
	SLO-2	*IDEs for python*	*Correlation and covariance*		*Scatter plots and bar charts in 3D*	
S-13	SLO-1	*Scipy: Numpy*	*"Not a number" Data*	*Case study on data preprocessing*	*Multi-panel plot*	*Support Vector Regression*
	SLO-2	*Pandas, Matplotlib*	*Hierarchical Indexing and leveling*			
S 14-15 (LAB)	SLO-1 SLO-2	***LAB 3: For loop and If statements***	***LAB 6: Exploratory Data Analysis with Pandas***	***LAB 9: Data aggregation using python***	***LAB 12: Implementing multi-panel plots***	***LAB 15: Implement SVM classifier***

Learning Resources	1. *Fabio Nelli, Python Data Analytics with Pandas, Numpy and matplotlib (Second edition), Apress* 2. *Wes McKinney, Python for Data Analysis, 2nd Edition, O'Reilly Media, Inc. (https://learning.oreilly.com/library/view/python-for-data/9781491957653/)*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		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	Experts from Higher Technical Institutions	Internal Experts
Mr. Senthilnathan, Co-founder, Tenzai, Bangalore	*Dr. E. Sivasankar, Assistant Professor, Department of CSE, NIT, Trichy*	*Dr. A. Alice Nithya, School of Computing, SRMIST*

Course Code	18AIS101J	Course Name	INTRODUCTION TO MATLAB FOR ARTIFICIAL INTELLIGENCE	Course Category	S	Engineering Sciences	L	T	P	C
							1	0	4	3

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

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

	It is designed to give students fluency in MATLAB	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering 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 - I	PSO - II	PSO – III
CLR-1 :	Students will be able to learn the different functionalities of MATLAB																		
CLR-2 :	Students will be able to do plotting																		
CLR-3 :	Design and implement MATLAB code to solve small-scale scientific and engineering problems																		
CLR-4 :	Understand basic numerical method techniques for solving non-linear equations.																		
CLR-5 :	Design and implement MATLAB code for classifier algorithm																		
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																		
CLO-1 :	Locate, understand, and use a wide range of pre-defined functions.	3	90	85															
CLO-2 :	Select and use appropriate scalar and aggregate data types.	2	95	90															
CLO-3 :	Select and use appropriate control structures.	3	90	85															
CLO-4 :	Select and use appropriate input/output operations for terminal, file, graphical, and GUI-based input/output	3	90	85															
CLO-5 :	Understand basic numerical method techniques for solving non-linear equations in MATLAB	3	85	80															
CLO-6 :	Implement classifier machine learning algorithms in MATLAB	2	90	85															

Duration (hour)		15	15	15	15	15
S-1	SLO-1	MATLAB introduction	Functions	Linear algebra	Introduction to machine learning	GUI
	SLO-2	Basics	User defined functions	System of linear equations		
S-2	SLO-1	Scripts	Function overloading	Matrix decomposition	Supervised learning	Making the GUI
	SLO-2	Writing scripts	Function overloading	Matrix decomposition		
S-3	SLO-1	Variables	Relational operators	polynomials	Classification	Draw the GUI
	SLO-2	Naming	Conditions			
S-4	SLO-1	Scalars	Looping statements	Polynomial operations	Decision tree classifier	Change the settings
	SLO-2	Arrays	Looping statements			
S-5	SLO-1	Row vectors	Plot options	Polynomial fitting	Create a decision tree for the iris data and see how well it classifies the irises into species.	Save
	SLO-2	Column vectors, size and length	Plot options			
S-6	SLO-1	**Matrices**	**Line and market options**	**Non linear root finding**	**visualize the regions assigned to each species**	**Adding functionalities to M file**
	SLO-2	Basic scalar operations	Line and market options			
S-7	SLO-1	**Built in functions, transpose, addition and subtraction**	**Cartesian plots**	**Minimizing a function**	**draw a diagram of the decision rule and class assignments.**	**Running**
	SLO-2	**Element wise functions**	**Cartesian plots**	**Anonymous**		
S-8	SLO-1	Operators	3D plots	Optimization tool box	Compute the resubstitution error and the cross-validation error for decision tree.	Helper functions

	SLO-2	*Vector operations*	*3D plots*			
S-9	**SLO-1**	*Vector functions*	*Axis modes*	*Min-finding*	*Heart sound classification using MATLAB*	*Simulink*
	SLO-2	*Vector indexing*	*Multi plots in one figure*			
S-10	SLO-1	*Matrix indexing*	*Visualising matrices*	*Numerical differentiation*	*Access and explore the data*	*Simulink library*
	SLO-2	*Matrix indexing*	*Visualising matrices*			
S-11	SLO-1	*Indexing*	*Colour maps*		*Pre process and extract the features*	*Connection*
	SLO-2	*Indexing*	*Colour maps*	*Numerical integration*		
S-12	SLO-1	*Advanced indexing*	*Surface plots*	*Differential equation*	*Using decision tree classifier train the data*	*Block specifications*
	SLO-2	*Advanced indexing*	*Surface plots*	*ODE solvers*		
S-13	SLO-1	*Plotting*	*Surf*	*ODE solvers MATLAB*	*Iteratively train*	*Toll boxes*
	SLO-2	*Plotting basics*	*Surf options*			
S-14	SLO-1	*Plot a straight line*	*Contour*	*ODE solvers syntax*	*Evaluate*	*Symbolic tool box*
	SLO-2	*Plot a straight line*	*Find*			
S-15	SLO-1	*Plot knowledge trajectory*	*Vectorization*	*ODE functions*	*Evaluate*	*Symbolic variables*
	SLO-2	*Plot knowledge trajectory*	*Preallocation*	*ODE functions: viewing results*		*Symbolic expressions*

Learning Resources	*1.*	*2.*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
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 Industry	Experts from Higher Technical Institutions	Internal Experts

Course Code	18AIS102J	Course Name	SMART MANUFACTURING	Course Category	S	*Engineering Sciences*	L	T	P	C
							1	0	4	3

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

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

		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	1 Engineering Knowledge	2 Problem Analysis	3 Design & Development	4 Analysis, Design,	5 Modern Tool Usage	6 Society & Culture	7 Environment &	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
CLR-1 :	*Gain knowledge about Smart manufacturing*																		
CLR-2 :	*Leaning about various types of sensors*																		
CLR-3 :	*Familiarizing Arduino controller and its interfacing*																		
CLR-4 :	*Obtaining knowledge on Machine to Machine communication*																		
CLR-5 :	*Creating insights to Virtual and Augmented Reality*																		
CLR-6 :	*Knowing the security attacks and their counter measures*																		
Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*																		
CLO-1 :	*Understand the impact of smart manufacturing*	*1*	*85*	*80*												*H*			
CLO-2 :	*Design real time applications with sensors*	*3*	*80*	*75*	*H*	*H*	*H*						*H*						
CLO-3 :	*Interface devices with Aurdino controller*	*2*	*80*	*75*	*H*	*H*	*H*		*H*				*H*						
CLO-4 :	*Implement data transfer between devices*	*2*	*80*	*75*		*H*		*H*					*H*						
CLO-5 :	*Build AR and VR systems*	*3*	*75*	*70*	*H*	*H*	*H*	*H*	*H*				*H*						
CLO-6 :	*Secure the information systems and networks*	*2*	*85*	*80*				*H*				*H*	*H*						

Duration (hour)		18	18	18	18	18
S-1	**SLO-1**	*INTRODUCTION TO SMART MANUFACTURING : What is smart manufacturing ?*	*INTERCONNECTIVITY: Introduction to Arduino controller*	*MACHINE TO MACHINE (M2M)COMMUNICATION : Introduction to mobile networks*	*AUGMENTED REALITY (AR) AND VIRTUAL REALITY (VR) Introduction to AR and VR*	*CYBER SECURITY SYSTEMS: What is Cyber crime and security?*
	SLO-2	*Drivers, enablers, forces and challenges of smart manufacturing*	*Basic structure*	*Fixed networks and sensor networks*	*VRML: Building objects*	*Cyber attacks*
S-2	**SLO-1**	*Components of smart manufacturing*	*Input and output processing in Arduino controller*	*Access technologies*	*VRML: Building world*	*Types of attacks*
	SLO-2	*Sensors: Introduction and types*	*Timers in arduino*	*M2M terminals and modules*	*VRML: Adding light, sound effects*	*Intruder detection systems*
S-3	**SLO-1**	*Flow and temperature sensors*	*Programming Arduino*	*Hardware and power interfaces*	*VRML: Forming complex shapes*	*Threats to information systems*
	SLO-2	*Force, pressure and torque sensors*	*Simple code to be executed on Arduino*	*USB Interface*	*VRML: Animations*	*Threats to communication networks*
S-3-6	**SLO-1**	*Optical sensors*	*Study of Arduino microcontroller interfacing*	*GPIO*	*VRML: Adding colors and textures*	*Study of different wireless network components*
	SLO-2	*Design of automatic street lighting system using light sensors*	*Arduino microcontroller interfacing*	*Designing LED wireless lamp*	*Transformation of color model using VRML*	*Study of security system in mobile application*
S-7-	**SLO-1**	*Humidity and water sensors*	*Study of Basic sensors interfacing*	*Oscilloscope*	*Scene creation*	*Firewalls: Introduction*

10	**SLO-2**	*Rain Alarm project*	*Basic sensors interfacing*	*Amplitude and frequency modulation*	*Creation of 3D scene*	*Configuration of firewalls*
S 11-15	SLO-1	***Gas sensor***	***Brief description on GPS and Data logging***	***Study on IR rays***	***Simulation of real time environment***	***Security in web browsers***
	SLO-2	***Gas leakage detection system***	***GPS and Data logging***	***Designing an IR transmitter and receiver***	***Simulation of classroom***	***Implementing security measures in web browser***

Learning Resources	*1. 1. J. Vetelino and A . Reghu, Introduction to sensors, CRC Press, 2010, ISBN 9781439808528.* *2. J. Fraden, Handbook of Modern Sensors: Physics, Designs and Applications, 4th edition, Springer, 2010.* *3.. J. Nussey, Arduino for Dummies, 1st edition, Wiley, 2013. ISBN: 9781118446379.*	*4. J. Edward Carryer, et al., Introduction to Mechatronic Design, Prentice Hall, 1st edition, 2010, ISBN: 978-8131788257.* 5. Michael E Whitman and Herbert J Mattord, ―Principles of Information Security, Vikas Publishing House, New Delhi, 2003

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		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	Experts from Higher Technical Institutions	Internal Experts

Course Code	18MAB206T	Course Name	Numerical Methods and Analysis	Course Category	*BS*	*Basic Sciences*	L	T	P	C
							3	1	0	4

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

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 :	Understand the methodologies to solve algebraic and transcendental equations	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 :	Acquaint knowledge on direct and iterative methods to solve system of linear equations																		
CLR-3 :	Gain knowledge on interpolating and extrapolating methods in various intervals in real life																		
CLR-4 :	Understand the concept of numerical differentiation and integration																		
CLR-5 :	Solve initial and boundary value problems in differential equations using numerical methods.																		
CLR-6 :	Familiarise in applying various numerical methods in real life problems																		
Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*																		
CLO-1 :	Obtain numerical solutions of algebraic and transcendental equations.	3	85	80	H	H	L	-	-	-	-	-	M	L	-	H	-	-	-
CLO-2 :	Find numerical solutions of system of linear equations and check the accuracy of the solutions.	3	85	80	M	H	-	M	M	-	-	-	M	-	-	H	-	-	-
CLO-3 :	Learn about various interpolating and extrapolating methods.	3	85	80	H	H	-		-	-	-	-	M	-	-	H	-	-	-
CLO-4 :	Compute numerical differentiation and integration	3	85	80	H	H	H	M	-	-	-	-	M	L	-	H	-	-	-
CLO-5 :	Interpret initial and final value problems in differential equations	3	85	80	M	H	L	-	-	-	-	-	M	-	-	H	-	-	-
CLO-6 :	Apply various numerical methods in real life problems.	3	85	80	M	H	-	-	-	-	-	-	M	-	-	H	-	-	-

Duration (hour)		12	12	12	12	12
S-1	**SLO-1**	Numerical solutions of Algebraic and transcendental equation-Introduction.	Introduction to Finite Differences-Forward and Backward Differences	Numerical Differentiation-Newton's forward difference formulae to compute first	Numerical solution of ordinary differential equations - Single step methods-	Numerical solutions for partial differential equations-Classification of second order

				and higher order derivatives.	Taylor series method	partial differential equations.
	SLO-2	Numerical solution of Algebraic and Transcendental equation by Bisection Method	Relation between operators	Newton's Backward difference formulae to compute first and higher order derivatives.	Numerical solution of ordinary differential equations - Single step methods- Taylor series method Euler's method	Elliptic equations- Finite difference scheme
S-2	**SLO-1**	Numerical solution of Algebraic and Transcendental equation by Method of False Position.	Differences of a polynomial – Factorial polynomial	Problems by Newton's forward and backward differences formulae.	Euler's method	Standard five-point finite difference formula
	SLO-2	Numerical **solution of Algebraic and Transcendental equation by** Method of False Position.	Newton's interpolation - Newton's forward interpolation for equal interval	Problems by Newton's forward and backward differences formulae.	Euler's method	Diagonal five-point finite difference formula
S-3	**SLO-1**	Numerical solution of Algebraic and Transcendental equation by Newton-Raphson method	Newton's interpolation - Newton's forward interpolation for equal interval	Problems by Newton's forward and backward differences formulae.	Improved Euler's method	Liebman's Iterative process.
	SLO-2	Numerical solution of Algebraic and Transcendental equation by Newton-Raphson method	Newton's backward interpolation for equal intervals	Problems by Newton's forward and backward differences formulae.	Improved Euler's method	Solution of Laplace Equations by Liebman's Iterative process.
S-4	**SLO-1**	Problems solving using Computational Techniques	Problems solving using Computational Techniques	Problems solving using Computational Techniques	Problems solving using Computational Techniques	Problems solving using Computational Techniques
	SLO-2	Problems solving using Computational Techniques	Problems solving using Computational Techniques	Problems solving using Computational Techniques	Problems solving using Computational Techniques	Problems solving using Computational Techniques
S-5	**SLO-1**	Solving system of Simultaneous linear Algebraic equation by Gauss	Divided differences and Properties	Numerical Integration- Trapezoidal rule.	Modified Euler's method	Solution of Poisson Equation.

		Elimination method				
	SLO-2	Solving system of Simultaneous linear Algebraic equation by Gauss Elimination method	Divided differences and Properties	Numerical Integration-Trapezoidal rule.	Modified Euler's method	Solution of Poisson Equation.
S-6	**SLO-1**	Solving system of Simultaneous linear Algebraic equation by Gauss Elimination method	Interpolation with unequal intervals by newton's divided difference	Simpson's one third rule.	Modified Euler's method	Solution of Poisson Equation.
	SLO-2	Solving system of Simultaneous linear Algebraic equation by Gauss Elimination method	Interpolation with unequal intervals by newton's divided difference	Simpson's one third rule	Modified Euler's method	Solution of Poisson Equation.
S-7	**SLO-1**	Solving system of Simultaneous linear Algebraic equation by Gauss Jordan method	Lagrange's interpolation formula for unequal intervals	More problems using Simpson's one – third rule.	More problems solving Using Modified Euler's Method	one-dimensional parabolic equation-Explicit Scheme
	SLO-2	Solving system of Simultaneous linear Algebraic equation by Gauss Jordan method	Lagrange's interpolation formula for unequal intervals	More problems using Simpson's three-eighth rule.	More problems solving Using Modified Euler's Method	one-dimensional parabolic equation-Explicit Scheme
S-8	**SLO-1**	Problems solving using Computational Techniques	Problems solving using Computational Techniques	Problems solving using Computational Techniques	Problems solving using Computational Techniques	Problems solving using Computational Techniques
	SLO-2	Problems solving using Computational Techniques	Problems solving using Computational Techniques	Problems solving using Computational Techniques	Problems solving using Computational Techniques	Problems solving using Computational Techniques
S-9	**SLO-1**	Solving system of Simultaneous linear Algebraic equation by Gauss Jacobi method	Lagrange's interpolation formula for unequal intervals	Applications of Trapezoidal rule	Runge-Kutta method of fourth order.	Solution of one-dimensional parabolic equation by Bender-Schmidt scheme
	SLO-2	Solving system of Simultaneous linear Algebraic equation by	Lagrange's interpolation formula for	Applications of Trapezoidal rule	Runge-Kutta method of fourth order.	Solution of one-dimensional parabolic

		Gauss Jacobi method	unequal intervals			equation by Bender-Schmidt scheme
S-10	**SLO-1**	Solving system of Simultaneous linear Algebraic equation by Gauss Seidel method	Lagrange's interpolation formula for unequal intervals	Applications of Simpson's one-third rule	Runge-Kutta method of fourth order.	Solution of one-dimensional parabolic equation by Crank-Nicholson scheme
	SLO-2	Solving system of Simultaneous linear Algebraic equation by Gauss Seidel method	Lagrange's interpolation formula for unequal intervals	Applications of Simpson's one-third rule	Runge-Kutta method of fourth order.	Solution of one-dimensional parabolic equation by Crank-Nicholson scheme
S-11	**SLO-1**	Solving system of Simultaneous linear Algebraic equation by Gauss Seidel method	Inverse interpolation– Lagrange's formula for inverse interpolation	Applications of Simpson's three-eighth rule	Runge-Kutta method of fourth order.	Solution of one-dimensional parabolic equation by Crank-Nicholson scheme
	SLO-2	Solving system of Simultaneous linear Algebraic equation by Gauss Seidel method	Inverse interpolation– Lagrange's formula for inverse interpolation	A Applications of Simpson's three-eighth rule	Runge-Kutta method of fourth order.	Solution of one-dimensional parabolic equation by Crank-Nicholson scheme
S-12	**SLO-1**	Problems solving using Computational Techniques	Problems solving using Computational Techniques	Problems solving using Computational Techniques	Problems solving using Computational Techniques	Problems solving using Computational Techniques
	SLO-2	Problems solving using Computational Techniques	Problems solving using Computational Techniques	Problems solving using Computational Techniques	Problems solving using Computational Techniques	Problems solving using Computational Techniques

Learning Resources	1. Brian Bradie (2006), A Friendly Introduction to Numerical Analysis. Pearson. 2. C. F. Gerald & P. O. Wheatley (2008). Applied Numerical Analysis (7th edition), Pearson Education, India 3. F. B. Hildebrand (2013). Introduction to Numerical Analysis: (2nd edition). Dover	4. M. K. Jain, S. R. K. Iyengar & R. K. Jain (2012). Numerical Methods for Scientific and Engineering Computation (6th edition). New Age International Publishers.

	Publications.	5. Kandasamy P, Thilagavathy. K and G. Gunawathy, Numerical Methods, S.Chand & Sons, 3rd Revised Edition, 2013. 6. Robert J. Schilling & Sandra L. Harris (1999). Applied Numerical Methods for Engineers Using MATLAB and C. Thomson-Brooks/Cole.

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* *Understand*	*40%*		*30%*		*30%*		*30%*		*30%*	
Level 2	*Apply* *Analyze*	*40%*		*40%*		*40%*		*40%*		*40%*	
Level 3	*Evaluate* *Create*	*20%*		*30%*		*30%*		*30%*		*30%*	
	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	Experts from Higher Technical Institutions	Internal Experts
Mr. V. Maheshwaran, Cognizant Technology Solutions maheshwaranv@yahoo.com	Prof. Y.V.S.S. Sanyasiraju, IIT Madras, sryedida@iitm.ac.in	Dr. A. Govindarajan, SRMIST Dr. N. Parvathi, SRMIST
	Prof. B.V. Rathish Kumar, IIT Kanpur, bvrk@iitk.ac.in	Dr. B. Vijayakumar, SRMIST Dr. R. Perumal, SRMIST

Course Code	18AIC201J	Course Name	FOUNDATION OF ARTIFICIAL INTELLIGENCE	Course Category	C	Professional Core Course	L	T	P	C
							2	0	2	3

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering 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-1:	Analyze the various characteristics of Intelligent agents																		
CLR-2:	Organizing different search strategies in AI																		
CLR-3:	Incorporating Knowledge in solving AI problems																		
CLR-4:	Constructing in different ways of designing software agents																		
CLR-5:	Planning various applications of AI.																		
CLR-6:	Applying different scenarios of reasoning																		
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																		
CLO-1:	Use appropriate search algorithms for any AI problem	3	80	70	H		-	-	-	-	-	-	-	-	-	-	H	H	H
CLO-2:	Represent a problem using first order and predicate logic	3	85	75	H	H	H	-	-	-	-	-	-	-	-	-	H	H	H
CLO-3:	Provide the apt agent strategy to solve a given problem	3	75	70	H	H	M	L	L	-	-	-	-	-	-	-	H	H	H
CLO-4:	Design software agents to solve a problem	3	85	75	H	L	M	M	M	L	-	-	-	-	-	-	H	H	H
CLO-5:	Design application that uses Artificial Intelligence.	3	85	75	H	L	H		H		-	-	-	-	M	-	H	H	H
CLO-6:	Experiment with various scenarios in Reasoning	3	80	70	H	L	M	M	M	L	-	-	-	-	-	-	H	H	H

Duration (hour)		12	12	12	12	12
S-1	SLO-1	Introduction, Definition	Alpha beta pruning	Architecture for intelligent agents, Agent communication	Planning, Moving	Resolution method, First order logic
	SLO-2	Future of Artificial Intelligence, Characteristics	First order predicate logic	Negotiation	Frames	Second order logic
S-2	SLO-1	Typical Intelligent agents	Porlog programming, Unification	Bargaining, Argumentation	Scripts	Genetic algorithms
	SLO-2	Problem solving approach	Forward Chaining	Agents	Goals	Travelling sales man problem
S 3-4	SLO-1	***Lab 1: Implement an approach to solve knapsack problem.***	***Lab 4: Implement decision tree with alpha and beta as its parameters***	***Lab 7: Develop an intelligent approach to create Linear Kernel to classify Iris Dataset available in the dataset library of Python***	***Lab 10: Develop a speech recognition system to convert text to speech and speech to text***	***Lab 13: Develop an effective solution for Travelling sales man problem***
	SLO-2					
S-5	SLO-1	Search strategies	Backward chiming	Trust, Reputation	Plans, Inheritance in Taxonomies	Neural networks
	SLO-2	Uniformed and informed	Resolution	Multi agent systems	Description logics	Ant colony optimization
S-6	SLO-1	Heuristics, Local search	Knowledge Representation	AI applications	Formal concept analysis	Generate and search
	SLO-2	Algorithm and optimization problems	Knowledge Representation	Language Models, Information Retrieval	Conceptual graphs, Hierarchies in domain	Depth first search, Breadth first search
S 7-8	SLO-1	***Lab 2: Develop a local search algorithm***	***Lab 5: Develop an approach to sort the elements in m * n matrix and shortest path to reach a given cell in the m * n matrix***	***Lab 8: Implement an information retrieval using any supervised learning algorithms***	***Lab 11: Implement K-means clustering algorithm using a dataset and provide its accuracy***	***Lab 14: Develop BFS and DFS***
	SLO-2					
S-9	SLO-1	Constraint satisfactory problems	Events, Mental Events	Information extraction,	Knowledge based reasoning, Agents	Quality of Solution
	SLO-2	Constraint propagation	Mental Objects	Natural language processing	Facts of knowledge	Depth bounded DFS
S-10	SLO-1	Back tracking search	Reasoning Systems	Machine translation, Speech recognition	Logic and inference	Hill climbing
	SLO-2	Game playing, Optimal decision	Reasoning with default information, Typical AI Problems	Robot Hardware, Perception	Formal logic, Propositional logic	Beam search

S 11-12	SLO-1	***Lab 3: Develop a search strategy to determine the peak element in an array and find the square root of the peak number***	***Lab 6: Develop a solution for a typical AI problem that focus on finding the best move in Tic-Tac-Toe AI game***	***Lab 9: Implement an information extraction using any supervised learning algorithms***	***Lab 12: Implement K Nearest Neighbour using a dataset and provide its outcome***	***Lab 15: Develop a heuristic based approach for a large set of inputs using Hill climbing optimization technique***
	SLO-2					

Learning Resources	1. *S. Russell and P. Norvig, "Artificial Intelligence: A Modern Approach‖, Prentice Hall, Third Edition, 2009.* 2. *I. Bratko, ―Prolog: Programming for Artificial Intelligence‖, Fourth edition, Addison-Wesley Educational Publishers Inc., 2011* 3. *M. Tim Jones, ―Artificial Intelligence: A Systems Approach (Computer Science) ‖, Jones and Bartlett Publishers, Inc.; First Edition, 2008* 4. *Nils J. Nilsson, ―The Quest for Artificial Intelligence‖, Cambridge University Press, 2009.* 5. *William F. Clocksin and Christopher S. Mellish, Programming in Prolog: Using the ISO Standard‖, Fifth Edition, Springer, 2003.* 6. *Gerhard Weiss, ―Multi Agent Systems‖, Second Edition, MIT Press, 2013.* 7. *David L. Poole and Alan K. Mackworth, ―Artificial Intelligence: Foundations of Computational Agents‖, Cambridge University Press, 2010.* 8. *"A First Course in Artificial Intelligence", Deepak Khemani, McGraw Hill Education, 2013.* 9. *"Artificial Intelligence" E. Rich and K. Knight, Mc Graw Hill Publishers INC, 3rd Edition 2017.*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	*20%*	*20%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*
Level 2	Apply Analyze	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*
Level 3	Evaluate Create	*10%*	*10%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*
	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	Experts from Higher Technical Institutions	Internal Experts
Dr. Marriappan Vaithilingam, Senior Director of Engineering, Fresh works	*Dr. Udendran, Dept. of CSE., Bharathidasan University, Tiruchirappalli*	*Dr. A. Suresh, SRMIST* *Dr. A. Alice Nithya, SRMIST* *Mr. Joseph James, SRMIST*

Course Code	18AIC202J	Course Name	DATA STRUCTURE AND ITS APPLICATIONS	Course Category	C	*Professional Core Courses*	L	T	P	C
							3	0	2	4

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

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

			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)		1 Engineering 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
CLR-1 :	*Utilize the different data types to learn searching and sorting algorithms for data search and develop applications using linked list*		1	2	3		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-2 :	*Utilize stack and queues in processing data for real-time applications*																				
CLR-3 :	*Utilize tree data storage structure for real-time applications*																				
CLR-4 :	*Utilize algorithms to find shortest data search in graphs for real-time application development*																				
CLR-5 :	*Learn basic hashing of hashing and apply in feature vectorization*																				
Course Learning Outcomes (CLO):	**At the end of this course, learners will be able to:**																				
CLO-1 :	*Identify linear and non-linear data structures, working principle of searching and sorting techniques and implementation of linked list.*		3	80	70		L	H	-	-	-	-	-	-	-	-	-	M	H	H	H
CLO-2 :	*Construct stack and queue data structures and evaluate its operations*		3	85	75		M	H	L	-	-	-	-	-	-	-	-	M	H	H	H
CLO-3 :	*Create tree data structures and evaluate its types and operations*		3	75	70		M	H	M	-	-	-	-	-	-	-	-	M	H	H	H
CLO-4 :	*Create graph data structure, evaluate its operations, implement algorithms to identify shortest path*		3	85	80		M	H	M	-	-	-	-	-	-	-	-	M	H	H	H
CLO-5 :	*Construct the different Hashing techniques and use them in feature vectorization*		3	80	70		H	H	M	-	-	-	-	-	-	-	-	M	H	H	H

Duration (hour)		15	15	15	15	15
S-1	SLO-1	*Introduction-Basic Terminology-Data Structures-Data Structure Operations-ADT*	*Stack ADT – Array Implementation*	*General Trees- Tree Terminologies*	*Graph Terminologies*	*Hashing: Hash functions - Introduction*
	SLO-2	*Data Structures and its Types-Linear and Non-Linear Data Structures*	*Stack ADT - Linked list Implementation*	*Binary Tree Representation*	*Graph Representation*	*Basics of Hash Tables*
S-2	SLO-1	*1D, 2D Array Initialization and accessing using Pointers*	*Applications of Stack- Infix to Postfix Conversion*	*Expression Trees*	*Graph Traversal*	*Hashing*
	SLO-2	*Declaring structures, Arrays of Structures and accessing*	*Applications of Stack- Balancing the symbols*	*Tree traversals*	*BFS*	*Collision avoidance*
S-3	SLO-1	*Array- Operations on Arrays – Insertion and Deletion*	*Applications of Stack- Postfix Evaluation*	*Binary Tree Traversal*	*Graph Traversal - DFS*	*Hashing*
	SLO-2	*Multidimensional Arrays- Sparse Matrix*	*Applications of Stack- Nested Function calls and Recursion concepts using stack*	*Threaded Binary Trees*	*Applications of Graph Traversal*	*Separate chaining*
S 4-5 (LAB)	**SLO-1**	***Lab 1: 6x6 2D Array,2D of n empty arr.***	***Lab 4: Tower of Hanoi***	***Lab 7: Top view problem, Swap nodes***	***Lab 10: Jesse and Cookies problem,***	***Lab 13: Print Binary tree in vertical order***
	SLO-2	***Left rotation***	***Largest Rectangle, Poisonous Plants***	***Huffman Decoding, Level Order Traversal***	***Minimum Average waiting Time***	***Union and intersection of linked list***

S-6	SLO-1	*Algorithms – Searching Techniques*	*Queue ADT - Implementation using array*	*AVLTrees*	*Introduction to Spanning Tree*	*Open Addressing*
	SLO-2	*Complexity-Time, Space Trade off*	*Queue ADT - Implementation using Linked List*	*AVL Trees Rotations*	*Minimum Spanning Tree*	*Linear Probing*
S-7	SLO-1	*Algorithms – Sorting Techniques*	*Circular Queue*	*AVL Tree Insertions*	*Prim's Algorithm*	*Quadratic probing*
	SLO-2	*Complexity-Time, Space Trade off*	*Implementation of Circular Queue*	*AVL Tree Deletion*	*Kruskal's Algorithm*	*Double Hashing*
S-8	SLO-1	*Linked List Implementation - Insertion*	*Applications of Queue*	*Introduction to Splay tree*	*Shortest Path Algorithm*	*Rehashing*
	SLO-2	*Deletion and Search*	*Double ended queue*	*Splay Trees – Insertion & Deletion*	*Dijkstra's Algorithm*	*Extensible Hashing*
S 9-10 (LAB)	SLO-1	***Lab 2: Sparse Array, Array Manipulation- Searching and Sorting Techniques***	***Lab 5: Castle on Grid, Down to Zero II, Truck Tour***	***Lab 8: Lowest Common Ancestor, Square Ten Tree***	***Lab 11: find mother vertex in graph, k core of undirected graph***	***Lab 14: Count max point on same line, find top k numbers in stream***
	SLO-2					
S-11	SLO-1	*Applications of Linked List*	*Priority Queue*	*Introduction to Red Black Trees*	*Shortest Path Algorithm*	*Applications of Hashing*
	SLO-2	*Polynomial Arithmetic*	*Priority Queue - Applications*	*Red Black Trees-Insertion & Deletion*	*Floyd warshall algorithm*	*Case Study: Contact Application*
S-12	SLO-1	*Doubly Linked List*	*Binary and Binomial Heap*	*Introduction to B-Trees*	*Articulation Points and Bridges*	*Case Study*
	SLO-2	*Doubly Linked List Insertion, Deletion and Search*	*Heap sort*	*B-Trees Insertion*	*Biconnected Components*	*Direct Connections*
S-13	SLO-1	*Circular Linked List Implementation*	*K-ary Heap*	*B-Trees Search*	*Strongly Connected Components*	*Case Study*
	SLO-2	*Applications of circular linked list*	*Iterative Heap sort*	*B-Trees Deletions*	*Topological Sorting*	*Self-Driving Bus*
S 14-15 (LAB)	**SLO-1**	***Lab 3: traversing a linked list, Reverse linked list***	***Lab 6: Equal Stacks, Simple Text Editor.***	***Lab 9: Balanced Tree, Tree Coordinates***	***Lab 12 : Printing path in Dijkstra's Algorithm***	***Lab 15: Feature Hashing in Machine rningLea***
	SLO-2	***Compare linked list, merge two linked list***	***Waiter problem, Game of Two Stacks.***	***Kitty's calculation***	***Shortest path in unweighted Graph***	

Learning Resources	*1.Seymour, Lipschutz. Data Structures with C, McGraw Hill, 2014.* *2.Gilberg RF, Forouzan BA. Data Structures. Thomson India Edition. 2005.* *3. Aho Alfred V, Hopcroft John E, Ullman Jeffrey D, Data structures and algorithms, Pearson Edition, 2003.*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		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	Experts from Higher Technical Institutions	Internal Experts
Dr. Marriappan Vaithilingam, Senior Director of Engineering, Fresh works		*Mr. D. Vivek, SRMIST* *Dr. A. Alice Nithya, SRMIST* *Mr. S. Joseph James, SRMIST*

Course Code	18AIC203J	Course Name	OBJECT ORIENTED DESIGN AND PROGRAMMING	Course Category	C	Professional Core	L	T	P	C
							3	0	2	4

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

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	**Learning**		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	*Utilize class and build domain model for real-time programs*			
CLR-2 :	*Utilize method overloading and operator overloading for real-time application development programs*			
CLR-3 :	*Utilize inline, friend and virtual functions and create application development programs*			
CLR-4 :	*Utilize exceptional handling and collections for real-time object oriented programming applications*			
CLR-5 :	*Construct UML component diagram and deployment diagram for design of applications*			
CLR-6 :	*Create programs using object oriented approach and design methodologies for real-time application development*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	**Learning**			**Program Learning Outcomes (PLO)**														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering 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 :	*Identify the class and build domain model*	*3*	*80*	*70*	*H*	*H*	*M*	-	-	-	-	-	*H*	*H*	-	-	*M*	*H*	*H*
CLO-2 :	*Construct programs using method overloading and operator overloading*	*3*	*85*	*75*	*H*	*H*	*H*	*H*	*H*	-	*M*	-	*H*	*H*	-	-	*M*	*H*	*H*
CLO-3 :	*Create programs using inline, friend and virtual functions, construct programs using standard templates*	*3*	*75*	*70*	*H*	*H*	*M*	*H*	*H*	-	*M*	-	*H*	*H*	-	-	*M*	*H*	*H*
CLO-4 :	*Construct programs using exceptional handling and collections*	*3*	*85*	*80*	*H*	*H*	*H*	-	-	-	-	-	*H*	*M*	-	-	*M*	*H*	*H*
CLO-5 :	*Create UML component diagram and deployment diagram*	*3*	*85*	*75*	*H*	*M*	*M*	*M*	*M*	*M*	*M*	-	*H*	*H*	-	*M*	*M*	*H*	*H*
CLO-6 :	*Create programs using object oriented approach and design methodologies*	*3*	*80*	*70*	*H*	*H*	*M*	-	-	-	-	-	*H*	*H*	-	-	*M*	*H*	*H*

Duration (hour)		**15**	**15**	**15**	**15**	**15**
S-1	SLO-1	*Comparison of Procedural and Object Oriented Programming*	*Types of constructor (Default, Parameter)*	*Feature Inheritance: Single and Multiple*	*Generic - Templates : Introduction*	*STL: Containers: Sequence and Associative Container*
	SLO-2	*OOPS and its features*	*Static constructor and copy constructor*	*Inheritance: Multilevel*	*Function templates*	
S-2	SLO-1	*I/O Operations, Data Types, Variables, static*	*Feature Polymorphism: Constructor overloading*	*Inheritance: Hierarchical*	*Example programs Function templates*	*Sequence Container: Vector, List*
	SLO-2	*Constants, Pointers, Type Conversions*	*Method Overloading*	*Inheritance: Hybrid*	*Class Templates*	*Sequence Container: Deque, Array*
S-3	SLO-1	*Features: Class and Objects*	*Example for method overloading*	*Inheritance: Example Programs*	*Class Templates*	*STL : Stack*
	SLO-2	*UML Diagrams Introduction*	*Method Overloading: Different parameter with different return values*		*Example programs for Class and Function templates*	
S 4-5	SLO-1 / SLO-2	*Lab 1: I/O operations*	*Lab 4: Constructor and Method overloading*	*Lab 7: Inheritance and its types*	*Lab 10: Templates*	*Lab 13: STL Containers*
S-6	SLO-1	*Feature :Class and Objects*	*Operator Overloading and types*	*Advanced Functions: Inline, Friend*	*Exceptional Handling: try and catch*	*Associative Containers: Map, Multimap*
	SLO-2	*Examples of Class and Objects*	*Overloading Assignment Operator*	*Advanced Functions: Virtual, Overriding*	*Exceptional Handling: Multilevel exceptional*	
S-7	SLO-1	*UML Class Diagram and its components*	*Overloading Unary Operators*	*Advanced Function: Pure Virtual function*	*Exceptional Handling: throw and throws*	*Iterator and Specialized iterator*
	SLO-2	*Class Diagram relations and Multiplicity*	*Example for Unary Operator overloading*	*Example for Virtual and pure virtual function*	*Exceptional Handling: finally*	*Functions of iterator*

S-8	SLO-1	*Feature Abstraction and Encapsulation*	*Overloading Binary Operators*	*Abstract class and Interface*	*Exceptional Handling: User defined exceptional*	*Algorithms: find(), count(), sort()*
	SLO-2	*Application of Abstraction and Encapsulation*	*Example for Binary Operator overloading*	*Example Program*	*Example Programs using C++*	*Algorithms: search(), merge()*
S 9-10	SLO-1 SLO-2	*Lab 2: Classes and Objects, Class Diagram*	*Lab 5: Polymorphism : Operators Overloading*	*Lab 8: Virtual Function and Abstract class*	*Lab 11: Exceptional Handling*	*Lab 15: STL Associative containers and algorithms*
S-11	SLO-1	*Access specifiers – public, private*	*UML Interaction Diagrams*	*UML State Chart Diagram*	*Dynamic Modeling: Package Diagram*	*Function Object : for_each(), transform()*
	SLO-2	*Access specifiers - protected, friend, inline*	*Sequence Diagram*	*UML State Chart Diagram*	*UML Component Diagram*	*Example for Algorithms*
S-12	SLO-1	*UML use case Diagram, use case, Scenario*	*Collaboration Diagram*	*Example State Chart Diagram*	*UML Component Diagram*	*Streams and Files: Introduction*
	SLO-2	*Use case Diagram objects and relations*	*Example Diagram*	*UML Activity Diagram*	*UML Deployment Diagram*	*Classes and Errors*
S-13	SLO-1	*Method, Constructor and Destructor*	*Feature: Inheritance*	*UML Activity Diagram*	*UML Deployment Diagram*	*Disk File Handling Reading Data and Writing Data*
	SLO-2	*Example program for constructor*	*Inheritance and its types*	*Example Activity Diagram*	*Example Package, Deployment, Package*	
S 14-15	SLO-1 SLO-2	*Lab 3: Methods and Constructor, Usecase*	*Lab 6: UML Interaction Diagram*	*Lab 9: State Chart and Activity Diagram*	*Lab12 : UML Component, Deployment, Package diagram*	*Lab15: Streams and File Handling*

Learning Resources

1. *Grady Booch, Robert A. Maksimchuk, Michael W. Engle, Object-Oriented Analysis and Design with Applications, 3rd ed., Addison-Wesley, May 2007*
2. *Reema Thareja, Object Oriented Programming with C++, 1st ed., Oxford University Press, 2015*
3. *Sourav Sahay, Object Oriented Programming with C++, 2nd ed., Oxford University Press, 2017*
4. *Robert Lafore, Object-Oriented Programming in C++, 4th ed., SAMS Publishing, 2008*
5. *Ali Bahrami, Object Oriented Systems Development", McGraw Hill, 2004*
6. *Craig Larmen, Applying UML and Patterns, 3rd ed., Prentice Hall, 2004*

Learning Assessment

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

For the laboratory component the students are advised to take an application and apply the concepts

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Mr. Girish Raghavan, Senior DMTS Member, Wipro Ltd.	*1. Dr. Srinivasa Rao Bakshi, IITM Chennai, sbakshi@iitm.ac.in*	*1. Ms. C.G.Anupama, SRMIST*
Ms. Thamilchelvi, Solutions Architect, Wipro Ltd	*2. Dr. Ramesh Babu, N, IITM Chennai, nrbabu@iitm.ac.in*	*2. Mr. C.Arun, SRMIST*
		3. Mr. Geogen George, SRMIST
		4. Mr. Muthukumaran, SRMIST

Course Code	18AIC204T	Course Name	Software Engineering Principles	Course Category	C	Professional Core Courses	L	T	P	C
							3	0	0	3

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

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

			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)		1 Engineering 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
CLR-1 :	*Familiarize the software life cycle models and software development process*																				
CLR-2 :	*Understand the various techniques for requirements, planning and managing a technology project*																				
CLR-3 :	*Examine basic methodologies for software design, development, testing, closure and implementation*																				
CLR-4 :	*Understand manage users expectations and the software development team*																				
CLR-5 :	*Acquire the latest industry knowledge, tools and comply to the latest global standards for project management*																				
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																				
CLO-1 :	*Identify the process of project life cycle model and process*		1	85	80		H	H	L	-	-	-	L		H	H	M	M	M	H	M
CLO-2 :	*Analyze and specify software requirements through a productive working Relationship with project stakeholders*		2	80	75		H	H	H	H	H	-	M	-	H	H	H	M	M	H	M
CLO-3 :	*Design the system based on Functional Oriented and Object Oriented Approach for Software Design*		3	85	85		H	H	M	H	H	M	M	L	H	H	M	-	M	H	M
CLO-4 :	*Develop the correct and robust code for the software products*		3	85	85		H	H	H		H	-	-	M	H	M	H	-	M	H	M
CLO-5 :	*Perform by applying the test plan and various testing techniques*		2	85	75		H	M	M	M	M	M	M	-	H	H	-	M	M	H	M

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Introduction to Software Engineering*	*Introduction to Requirement Engineering*	*Software Design - Software Design Fundamentals*	*Coding Standard*	*Product Release*
	SLO-2	*Software Process*	*Principles that guide practice*	*Design Standards - Design Type*	*Coding Framework*	
S-2	SLO-1	*Generic process model*	*Requirements Elicitation*	*Design model – Architectural design, Software architecture*	*Coding Method*	*Product Release management*
	SLO-2	*Umbrella Activates*	*Brain Storming, Focus group, Interview, survey, workshop, observation*	*Software Design Methods*	*Structured Programming*	
S-3	SLO-1	*Prescriptive Model-Waterfall, V Model*	*Joined application design*	*Top Down , Bottom Up*	*Automatic Code Generation*	*Implementation*
	SLO-2		*Questionnaires*	*Module Division (Refactoring)*	*Software Code Reuse*	
S 4	SLO-1	*INCREMENTAL MODEL, RAD MODEL*	*Requirement Analysis*	*Module Coupling*	*Introduction to testing*	*User Training*
	SLO-2			*Component level design*	*Verification and validation*	*Maintenance Introduction*
S-5	SLO-1	*Evolutionary Process Model-PROTOTYPING*	*Domain model, process model and workflow*	*User Interface Design*	*Black box testing tchnique*	*Maintenance Types - Corrective*

			model			
	SLO-2	*Evolutionary Process Model-Spiral model*		*Pattern oriented design*		*Adaptive*
S-6	SLO-1		*Requirements Specification*	*Web application design*	*White box testing techniques*	*Perfective*
	SLO-2	*Introduction to Agile model*		*Concurrent Engineering in Software Design*		*Preventive*
S-7	SLO-1	*Agile model-scrum*	*Requirements validation*	*Design Reuse*	*Level of testing*	*Maintenance Cost*
S-8	SLO-1	*Agile model-Extreme programming*	*Quality review, peer review, customer review*	*Design a System Architecture,*	*Test Strategy and test plan, prepare test case design*	*Maintenance Process*
	SLO-2			*Use Case Diagram, ER Diagram (Database), DFD Diagram (process) (Upto Level 1),*	*Introduction to Automation Testing tool, Test Case Reporting*	*Maintenance life cycle*
S-9	SLO-1	*Case study : Identify the appropriate Process Model, Comparative study with Agile Model*	*Case study : SRS documentation for given scenario*	*Case study Class Diagram (Applied For OOPS based Project),*	*Case study :Master Test Plan*	*Software Release*
	SLO-2			*Case study Collaboration Diagram (Applied For OOPS based Project) (Software – Rational Rose)*	*Case study: Test Case Design*	*Software Maintenance*

Learning Resources	*1. Roger S. Pressman, Software Engineering – A Practitioner Approach, 6th ed., McGraw Hill, 2005* *2. Ian Sommerville, Software Engineering, 8th ed., Pearson Education, 2010* *3. Rajib Mall, Fundamentals of Software Engineering, 4th ed., PHI Learning Private Limited, 2014* *4. Ramesh, Gopalaswamy, Managing Global Projects, Tata McGraw Hill, 2005*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
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 Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
Dr. Marriappan Vaithilingam, Senior Director of Engineering, Fresh works	*Dr. Udendran, Dept. of CSE., Bharathidasan University, Tiruchirappalli*	*Mrs. C.G. Anupama, SRMIST* *Dr. S. Selvakumara samy., SRMIST*

Course Code	18AIS201T	Course Name	LINEAR SYSTEMS AND SIGNAL PROCESSING	Course Category	S	Engineering Sciences	L	T	P	C
							3	0	0	3

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	Provide the fundamentals and classification of signals and systems			
CLR-2 :	Explore the overview time domain representation of signals			
CLR-3 :	Develop skills of discrete time signals and system in the Fourier transform			
CLR-4 :	Enable students to know thesampling and tine signals			
CLR-5 :	Impart the knowledge of z transform and its applications			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:				Program Learning Outcomes (PLO)														
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
					Engineering 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 :	Definethe fundamentals of signals and systems	3	80	70	L	L	-	-	-	-	-	-	-	-	-	H	H	M	H
CLO-2 :	Describe the properties of signals and systems	3	85	75	L	L	-	L	-	-	-	-	-	-	-	H	H	M	H
CLO-3 :	Characterize the input-output relationship of LTI systems using impulse response	3	75	70	L	H	-	L	-	-	-	-	-	-	-	H	H	M	H
CLO-4 :	Analyze continuous-time using Discrete and Continuous signals	3	85	80	L	H	-	L	-	-	-	-	-	-	-	H	H	M	H
CLO-5 :	Obtain the knowledge of Digital filters and equalizers	3	85	75	L	M	-	-	-	-	-	-	-	-	-	H	H	M	H

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Introduction to signals and System	Introduction to Time Domain Representation	Representations of signals	Convolution and modulation with mixed signal classes	Representation of Signals using Discrete-Time complex Exponentials: Introduction, The z-Transform
	SLO-2	Requirementsof signal and System analysis in communication	Impulse response representation	Block diagram representation	Fourier Transform representation for Discrete Signals	
S-2	SLO-1	Study of specific system-Communication and control system	Convolution sum	State variable description for LTI systems, Problems on representations	Sampling	Problems on z-Transform
	SLO-2	Remote sensing systems, Bio medical signal processing and auditory system	Problems on convolution sum	Transformations of the State	Reconstruction of Continuous-Time Signals from Samples	
S-3	SLO-1	Comparison of analog and digital signal processing	Convolution integral	Fourier Representations for signals: Introduction, Four Signal Classes	Representation of Signals using Continuous-Time complex Exponentials: Introduction, The Laplace Transform	Properties of the Region of Convergence
	SLO-2	Classification of signals	Problem on Convolution integral			
S-4	SLO-1	Fundamentals operations on signals	Properties of Impulse response representations-parallel connection of systems	Orthogonality of Complex Sinusoids	Problems on The Laplace Transform	Problems on the Region of Convergence
	SLO-2	Problems on signal operations	Properties of Impulse response representations- cascade connection of systems			
S-5	SLO-1	Time shifting and time scaling signals	Memoryless systems and stable systems	Discrete-Time periodic signals: The Discrete-Time Fourier Series	The Unilateral Laplace Transform	Properties of the z-Transform
	SLO-2	Time shifting and time scaling signals-precedence rule	Invertible system and deconvolution			
S-6	SLO-1	Elementary signals - Exponential signals	Step response	Continuous-Time periodic signals: The Fourier Series	Problems on the Unilateral Laplace Transform	Problems
	SLO-2	Sinusoidal signals, Exponentially damped sinusoidal signal	Sinusoidal steady state response			
S-7	SLO-1	Step Function	Differential and difference equation representation	Discrete-Time Nonperiodic signals: The Discrete-Time Fourier Transform	Inversion of the Laplace Transform	Inversion of the z-Transform

	SLO-2	*Impulse function and Ramp function*	*Natural Response*			
S-8	SLO-1	*Problems on different function*	*Forced Response*	*Continuous-Time Nonperiodic signals: The Fourier Transform*	*Problems on Inversion of the Laplace Transform*	*Problems on Inversion of the z-Transform*
	SLO-2	*Interconnection of operation in systems*	*Complete Response*			
S-9	SLO-1	*Properties of systems – stability, memory, causality*	*Impulse Response*	*Properties of Fourier Representations*	*Solving Differential Equations with Initial Conditions*	*Application to Filters and Equalizers: Introduction to Passive Filters, Introduction to Digital Filters*
	SLO-2	*Invertability , time in variance, linearity*	*Characteristics of systems described by differential and difference equation*			*Introduction to FIR Digital Filters, Introduction to IIR Digital Filters*

Learning Resources	*1. B.P.Lathi and Rpger Green Linear Systems and Signals, Third Edition, Oxford University Press,2017* *2. AlanV. Oppenheim, Alan S.Willsky with S.Hamid Nawab, Signals & Systems, 2nd edn., Pearson Education, 1997* *3. John G.Proakis and Dimitris G.Manolakis, Digital Signal Processing, Principles, Algorithms and Applications, 3rd edn., PHI, 2000.* *4. M.J.Roberts, Signals and Systems Analysis using Transform method and MATLAB, TMH 2003.*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
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%	

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Dr. Marriappan Vaithilingam, Senior Director of Engineering, Fresh works		*Dr. P. Kanmani, SRMIST* *Dr. R. Ranikrithika, SRMIST*

Course Code	18AIS202T	Course Name	DIGITAL LOGIC AND COMPUTER ARCHITECTURE	Course Category	S	*Engineering Sciences*	L	T	P	C
							3	0	0	3

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

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

CLR-1 :	*To introduce students to the basic concepts of Number System and Logic Gates.*		1	2	3		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-2 :	*Understanding of the Combinatorial and Sequential Circuits*		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)		Engineering 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-3 :	*To introduce students to the basic concepts of Computer Architecture*																				
CLR-4 :	*To study the various I/O and Memory Systems*																				
CLR-5 :	*To study the various concepts of Pipelining*																				
Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*																				
CLO-1 :	*Identify and apply various logic gates*		3	80	70		H	H	H	H	L	-	M	-	L	L	M	H	H	M	M
CLO-2 :	*Design various Combinatorial and Sequential circuits*		3	85	75		H	H	H	H	L	-	-	-	M	L	M	H	H	M	M
CLO-3 :	*Identify various Addressing Modes*		3	75	70		H	H	M	M	L	-	-	-	M	L	-	H	H	M	M
CLO-4 :	*Identify various I/O and Memory Systems*		3	85	80		M	H	M	H	L	-	-	-	M	L	-	H	H	M	M
CLO-5 :	*Distinguish between Direct, Associate and Set Associate Mappings*		3	85	75		H	H	H	H	L	-	-	-	M	L	-	H	H	M	M

Duration (hour)		09	09	09	09	09
S-1	SLO-1	*Computer Fundamentals*	*Simplification of Boolean Functions*	*Basic Structure of Computers*	*Input Output organization*	*Cache Memory*
	SLO-2	*Introduction to Number System and Codes*	*Karnaugh maps*	*Computer Types*	*Peripheral devices*	*Associative Mapping*
S-2	SLO-1	*Number Systems: Binary, Decimal*	*K-map simplification*	*Functional Units*	*Standard I/O Interface*	*Direct Mapping*
	SLO-2	*Octal, Hexadecimal*	*Tabulation method*	*Basic Operational Concepts*	*Accessing I/O Devices*	*Set Associative Mapping*
S-3	SLO-1	*Codes: Grey, BCD*	*Minimum cover calculation*	*Bus Structures*	*Interrupts*	*Performance Considerations*
	SLO-2	*Excess-3, ASCII*	*Hazards*	*Software*	*Direct Memory Access*	*Requirements of Memory Management*
S 4	SLO-1	*Binary Arithmetic: Addition, Subtraction*	*Combinatorial Components*	*Multiprocessors*	*Buses*	*Secondary Memory*
	SLO-2	*Multiplication, Division using Sign Magnitude*	*Introduction to Combinational Logic Circuits, Half adder, Full adder, BCD Adder*	*Multicomputer*	*Introduction to Memory System*	*Virtual Memory*
S-5	SLO-1	*1's compliment*	*Multiplexers, Demultiplexers*	*Machine instructions*	*Memory System*	*Memory Management,*
	SLO-2	*2's compliment*	*Encoder, Decoder*	*Addressing Modes*	*Basic Concepts: RAM Memory*	*Paging*
S-6	SLO-1	*BCD Number System*	*Comparator*	*Basic Processing Unit: Fundamental Concepts*	*Read-Only Memory*	*Page replacement algorithm*
	SLO-2	*BCD and Hex Arithmetic Operation*	*Analysis Procedure and Design Procedure of Combinational Logic Circuits*	*Register Transfers*	*Cache memory*	*Pipelining*
S-7	SLO-1	*IEEE-754 Floating point Representation: Single Precision*	*Introduction to Sequential Logic Circuits, Latches and flip-flops*	*Performing Arithmetic Operations*	*cache coherence*	*Basic Concepts : Data Hazards, Instruction to Hazards*

	SLO-2	*IEEE-754 Floating point Representation: Double Precision*	*Flip Flops: SR, JK, JKMS, T, D Flip Flop*	*Performing logic Operations*	*Translation Look-aside Buffer (TLB)*	*Instruction set*
S-8	SLO-1	*Logic Gates: AND, OR, NOT*	*Analysis and Synthesis using T Flip Flop and D Flip Flop,*	*Execution of a Complete Instruction*	*Integration of the memory: the TLB and cache*	*Influence on Instruction set*
	SLO-2	*NAND, NOR, EX-OR, EX-NOR*	*Introduction to Counters: Ripple Counters, Synchronous Counters*	*Multiple Bus Organization*	*Storage and other aspects of the I / O*	*Data Path and Control Considerations*
S-9	SLO-1	*Boolean algebra, De Morgan's Theorem*	*Introduction to Registers: Shift Registers*	*Hardwired Control*	*Main Memory*	*Super Scalar operation*
	SLO-2	*Parity checker using XOR gate*	*Universal Shift register*	*Microprogrammed Control*	*Secondary Memory*	*Performance Considerations*

Learning Resources

1. *R. P. Jain, "Modern Digital Electronic", McGraw-Hill Publication, 4th Edition. 2010*
2. *M. Maris Mano, "Computer System Architecture", Pearson Publication, 3rd Edition , 2007*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
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 Industry	Experts from Higher Technical Institutions	Internal Experts
Dr. Marriappan Vaithilingam, Senior Director of Engineering, Fresh works	*Dr. E. Sivasankar, Assistant Professor, Department of CSE, NIT, Trichy*	*Mr. H. Karthikeyan, SRMIST*

Course Code	18AIC205J	Course Name	Neural Networks and Machine Learning	Course Category	C	Professional Core Courses	L	T	P	C
							3	0	2	4

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

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

CLR-1 :	*Provide the basic understanding of learning problems and Bayesian Learning*		1	2	3		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15										
CLR-2 :	*Gain the knowledge of probabilistic learning and Support Vector Machines*																														
CLR-3 :	*Acquire the details of unsupervised learning and dimensionality reduction*																														
CLR-4 :	*Express the models of biological neurons to Neural Networks, single layer perceptron and multilayer perceptron's*																														
CLR-5 :	*Demonstrate the working of different kind of Artificial Neural Networks*																														
Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)		Engineering 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:	*Formulate the Learning problems and Bayesian learning algorithm*		*1*	*80*	*70*		-	*M*	*M*	*H*	*M*	-	-	-	-	-	-	*H*	*H*	*H*	*H*										
CLO-2:	*Apply the decision tree algorithm and Support Vector Machines for classification and regression problem*		*2*	*85*	*75*		-	*H*	*M*	*M*	*M*	-	-	-	-	-	-	*M*	*H*	*H*	*H*										
CLO-3:	*Apply unsupervised learning and dimensionality reduction algorithms to solve the real-world problems*		*2*	*75*	*70*		-	*H*	*M*	*H*	*M*	-	-	-	-	-	-	*M*	*H*	*H*	*H*										
CLO-4:	*Analyze the perception of neurons and network functioning*		*2*	*85*	*85*		-	*H*	*H*	*H*	*M*	-	-	-	-	-	-	*M*	*H*	*H*	*H*										
CLO-5:	*Develop NN models to solve real world problems*		*3*	*85*	*75*		-	*H*	*H*	*H*	*M*	-	-	-	-	-	-	*H*	*H*	*H*	*H*										

Duration (hour)		15	15	15	15	15
S-1	SLO-1	*Learning: Machine Learning Process*	*Multi-layer Perceptron-Introduction*	*Machine learning: Importance of ML*	*Support Vector Machines- Introduction*	*Data Fusion and Ensemble Learning-Introduction*
	SLO-2	*Learning and Inference Methods*	*Going Forwards, Biases*	*Introduction to Feature Extraction*	*Optimal Separation*	*Majority Voting*
S-2	SLO-1	*Some terminologies: Weight space, curse of dimensionality*	*Multi-Layer Perceptron in Practice: Amount of training data*	*Feature descriptors*	*Kernels*	*Bagging*
	SLO-2	*Knowing what you know: Testing algorithms*	*Number of Hidden layers and when to stop learning*	*Feature Vectors*	*SVM Algorithm - Implementation*	*Boosting*
S-3	SLO-1	*Turning Data into probabilities: Minimizing Risk*	*Examples of using MLP*	*Creating features from an Image using GLCM*	*Multi-class Classification using SVM*	*Random Forests*
	SLO-2	*Basic Statistics: Bias-variance trade off*	*A Regression Problem*		*SVM Regression*	*Solving Multi-class Classification*

S 4-5 (LAB)	SLO-1 SLO-2	***Lab 1: Implement a Single Layer Perceptron to construct logical NOT, NAND and NOR of their inputs without libraries***	***Lab 4: Regression with MLP***	***Lab 7: Implement GLCM to extract features from an Image***	***Lab 10: Implement SVM for a multi class problem and try out the different kernels.***	***Lab 13: Implement Multi-class Classification problems using Ensemble Learners***
S-6	SLO-1	*The Brain and the Neuron – Hebb's Rule*	*Examples of using MLP*	*Linear Regression*	*Dimensionality Reduction*	*Unsupervised Learning- Examples*
	SLO-2	*McCulloch-Pitts Neurons*	*A Classification Problem*	*Linear Regression Examples*	*Linear Discriminant Analysis (LDA)*	*Types of unsupervised Learning*
S-7	SLO-1	*Neural Networks*	*MLP: Going Backwards*	*Logistic Regression*	*Principal Component Analysis (PCA)*	*Clustering- Exclusive (partitioning)*
	SLO-2	*The Perceptron*	*Back Propagation of Error*	*Logistic Regression Examples*	*The Viterbi Algorithm*	*K-Means Algorithm*
S-8	SLO-1	*The Perceptron Learning Algorithm*	*Deriving Backpropagation*	*Naïve Bayes' Classifier*	*PCA Algorithm*	*Agglomerative*
	SLO-2	*An Example of Perceptron Learning: Logic Functions*	*Incremental learning vs batch Learning*	*Naïve Bayes' Classifier: An example*	*The Particle Filter*	*Hierarchical clustering*
S 9-10 (LAB)	SLO-1 SLO-2	***Lab2: Implement a Single Layer Perceptron for a classification problem***	***Lab 5: Implement a BPNN***	***Lab 8: Implement Naïve Bayes' classifier***	***Lab 11: Compare the results of LDA and PCA in any given dataset.***	***Lab 14: Implement a clustering algorithm to perform anomaly detection***
S-11	SLO-1	*Linear Separability*	*Graphical Models*	*Probabilistic learning: Gaussian Mixture Models - The Expectation- Maximisation (EM) Algorithm*	*Independent Component Analysis (ICA)*	*The Self-Organising Feature Map*
	SLO-2	*Linear Regression*	*Bayesian Networks*	*Information Criteria*	*ICA Algorithm*	*The SOM Algorithm*
S-12	SLO-1	*Learning and Generalization*	*Hidden Markov Models (HMM) – The Forward Algorithm*	*Nearest Neighbour Methods- Nearest Neighbour Smoothing*	*Kernel Methods: Kernel PCA*	*Neighbourhood Connections*
	SLO-2		*The Viterbi Algorithm*	*Efficient Distance Computations: the KD-Tree and Distance measures*	*Kernel PCA Algorithm*	*Self-Organisation*
S-13	SLO-1	*Model Selection*	*Tracking Methods-Kalman Filter*	*Constructing Decision trees – ID3*	*Kernel LDA*	*Network Dimensionality and Boundary Conditions*
	SLO-2	*Criterion Functions and Robust learning*	*The Particle Filter*	*Classification and Regression Tress (CART)*	*Kernel Clustering*	*Examples of Using the SOM*
S 14-15 (LAB)	SLO-1 SLO-2	**Lab 3: Implement a Single Layer Perceptron for a Regression problem**	**Lab 6: Implement Hidden Markov Model**	**Lab 9: Implement Decision tree based ID3 and CART algorithm**	**Lab 12: Compare the results of PCA and kernel PCA in any given dataset.**	**Lab 15: Implement Self-Organizing Maps**

Learning Resources	*Text books:* *Machine Learning: An Algorithmic Perspective 2nd Edition, by Marsland, Stephen, CRC Press, 2014.* *Neural Networks and Statistical Learning, Du, Ke-Lin, and Swamy, M. N. S., Germany, Springer London, 2019.* *Michael Bowles,Machine Learning in Python,Wiley&Sons,2015* *Reference Books:* *Trevor Hastie, Robert Tibshirani, Jerome Friedman, h The Elements of Statistical Learning, 2nd edition, springer series in statistics.* *Ethem Alpaydın, Introduction to machine learning, second edition, MIT press.*

Learning Assessment			
	Bloom's	Continuous Learning Assessment (50% weightage)	Final Examination (50% weightage)

	Level of Thinking	CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		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	Experts from Higher Technical Institutions	Internal Experts
1. Dr. Mariappan Vaithiyanathan, Senior Director of Engineering, Fresh Works.	*1.Dr. E. Sivasankar, Assistant Professor, Department of CSE, NIT, Trichy industry*	*1. Dr. A. Alice Nithya, SRMIST*
2.Mr. Senthilnathan, Co-founder, Tenzai, Bangalore		*2. Dr.C.Amuthadevi, SRMIST*
		3. Dr. C. Lakshmi, SRMIST

Course Code	18AIC206J	Course Name	ANALYSIS AND DESIGN OF ALGORITHMS	Course Category	C	Professional Core Courses	L	T	P	C
							3	0	2	4

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

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1 :	*Design efficient algorithms in solving complex real time problems*
CLR-2 :	*Analyze various algorithm design techniques to solve real time problems in polynomial time*
CLR-3 :	*Utilize various approaches to solve greedy and dynamic algorithms*
CLR-4 :	*Utilize back tracking and branch and bound paradigms to solve exponential time problems*
CLR-5 :	*Analyze the need of approximation and randomization algorithms, utilize the importance Non polynomial algorithms*
CLR-6 :	*Construct algorithms that are efficient in space and time complexities*

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning 1 Level of Thinking (Bloom)	2 Expected Proficiency (%)	3 Expected Attainment (%)	Program Learning Outcomes (PLO) 1 Engineering 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 :	***Apply efficient algorithms to reduce space and time complexity of both recurrent and non-recurrent relations***	3	80	70	L	H	-	H	L	-	-	-	L	L	-	H	H	H	H
CLO-2 :	***Solve problems using divide and conquer approaches***	3	85	75	M	H	L	M	L	-	-	-	M	L	-	H	H	H	H
CLO-3 :	***Apply greedy and dynamic programming types techniques to solve polynomial time problems.***	3	75	70	M	H	M	H	L	-	-	-	M	L	-	H	H	H	H
CLO-4 :	***Create exponential problems using backtracking and branch and bound approaches.***	3	85	80	M	H	M	H	L	-	-	-	M	L	-	H	H	H	H
CLO-5 :	***Interpret various approximation algorithms and interpret solutions to evaluate P type, NP Type, NPC, NP Hard problems***	3	85	75	H	H	M	H	L	-	-	-	M	L	-	H	H	H	H
CLO-6 :	***Create algorithms that are efficient in space and time complexities by using divide conquer, greedy, backtracking technique***	3	80	70	L	H	M	H	L	-	-	-	L	L	-	H	H	H	H

Duration (hour)		15	15	15	15	15
S-1	SLO-1	Introduction-Algorithm Design	Introduction-Divide and Conquer	Introduction-Greedy and Dynamic Programming	Introduction to backtracking - branch and bound	Introduction to randomization and approximation algorithm
	SLO-2	Fundamentals of Algorithms	Maximum Subarray Problem	Examples of problems that can be solved by using greedy and dynamic approach	N Queens Problem - backtracking	Randomized hiring problem
S-2	SLO-1	Correctness of algorithm	Binary Search	Huffman coding using greedy approach	Sum of subsets using backtracking	Randomized quick sort
	SLO-2	Time complexity analysis	Complexity of binary search	Comparison of brute force and Huffman method of encoding	Complexity calculation of sum of subsets	Complexity analysis
S-3	SLO-1	Insertion sort-Line count, Operation count	Merge sort	Knapsack problem using greedy approach	Graph introduction	String matching algorithm
	SLO-2	Algorithm Design paradigms	Time complexity analysis	Complexity derivation of knapsack using greedy	Hamiltonian circuit - backtracking	Examples
S 4-5	SLO-1 SLO-2	**Lab 1: Simple Algorithm-Insertion sort**	**Lab 4: Quicksort, Binary search**	**Lab 7: Huffman coding, knapsack and using greedy**	**Lab 10: N Queens Problem**	**Lab 13: Randomized quick sort**
S-6	SLO-1	Designing an algorithm	Quick sort and its Time complexity analysis	Tree traversals	Branch and bound - Knapsack problem	Rabin Karp algorithm for string matching
	SLO-2	And its analysis-Best, Worst and Average case	Best case, Worst case, Average case analysis	Minimum spanning tree - greedy Kruskal's algorithm - greedy	Example and complexity calculation. Differentiate with dynamic and greedy	Example discussion
S-7	SLO-1	Asymptotic notations Based on growth functions.	Strassen's Matrix multiplication and its recurrence relation	Minimum spanning tree - Prims algorithm	Travelling salesman problem using branch and bound	Approximation algorithm

	SLO-2	O,O, , Θ ω, Ω	Time complexity analysis of Merge sort	Introduction to dynamic programming	Travelling salesman problem using branch and bound example	Vertex covering
S-8	**SLO-1**	Mathematical analysis	Largest sub-array sum	0/1 knapsack problem	Travelling salesman problem using branch and bound example	Introduction Complexity classes
	SLO-2	Induction, Recurrence relations	Time complexity analysis of Largest sub-array sum	Complexity calculation of knapsack problem *Various tree traversals, Krukshall's*	Time complexity calculation with an example	P type problems
S 9-10	**SLO-1** **SLO-2**	**Lab 2: Bubble Sort**	**Lab 5: Strassen Matrix multiplication**	**Lab 8: MST**	**Lab 11: Travelling salesman problem**	**Lab 14: String matching algorithms**
S-11	**SLO-1**	Solution of recurrence relations	Master Theorem Proof	Matrix chain multiplication using dynamic programming	Graph algorithms	Introduction to NP type problems
	SLO-2	Substitution method	Master theorem examples	Complexity of matrix chain multiplication	Depth first search and Breadth first search	Hamiltonian cycle problem
S-12	**SLO-1**	Solution of recurrence relations	Finding Maximum and Minimum in an array	Longest common subsequence using dynamic programming	Shortest path introduction	NP complete problem introduction
	SLO-2	Recursion tree	Time complexity analysis-Examples	Explanation of LCS with an example	Floyd-Warshall Introduction	Satisfiability problem
S-13	**SLO-1**	Solution of recurrence relations	Algorithm for finding closest pair problem	Optimal binary search tree (OBST)using dynamic programming	Floyd-Warshall with sample graph	NP hard problems
	SLO-2	Examples	Convex Hull problem	Explanation of OBST with an example.	Floyd-Warshall complexity	Examples
S 14-15	**SLO-1** **SLO-2**	**Lab 3: Recurrence Type-Merge sort, Linear search**	**Lab 6: Finding Maximum and Minimum in an array, Convex Hull problem**	**Lab 9: Longest common subsequence**	**Lab 12: BFS and DFS implementation with array**	**Lab 15: Discussion over analyzing a real time problem**

Learning Resources	**Thomas H Cormen, Charles E Leiserson, Ronald L Revest, Clifford Stein, Introduction to Algorithms, 3rd ed., The MIT Press Cambridge, 2014** **Mark Allen Weiss, Data Structures and Algorithm Analysis in C, 2nd ed., Pearson Education, 2006**	**Ellis Horowitz, Sartajsahni, Sanguthevar, Rajesekaran, Fundamentals of Computer Algorithms, Galgotia Publication, 2010** **S. Sridhar, Design and Analysis of Algorithms, Oxford University Press, 2015**

Learning Assessment											
		Continuous Learning Assessment (50% weightage)								**Final Examination (50% weightage)**	
		CLA 1 (10%)		**CLA 2 (15%)**		**CLA 3 (15%)**		**CLA 4 (10%)**			
	Bloom's Level of Thinking	**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%**
	Create			**\15%**							
	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	**Experts from Higher Technical Institutions**	**Internal Experts**
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2. Dr.SainarayananGopalakrishnan, HCL Technologies, sai.jgk@gmail.com	**2. V. Masilamani. IIITDM, masila@iiitdm.ac.in**	**2. Dr.A.Razia Sulthana, SRMIST**
		3. Mr. V. Sivakumar, SRMIST
		4. Ms. R. Vidhya, SRMIST

Course Code	18AIC207J	Course Name	DATABASE MANAGEMENT SYSTEMS FOR ARTIFICIAL INTELLIGENCE	Course Category	C	Professional Core Course	L	T	P	C
							2	0	2	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Artificial Intelligence	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 fundamentals of Database Management Systems, Architecture and Languages		1	2	3		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-2 :	Conceive the database design process through ER Model and Relational Model		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)		Engineering 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-3 :	Design Logical Database Schema and mapping it to implementation level schema through Database Language																				
CLR-4 :	Familiarize queries using Structure Query Language (SQL) and PL/SQL																				
CLR-5 :	Familiarize the Improvement of the database design using normalization criteria and optimize queries																				
CLR-6 :	Understand the practical problems of concurrency control and gain knowledge about failures and recovery																				
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																				
CLO-1 :	Acquire the knowledge on DBMS Architecture and Languages		3	80	70		H	M	L	L	-	-	-	-	L	L	L	H	H	H	H
CLO-2 :	Apply the fundamentals of data models to model an application's data requirements using conceptual modelling tools like ER diagrams		3	85	75		H	H	H	H	H	-	-	-	H	H	H	H	H	H	H
CLO-3 :	Apply the method to convert the ER model to a database schemas based on the conceptual relational model		3	75	70		H	H	H	H	H	-	-	-	H	H	H	H	H	H	H
CLO-4 :	Apply the knowledge to create, store and retrieve data using Structure Query Language (SQL) and PL/SQL		3	85	80		H	H	H	H	H	-	-	-	H	H	H	H	H	H	H
CLO-5 :	Apply the knowledge to improve database design using various normalization criteria and optimize queries		3	85	75		H	H	L	M	L	-	-	-	M	M	M	L	H	H	H
CLO-6 :	Appreciate the fundamental concepts of transaction processing- concurrency control techniques and recovery procedures		3	85	75			H	L	L	L	-	-	-	H	L	L	L	H	H	H

Duration (hour)		12	12	12	12	12
S-1	SLO-1	What is Database Management System	ER Diagram Issues	Joins	Query Processing	Multi- valued dependency, 4NF
	SLO-2	Advantage of DBMS over File Processing System	Weak Entity, Relational Model			Join dependency and 5NF
S-2	SLO-1	Introduction and applications of DBMS	Conversion of ER to Relational Table	Transaction Control Commands	Relational Algebra – Fundamental Operators and syntax, relational	Transaction concepts, properties of transactions

	SLO-2	Purpose of database system		Commit, Rollback, Save point	algebra queries	Serializability of transactions
S 3-4 (LAB)	**SLO-1**	**Lab 1: SQL Data Definition Language Commands on sample exercise * The abstract of the project to construct database must be framed**	**Lab 4: Inbuilt functions in SQL on sample Exercise.**	**Lab 7: Join Queries on sample exercise. * Frame and execute the appropriate DDL,DML,DCL,TCL for the project**	**Lab 10: PL/SQL Functions**	**Lab 13:PL/SQL Trigger * Frame and execute the appropriate PL/SQL Cursors and Exceptional Handling for the project**
	SLO-2					
S-5	**SLO-1**	Views of data	Basics of SQL-DDL,DML,DCL,TCL	Stored Procedure	Pitfalls in Relational database, Decomposing bad schema	testing for serial inability
	SLO-2	Data Independence	Structure Creation, alternation		Functional Dependency – definition, trivial and non-trivial FD	System recovery
S-6	**SLO-1**	Language Commands * Identification of project Modules and functionality	Defining Constraints-Primary Key, Foreign Key, Unique, not null, check, IN operator	Functions Triggers	closure of FD set , closure of attributes	Concurrency Control
	SLO-2		Functions-aggregation functions	Exceptional Handling	irreducible set of FD	Two- Phase Commit protocol
S 7-8 (LAB)	**SLO-1**	**Lab 2: Database Design**	**Lab 5: Construct a ER Model for the application to be constructed to a Database**	**Lab 8 :PL/SQL Conditional and Iterative Statements,sets and views * Frame and execute the appropriate Nested Queries for the project**	**Lab 11: PL/SQL Cursors * Frame and execute the appropriate PL/SQL Conditional and Iterative Statements for the project**	**Lab 14: Convert postgre database data to CSV and migration of SQL to PorstgreSQL PL/SQL**
	SLO-2	**Entity Relation Model**				
S-9	**SLO-1**	ER diagram	Built-in Functions-numeric, date, string functions, string functions, Set operations.	PostgreSQL Overview	Normalization – 1Nf, 2NF, 3NF	concurrent executions of transactions and related problems
	SLO-2		Sub Queries, correlated sub queries	Displaying output as CSV		Locking mechanism, solution to concurrency SLO-2 Weak Entity related problems
S-10	**SLO-1**	Keys , Attributes and Constraints	Nested Queries	Migrating SQL statements to PostgreSQL	Decomposition using FD- dependency preservation, BCNF	Deadlock
	SLO-2	Mapping Cardinality, Generalization, Specialization and Aggregation	Views and its Types			two-phase locking protocol
S 11-12 (LAB)	**SLO-1**	**Lab 3: SQL Data Control Language Commands and Transaction control commands to the sample exercises * Identify the issues that can arise in a business perspective for the application**	**Lab 6: Nested Queries on sample exercise * Construction of Relational Table from the ER Diagram**	**Lab 9: PL/SQL Procedures on sample exercise. * Frame and execute the appropriate Join Queries for the project**	**Lab 12: Exception Handling * Frame and execute the appropriate PL/SQL Procedures and Functions for the project**	**Lab 15: JDBC connectivity with PostgreSQL**
	SLO-2					

Learning Resources	1. Abraham Silberschatz, Henry F. Korth, S. Sudharshan, Database System Concepts, Sixth Edition, Tata McGraw Hill,2019. 2. Ramez Elmasri, Shamkant B. Navathe, Fundamentals of Database Systems, Sixth Edition, Pearson Education,2015 3. Martin Gruber, Understanding SQL, Sybex,1990 4. Sharad Maheshwari,Introduction to SQLandPL/SQL,2ded.,LaxmiPublications,2016. 5. Hans- Jurgen Schonig, Mastering PostgreSQL 12, Third Edition, PacktPublishing, 2019. 6. Thomas Lockhart, PostgreSQL Programmer's Guide, PostgreSQL Development Team **7.** RaghuramaKrishnan,Johannes Gehrke,Database Management Systems,3rdEdition,McGrawHill Education,2003.

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		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	Experts from Higher Technical Institutions	Internal Experts
1. Dr. Mariappan Vaithiyanathan, Senior Director of Engineering, Fresh Works.	*1.Dr. E. Sivasankar, Assistant Professor, Department of CSE, NIT, Trichy industry*	1. Mr. S. Joseph James, SRMIST

Course Code	18AIC208J	Course Name	OPERATING SYSTEM DESIGN	Course Category	C	Professional Core Course	L	T	P	C
							2	0	2	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Artificial Intelligence	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 :	Introduce the key role of an Operating system		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)		Engineering 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 :	Insist the Process Management functions of an Operating system																				
CLR-3 :	Emphasize the importance of Memory Management concepts of an Operating system																				
CLR-4 :	Realize the significance of Device Management part of an Operating system																				
CLR-5 :	Comprehend the need of File Management functions of an Operating system																				
CLR-6:	Explore the services offered by the Operating system practically																				
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																				
CLO-1 :	Identify the need of an Operating system		1	80	70		H	L	M	`	H	`	`	`	`	`	`	`	H	H	H
CLO-2 :	Know the Process management functions of an Operating system		1	85	75		H	L	M	`	H	`	`	`	`	`	`	`	H	H	H
CLO-3 :	Understand the need of Memory Management functions of an Operating system		1	75	70		H	L	M	`	H	`	`	`	`	`	`	`	H	H	H
CLO-4 :	Find the significance of Device management role of an Operating system		2	85	80		H	L	M	`	H	`	`	`	`	`	`	`	H	H	H
CLO-5 :	Recognize the essentials of File Management part of an Operating system		2	85	75		H	L	M	`	H	`	`	`	`	`	`	`	H	H	H
CLO-6 :	Gain an insight of Importance of an Operating system through practical		3	80	70		H	L	M	`	H	`	`	`	`	`	`	`	H	H	H

Duration (hour)		12	12	12	12	12
S-1	SLO-1	Fundamental Concepts of Operating System: Operating system functions and characteristics	CPU SCHEDULING: FCFS, SJF, Priority CPU Scheduling: Round robin, Multilevel queue Scheduling, Multilevel feedback Scheduling	Paged memory management: Understanding the Paging technique. PMT hardware mechanism	Copy-on write Understanding the need for Copy-on write	FILE SYSTEM IMPLEMENTATION: File system structure file protection mechanisms
	SLO-2	Historical evolution of Operating systems, issues in operating system design.	Understanding the scheduling techniques	Structure of Page Map Table Understanding the components of PMT	Page replacement Mechanisms: FIFO, Optimal, LRU and LRU approximation Techniques	Implementation issues, file system hierarchy. Directory Implementation
S-2	SLO-1	OS Design considerations for Multiprocessor and Multicore	Real Time scheduling: Rate Monotonic Scheduling and Deadline Scheduling	Example: Intel 32 bit and 64 –bit Architectures	Understanding the Pros and cons of the page replacement techniques	FILE SYSTEM IMPLEMENTATION: Allocation methods Understanding the pros and Cons of various disk allocation methods

	SLO-2	Understanding the key design issues of Multiprocessor Operating systems and Multicore Operating systems	Comparative study of scheduling algorithms, multiple processor scheduling.	Understanding the Paging in the Intel architectures	Counting based page replacement and Page Buffering Algorithms To know on additional Techniques available for page replacement strategies	FILE SYSTEM IMPLEMENTATION: Free space Management, Swap space Management, Understanding the Low-level task of the OS
S 3-4 (LAB)	**SLO-1** **SLO-2**	**LAB 1 : Understanding the booting process of Linux**	**LAB 4: Analyze and simulate CPU Scheduling Algorithms like FCFS, Round Robin, SJF, and Priority**	**LAB 7: Shell Programs – Basic level**	**LAB 10: Implement page replacement schemes**	**LAB 13: Implement Single and two Level Directory using File Organization Techniques Implement File Allocation Strategies**
S-5	**SLO-1**	Process Management: Process abstraction, process address space, process management, system calls, threads, process hierarchy.	DEADLOCKS: Necessary conditions, Resource allocation graph Deadlock prevention methods	Example: ARM Architectures Understanding the Paging with respect to ARM	Allocation of Frames - Global Vs Local Allocation	BASICS OF REAL-TIME CONCEPTS: Terminology: RTOS concepts and definitions, real-time design issues, examples
	SLO-2	Operations on Process – Process creation, Process termination, Understanding the system calls – fork(), wait(),exit() Threads – Overview and its Benefits, Understanding the importance of threads	Deadlocks: Deadlock Avoidance, Detection and Recovery	Segmented memory management Understanding the users view of memory with respect to the primary memory	Thrashing, Causes of Thrashing	Hardware Considerations: logic states, CPU, memory, I/O, Architectures, RTOS building blocks, Real-Time Kernel
S-6	**SLO-1**	Process Scheduling: Scheduling Queues,Schedulers, Context switch Understanding basics of Process scheduling	Understanding the deadlock avoidance, detection	Paged segmentation Technique	Working set Model	Real Time Operating Systems: - RTOS Overview, RTOS Components,
	SLO-2	Inter Process communication: SharedMemory, Message Passing, Pipe() Understanding the need for IPC	Understanding the deadlock recovery mechanisms	Understanding the combined scheme for efficient management	Understanding the working set model for controlling the Working set Model	Task Management & Memory Management, Scheduling Strategies, Commercial Real-time Operating Systems.
S 7-8 (LAB)	**SLO-1** **SLO-2**	**LAB 2: Familiarization with UNIX system calls for process management and inter-process communication**	**LAB 5: Simulate Algorithm for Deadlock Prevention**	**LAB 8: Implement Paging Technique for memory management**	**LAB11: IPC using pipes, shared memory and Message queues**	**LAB 14: Experiments on RTOS applications**
S-9	**SLO-1**	PROCESS SYNCHRONIZATION: Background, Critical section Problem Understanding the race conditions and the need for the Process synchronization	MEMORY MANAGEMENT: Memory Management: Logical Vs Physical address space, Swapping	VIRTUAL MEMORY– Background Understanding the need of demand paging	STORAGE MANAGEMENT: Mass storage structure – Overview of Mass storage structure – Magnetic Disks	Inter-task Communication and Synchronization, Real Time Kernels, Practical Real Time Operating Systems
	SLO-2	PROCESS SYNCHRONIZATION: Peterson's solution, Synchronization Hardware, Understanding the two-process solution and the benefits of the synchronization hardware	Contiguous Memory allocation – Fixed and Dynamic partition	page fault handling Understanding, how an OS handles thepage faults	Disk Scheduling	Fault Tolerance Techniques: Failures, Errors, and Faults, Error Detection, Testing Techniques.
S-10	**SLO-1**	Process synchronization:	Getting to know about Partition memory	Performance of Demand paging	Understanding the various scheduling	Security in RTOS: A Model for Network

		Semaphores, usage, implementation Gaining the knowledge of the usage of the semaphores for the Mutual exclusion mechanisms	management and issues: Internal fragmentation and external fragmentation problems		With respect to the disk	Security, Potential Attacks to Real Time Systems, Cryptography, Authentication, Design Principles.
	SLO-2	Classical Problems of synchronization – Reader's writer's problem, Bounded Buffer problem, Dining Philosophers problem (Monitor) Understanding the synchronization of limited resources among multiple processes	Strategies for selecting free holes in Dynamic partition	Understanding the relationship of effective access time and the page fault rate	FILE SYSTEM INTERFACE: File concept, File access methods	Case Study in Software Requirements Specification for Four-way, Traffic Intersection Traffic Light Controller Systems.
S 11-12 (LAB)	**SLO-1**	**LAB 3: Understanding the producer-consumer & dining Philosopher problem using semaphore**	**LAB 6: Experiments on Memory Management techniques**	**LAB 9 : Overlay concept**	**LAB 12: Process synchronization**	**LAB 15: Experiments on RTOS applications**
	SLO-2					

Learning Resources	1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Operating systems, 9th ed., John Wiley & Sons, 2013 2. William Stallings, Operating Systems-Internals and Design Principles, 7th ed., Prentice Hall, 2012 3. J Labrosse, "MicroC/OS-II: The Real –Time Kernel", Newnes, 2002 4. Andrew S.Tanenbaum, Herbert Bos, Modern Operating systems, 4th ed., Pearson, 2015 **5.** Bryant O'Hallaxn, Computer systems- A Programmer's Perspective,Pearson, 2015

Learning Assessment

	Bloom's Level of Thinking	**Continuous Learning Assessment (50% weightage)**								**Final Examination (50% weightage)**	
		CLA – 1 (10%)		**CLA – 2 (15%)**		**CLA – 3 (15%)**		**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	**Experts from Higher Technical Institutions**	**Internal Experts**
1. Dr. Mariappan Vaithiyanathan, Senior Director of Engineering, Fresh Works.	*1.Dr. E. Sivasankar, Assistant Professor, Department of CSE, NIT, Trichy* *industry*	*Dr.R.Rani Krithiga,, SRMIST*

Course Code	18AIS203J	Course Name	Computer Networks and Communications	Course Category	S	Engineering Sciences	L	T	P	C
							2	0	2	3

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

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

			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)		Engineering 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-1 :	Understand the basic functionalities of network and its layers		1	2	3		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-2 :	Acquire Knowledge in IP addressing and Routing Protocols																				
CLR-3 :	Explore the services and techniques adapted in Link layer																				
CLR-4 :	Understand the standards and framework in Physical Layer																				
CLR-5 :	Analyze the impact of networking in IOT																				
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																				
CLO-1 :	Differentiate the devices, addresses and functionalities of OSI Layers		3	75%	75%		H		L		L	-	-	-	-	-	-	H	M	H
CLO-2 :	Appraise routing protocols to networks using classful and classless addressing		2	75%	75%		H	M	-	-	-	-	-	-	-	-	M	H	M	H
CLO-3 :	Relate mechanisms for error control and flow control		3	75%	75%		H	M	-	-	-	-	-	-	-	-	-	H	M	H
CLO-4 :	Critique various IEEE standards for wireless communication		2	75%	75%		H	-	L	-	-	-	-	-	-	-	-	H	M	H
CLO-5 :	Examine the purpose of networking in IOT and its architecture		3	75%	75%		H	-	L	-	-	-	-	-	-	-	-	H	M	H

Duration (hour)		12	12	12	12	12
S-1	SLO-1	Evolution of Computer Networks, Uses of Computer Networks	IPv4 addresses- Classful addressing	Error Detection and correction : Types of errors, redundancy	Wireless LANs IEEE 802.11 : architecture and Protocol Stack	Genesis of IOT IOT and Digitization
	SLO-2	Types of Networks, Network Topologies	Classless Addressing	Block Coding	Wireless Broadband Standard IEEE 802.16: Architecture and Protocol Stack	IOT Impact – Roadways, Buildings IOT Challenges
S-2	SLO-1	Transmission modes, Circuit vs Packet Switching	Network Address Translation (NAT)	Cyclic Redundancy Check (CRC)	Bluetooth: Architecture and Applications	Drivers behind new network architectures

	SLO-2	Network Devices Protocols and Standards	IPv4 vs IPv6	Checksum	Protocol Stack, Frame Structure	A Simplified IOT Architecture
S 3-4 (LAB)	**SLO-1**	**Study of Packet Tracer Network Topologies**	**Static Routing – Classful Addressing**	**RIPv1**	**EIGRP Configuration, Bandwidth, and Adjacencies**	**Smart Home Design**
	SLO-2					
S-5	**SLO-1**	OSI Layers- Physical, Data link, Network	Subnetting	Framing, Flow and Error Control	Physical Layer overview	The core IOT functional stack- Layer 1 and Layer 2
	SLO-2	OSI Layers – Transport, Session, Presentation, Application	Supernetting	Protocols: Simple, Stop and wait	Latency, Bandwidth, Delay – Problem Solving	The core IOT functional stack- Layer 3 and Layer 4
S-6	**SLO-1**	TCP/IP protocol Suite OSI model vs TCP/IP model	Introduction to Routing Protocols	Go-Back-N Automatic Repeat Request, Selective Repeat Automatic Repeat Request	Transmission Media - Guided	The business case for IP
	SLO-2	Link Layer Protocols	RIP v1 and RIPv2	Channel Allocation Problem		The need for optimization
S 7-8 (LAB)	**SLO-1**	**Router Configuration**	**Static Routing three router configuration**	**RIP v2 – Classless Aressing**	**EIGRP Authentication and Timers**	**Project on IOT**
	SLO-2					
S-9	**SLO-1**	Network Layer Protocols	OSPF	Random Access	Wireless Transmission	From 6LoWPAN to 6Lo Header Compression
	SLO-2	Transport Layer Protocols	EIGRP	ALOHA Controlled Access		Fragmentation Mesh Addressing Mesh-Under Versus Mesh-Over Routing
S-10	**SLO-1**	Serial and Parallel Transmissions	BGP	Channelization	Digital Modulation and Multiplexing: Baseband, Passband Transmission	IoT Application Transport Methods
	SLO-2	Serial and Parallel Transmissions	Redistribution of routing protocols	Ethernet: IEEE Standards Standard Ethernet	Multiplexing	
S 11-12 (LAB)	**SLO-1**	**Router Console Password Configuration and perform password encryption**	**Static Routing – Classless Addressing**	**OSPF**	**Redistribution Between EIGRP and OSPF**	**Model Examination**
	SLO-2					

Learning Resources	1. Behrouz A. Forouzan, "Data Communications and Networking" 5th edition, July 1, 2010, ISBN: 9780073376226 2. Andrew S Tanenbaum, "Computer Networks" 5th Edition, Prentice Hall, 2011. 3. William Stallings, "Data and Computer Communications", Edition 9, 2010. **4.** David Hanes,"IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things" Cisco Press, 2017.

Learning Assessment											
	Bloom's Level of Thinking	**Continuous Learning Assessment (50% weightage)**								**Final Examination (50% weightage)**	
		CLA – 1 (10%)		**CLA – 2 (15%)**		**CLA – 3 (15%)**		**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 %	

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Course Designers		
Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
1. Dr. Mariappan Vaithiyanathan, Senior Director of Engineering, Fresh Works.	**1.Dr. E. Sivasankar, Assistant Professor, Department of CSE, NIT, Trichy industry**	**1.Dr. J. S. Femilda, SRMIST**

Course Code	18AIC209T	Course Name	Foundation of Metric Spaces	Course Category	C	Professional Core Courses	L	T	P	C
							1	0	0	1

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

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

CLR- 1 :	To provide a basic course in analysis in this setting		1	2	3		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR- 2 :	To provide a foundation for later analysis courses		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)		Engineering 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- 3 :	To impart knowledge about the concepts of machine learning																				
CLR- 4 :	To become familiar with specific, widely used machine learning algorithms																				
CLR- 5 :	Analyse and formalize the problem as a state space, graph, design heuristics and select amongst different search or game-based techniques to solve them																				
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																				
CLO- 1 :	Discover whether examples of metric spaces are complete using Cauchy sequences		2	80	85		H	M	M	H	-	-	L		-	H	M	M	M	M	M
CLO- 2 :	Understand iterative processes on general spaces		2	75	80		H	H	H	M	H	-	M		-	H	H	M	M	M	M
CLO- 3 :	Can apply principles and algorithms to evaluate models generated from data		2	85	80		H	H	M	H	H	M	M	M	L	H	M	-	M	M	M
CLO- 4 :	Able to identify the difference of metric spaces of AI and Machine learning techniques		2	80	75		H	H	M	H	M	-	-		M	L	H	-	M	M	M
CLO- 5 :	Implement various methods and algorithms in real life problem.		2	85	80		H	H	M	M	M	M	M	M	-	M	-	M	M	M	M

Duration (hour)		3	3	3	3	3
S-1	SLO-1	Definition of Metric Space, Examples	Types of Maps between Metric spaces	Topology and its properties	Generalizations of metric spaces	Connected spaces, components, path components and its examples
S-2	SLO-1	Open and closed sets, topology and convergence	Notation of metric spaces equivalence	Distance between points and sets; Hausdorff distance and Gromov metric	Compact spaces, examples, Tychonofs theorem.	totally disconnected spaces, locally connected spaces and its examples.

S-3	SLO-1	Types of metric spaces	Completeness, space filling curve, nowhere differentiable functions	Product and quotient metric spaces	locally compact spaces, limit point compactness, local compactness	Countability & separation axioms, completely regular and normal spaces, Urysohns lemma, Tietze extension theorem, Urysohn embedding theorem, Stone-Cech compactification

Learning Resources	1.Rendic. Circ. Mat. Palermo 22 (1906) 1–74 2.B. Choudhary (1992). The Elements of Complex Analysis. New Age International. p. 20. ISBN 978-81-224-0399-2. 3.J. R. Munkres, Topology (2nd Edn), Dorling Kindersley, 2006. Bryant, Metric Spaces iteration and application, Blackwells 4.G. F. Simmons, Introduction to Topology and Modern Analysis, Tata McGraw Hill, 2008.

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	40%	-	30%	-	30%	-	30%	-	30%	-
	Understanding										
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 Industry	Experts from Higher Technical Institutions	Internal Experts
1. Dr. Mariappan Vaithiyanathan, Senior Director of Engineering, Fresh Works.	*1.Dr. E. Sivasankar, Assistant Professor, Department of CSE, NIT, Trichy industry*	**Dr. R. Renuka Devi, SRMIST** **Dr. R. Rani Krithiga, SRMIST**

Course Code	18AIH201T	Course Name	Professional Ethics of Artificial Intelligence	Course Category	H	Humanities and Social Science	L	T	P	C
							2	0	0	2

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

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

			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)		1 Engineering 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
CLR-1 :	To align the aims of autonomous *Artificial Intelligence* systems with our own		1	2	3		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-2 :	Prevent learning algorithms from acquiring morally objectionable biases																				
CLR-3 :	To embed *Artificial Intelligence* systems in our social relations																				
CLR-4 :	*To incorporate which type of* ethical rules should *Artificial Intelligence* use																				
CLR-5 :	*To learn types of moral harms Artificial Intelligence systems, suffer*																				
Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*																				
CLO-1 :	Demonstrate knowledge of philosophical issues involved in ethics of artificial intelligence		*1*	*H*	*H*		*M*	*M*	*M*	*H*	*L*	*H*	*H*	*H*	*H*	*H*	*L*	*H*	*H*	*L*	*L*
CLO-2 :	Demonstrate familiarity with relevant examples of AI systems		*1*	*H*	*H*		*M*	*H*	*M*	*M*	*M*	*H*	*H*	*H*	*H*	*H*	*L*	*H*	*H*	*L*	*M*
CLO-3 :	*Analyze the moral issues that harm Artificial Intelligent Systems*		*2*	*H*	*H*		*M*	*M*	*M*		*M*	*H*	*H*	*H*	*H*	*H*	*L*	*H*	*H*	*L*	*M*
CLO-4 :	*Categorize Risks in the Business of Artificial Intelligent Systems*		*2*	*M*	*M*		*M*	*H*	*M*	*M*	*M*	*H*	*H*	*H*	*H*	*H*	*L*	*H*	*H*	*L*	*M*
CLO-5 :	*Evaluate ethical rules that apply to Artificial Intelligent Systems*		*3*	*M*	*M*		*M*	*H*	*M*	*M*	*M*	*H*	*H*	*H*	*H*	*H*	*L*	*H*	*H*	*L*	*M*

Duration (hour)		*6*	*6*	*6*	*6*	*6*
S-1	SLO-1	*What is hard for Artificial Intelligence*	The Argument for a Singularity	*Introduction to theory of ethics that form the basis of ethical review of Artificial Intelligence*	*Risks in the business of Artificial Intelligence*	*Application Areas of Artificial Intelligence*
	SLO-2	*Science and Fiction on Artificial Intelligence*	The Intelligence Explosion Without Intelligence	Descriptive Ethics, Normative Ethics	*General Business Risks*	*Ethical Issues related to Artificial Intelligence Enhancement*
S-2	SLO-1	Ethics in Machine Learning and Other Domain-Specific *Artificial Intelligence* Algorithms	Obstacles to the Singularity	Meta-ethics, Applied Ethics	*Ethical Risk of Artificial Intelligence*	*Ethical Issues related to Robots and Healthcare*
	SLO-2	Artificial General Intelligence	Negotiating the Singularity	Relationship Between Ethics and Law	*Managing Risk of Artificial Intelligence*	*Telemedicine*
S-3	SLO-1	Machines with Moral Status Minds with Exotic Properties	Internal Constraints: Constraining Values	Machine Ethics	*Business Ethics for Artificial Intelligence Companies*	*Artificial Intelligence in Education*
	SLO-2		External Constraints: The Leakproof Singularity	*Responsibility and Liability in case of Artificial Intelligence Systems*	*Risk of Artificial Intelligence to workers*	*Forecasting student performance*
S 4	SLO-1	Super Intelligence	Uploading and Consciousness	*Case Study 1: Crash of Autonomous Vehicles*	*Psychological Aspects of Artificial Intelligence*	*Autonomous Vehicles – Current Situation, Ethical Benefits*
	SLO-2		Uploading and Personal Identity	*Case Study 2: Mistargeting by an Autonomous Weapon*		*Ethical Questions in Autonomous vehicles*
S-5	SLO-1	*Benefits and risks of Artificial Intelligence*	Integration into a Post-Singularity World	*Strict Liability*	*Privacy Issues of Artificial Intelligence*	*Military Uses of Artificial Intelligence*
	SLO-2			*Complex Liability*		Ethical Arguments for and Against AI for Military Purposes

S-6	**SLO-1**	*Trust and Fairness of in Artificial Intelligence Systems*	Uploading and Consciousness	*Artificial Intelligence Assisted Ethics*	*Application Areas of Artificial Intelligence*	*Ethics in Artificial Intelligence and Robotics: A Strategic Challenge*
	SLO-2	*Ethical Principles for Trustworthy and Fair Artificial Intelligence*	Uploading and Personal Identity			

Learning Resources	1. N. Bostrom and E. Yudkowsky. 'The ethics of artificial intelligence'. In W. M. Ramsey and K. Frankish, editors, The Cambridge Handbook of Artificial Intelligence, pages 316–334. Cambridge University Press, Cambridge, 2014 2. Christoph Bartneck Christoph Lutge Alan Wagner Sean Welsh, "An Introduction to Ethics in Robotics and AI", SPRINGER BRIEFS IN ETHICS 3. 'Benefits & risks of artificial intelligence', Future of Life Institute 4. 'Top 9 ethical issues in artificial intelligence', World Economic Forum, 21 Oct 2016 5. Chalmers, D. (2010). The singularity: A philosophical analysis. Journal of Consciousness Studies, 17(9-1), 7-65. 6. Bostrom, N. (2012). The Superintelligent Will: Motivation and Instrumental Rationality in Advanced Artificial Agents. Minds & Machines 22: 71–85. 7. Binns, R. (2017). 'Algorithmic Accountability and Public Reason', Philosophy & Technology 8. Sparrow, R. (2007). 'Killer robots', Journal of Applied Philosophy, 24, 62–77 9. Autor, D. H. (2015), 'WhyArehere Still So Many Jobs? he History and Future of Workplace Automation', he Journal of Economic Perspectives, 29, pp. 3–30 10. Allen, C., Varner, G., Zinser, J. (2000) 'Prolegomena to any future artificial moral agent' Journal of Experimental & Theoretical Artificial Intelligence 12, 251–261 11. Nyholm, S. 'he ethics of crashes with self-driving cars: A roadmap, I' Philosophy Compass 13, e12507 12. Nyholm, S. 'he ethics of crashes with self-driving cars: A roadmap, II' Philosophy Compass 13, e12506 13. Korsgaard, K. M. (2004). 'Fellow Creatures: Kantian Ethics and Our Duties to Animals', in The Tanner Lectures on Human Values, Grethe B. Peterson (ed.), Volume 25/26, Salt Lake City: University of Utah Press

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
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 Industry	Experts from Higher Technical Institutions	Internal Experts
Soundararajan Dhakshinamoorthy, Principle software Engineer, Technology Le OptumInsights India Pvt Ltd., Chennai	Dr. Lathaparthiban, Pondicherry University	Mrs. Anupama C G

Course Code	18MAB304T	Course Name	PROBABILITY AND APPLIED STATISTICS	Course Category	BS	Basic Sciences	L	T	P	C
							3	1	0	4

Pre-requisite Courses	18MAB201T	Co-requisite Courses	NIl	Progressive Courses	
Course Offering Department	Mathematics	Data Book / Codes/Standards	Statistical tables		

Course Learning Rationale (CLR):	The purpose of learning this course is:
CLR-1:	To apply the basic rules and theorems of probability theory such as Baye's theorem to determine probabilities that help to solve engineering problems and to determine the expectation and variance of a random variable from its distribution.
CLR-2:	To appropriately choose, define and/or derive probability distributions such as the Binomial, Poisson and Normal etc. to model and solve real life engineering problems.
CLR-3:	To Understand the principles of estimation theory and estimation techniques like maximum-likelihood estimate.
CLR-4:	To Learn the basic components of hypothesis testing and perform hypothesis tests on population means, variances and proportions.
CLR-5:	To understand how regression analysis can be used to develop an equation that estimates how two variables are related and how the analysis of variance procedure can be used to determine if means of more than two populations are equal.
CLR-6:	To comprehend the applications of probability and applied Statistics.

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering 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:	Pertain the Knowledge of probability concepts to determine probabilities that help to solve engineering problems and to determine the expectation and variance of a random variable from its distribution.	3	85	80	H	H	M	-	-	-	-	-	M	-	-	H	-	-	-
CLO-2:	Gain familiarity in deriving probability distributions such as the Binomial, Poisson and Normal etc. and apply them in the problems involving Science and Engineering.	3	85	80	H	H	-	M	M	-	-	-	M			H	-	-	-
CLO-3:	Demonstrate competency in Consistency, efficiency and unbiasedness of estimators and method of maximum likelihood estimation.	3	85	80	H	H	-	M	-	-	-	-	M			H	-	-	-
CLO-4:	Acquire knowledge in formulating and testing hypotheses about means, variances and proportions.	3	85	80	H	H	M	M	-	-	-	-	M		M	H	-	-	-
CLO-5:	Getting the knowledge of Regression analysis, ANOVA and apply them in real life the problems in Science and Engineering.	3	85	80	H	H	M	H	-	-	-	-	M		H	H	-	-	-
CLO-6:	The students should have the ability to use the appropriate and relevant, fundamental and applied mathematical and statistical knowledge, methodologies and modern computational tools.	3	85	80	H	H	M	M	-	-	-	-	M		M	H	-	-	-

		Module 1	Module 2	Module 3	Module 4	Module 5
Duration (hour)		12	12	12	12	12
S-1	SLO-1	Probability concepts, types of events	Discrete distributions - Introduction	Introduction to Estimation	Sampling Distributions – Type I and Type II errors	Correlation and its Properties

	SLO-2	Axioms and theorems	Binomial Distribution - M.G.F of Binomial Distribution	Point estimation	Small and large samples	Karl Pearson's coefficient of correlation
S-2	SLO-1	Conditional probability Baye's theorem – without proof	Mean and Variance of Binomial Distribution	Criteria for good estimates (un-biasedness)	Testing of Hypothesis	Spearman's rank correlation coefficient
	SLO-2	Applications of Baye's Theorem.	Mean and Variance of Binomial Distribution	Criteria for good estimates (un-biasedness)	Large sample test-Test of significance for single proportion	Problems on rank correlation – non-repeated ranks
S-3	SLO-1	Random variables – Discrete case	Fitting a Binomial distribution	Criteria for good estimates (consistency)	Test of significance for difference of proportions	Problems on repeated ranks
	SLO-2	Probability Mass function	Fitting a Binomial distribution	criteria for good estimates (consistency)	More problems on single and difference of proportions	Linear Regression lines and Properties
S-4	SLO-1	Problem solving using Computing Technologies	Problem solving using Computing Technologies	Problem solving using Computing Technologies	Problem solving using Computing Technologies	Problem solving using Computing Technologies
	SLO-2	Problem solving using Computing Technologies	Problem solving using Computing Technologies	Problem solving using Computing Technologies	Problem solving using Computing Technologies	Problem solving using Computing Technologies
S-5	SLO-1	Cumulative distribution function	Poisson Distribution - M.G.F of Poisson Distribution	Criteria for good estimates (efficiency)	Test of significance for single mean	Problems on regression coefficient
	SLO-2	Mathematical expectation –discrete case	Mean and Variance of Poisson Distribution	Criteria for good estimates (efficiency)	Test of significance for difference of means	More problems on regression coefficients
S-6	SLO-1	Variance	Fitting a Poisson distribution	Sufficient Statistic: Concept and examples	Small sample tests	Relation between correlation and regression
	SLO-2	Probability density function	Fitting a Poisson distribution	Sufficient Statistic: Concept and examples	Student's t- test for single mean	problems on relation between correlation and regression
S-7	SLO-1	Cumulative distribution function	Geometric distribution-M.G.F, mean and variance	Complete sufficiency and their application in estimation	't' test for the difference of means	Applications of regression in engineering
	SLO-2	Mathematical expectation-continuous case	Memory less property	Complete sufficiency and their application in estimation	More problems on t- test	Applications of regression in engineering
S-8	SLO-1	Problem solving using Computing Technologies	Problem solving using Computing Technologies	Problem solving using Computing Technologies	Problem solving using Computing Technologies	Problem solving using Computing Technologies
	SLO-2	Problem solving using Computing Technologies	Problem solving using Computing Technologies	Problem solving using Computing Technologies	Problem solving using Computing Technologies	Problem solving using Computing Technologies
S-9	SLO-1	Variance	Continuous distribution - Introduction	Methods of estimation	Fisher's F-test	Introduction to ANOVA Analysis of Variance – One-way Classification
	SLO-2	Raw Moments	Uniform distribution – MGF, Mean and Variance	Methods of estimation	Test of significance for two sample variances	Problems on one-way classification
S-10	SLO-1	Central Moments	Exponential distribution - MGF, Mean and Variance	Maximum likelihood estimation	Chi square test- for goodness of fit	More problems on one-way classification
	SLO-2	Moment generating function	Memory less property	Maximum likelihood estimation	Problems on goodness of fit	ANOVA – two-way classification
S-11	SLO-1	MGF- discrete random variable	Normal distribution	More examples based on maximum likelihood estimation	Chi square test- for independence of attributes	Problems on two-way classification
	SLO-2	MGF- continuous random variable	Problems on Normal distribution	More examples based on maximum likelihood estimation	More problems on Chi square test- for independence of attributes	More problems on two-way classification
S-12	SLO-1	Problem solving using Computing Technologies	Problem solving using Computing Technologies	Problem solving using Computing Technologies	Problem solving using Computing Technologies	Problem solving using Computing Technologies

	SLO-2	Problem solving using Computing Technologies	Problem solving using Computing Technologies	Problem solving using Computing Technologies	Problem solving using Computing Technologies	Problem solving using Computing Technologies
Learning Resources		1.S. Ross, A First Course in Probability,10th Ed., Pearson Education India, 2019. 2.Johnson. R.A., Miller & Freund's, Probability and Statistics for Engineers, 9th Edition, Pearson's Education, New Delhi, 2017. 3.Fundamentals of Statistics (Vol. I & Vol. II), A. Gun, M. k. Gupta and B.Dasgupta, World Press, 2016. 4.Vijay K. Rohatgi., A.K. Md. Ehsanes Saleh, An Introduction to Probability and Statistics, Third Edition, Wiley India Pvt. Ltd, 2015. 5.Jay L DeVore, Probability and Statistics for Engineering and the Sciences, 8th Edition, Cengage Learning India Pvt. Ltd, 2010. 6.Veerarajan T., Probability and Statistics, 3rd Edition, Tata McGraw-Hill, New Delhi, 2008.				

	Level of Thinking	Continuous Assessment				Final Examination (50%)
		CLAT– 1 (10%)	CLAT – 2 (15%)	CLAT – 3 (15%)	CLAT – 4 (10%) #	
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%

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

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. *Mr. V. Maheshwaran, Cognizant Technology Solutions*	*1. Prof. Y.V.S.S. Sanyasiraju, IIT Madras,* *2. Dr. K. C. Sivakumar, IIT, Madras*	*Dr. A. Govindarajan, SRMIST* *Dr. N. Parvathi, SRMIST* *Dr. R. Varadharajan, SRMIST* *Dr. B. Vijayakumar, SRMIST*

Course Code	18AIC301J	Course Name	Deep Learning Techniques	Course Category	C	Professional Core Courses	L	T	P	C
							3	0	2	4

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Artificial Intelligence	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 :	Illustrate the basic concepts of deep learning		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)		Engineering 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 :	Gain knowledge in Optimization algorithms and dimensionality reduction																				
CLR-3 :	Develop a broad understanding of word2vec models and Convolution Neural Network models																				
CLR-4 :	Acquire knowledge in Transfer learning and Sequential Models																				
CLR-5 :	Implement the attention mechanism and advanced deep learning models																				
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																				
CLO-1 :	Understand various deep learning models to solve real world problems		2	85	75		L	H	-	-	-	-	-	-	M	-	-	-	H	M	M
CLO-2 :	Compare the optimization algorithms and high dimensional data using reduction techniques		2	80	70		M	M	-	-	-	-	-	-	M	-	-	-	M	L	M
CLO-3 :	Implement word2vec models and Convolution Neural Network models		3	85	75		M	H	-	-	-	-	-	-	H	-	-	-	H	M	M
CLO-4 :	Apply RNN and transfer learning to real world scenarios		3	85	80		M	H	-	-	-	-	-	-	H	-	-	-	H	M	H
CLO-5 :	Use deep learning models to solve real-world applications		3	80	70		M	H	-	-	-	-	-	-	H	-	-	-	L	L	L

Duration (hour)		15	15	15	15	15
S-1	SLO-1	Biological neuron	Limitations of gradient descent learning algorithm	One hot representation of words	DenseNet Architecture	Language Modeling
	SLO-2	Motivation from biological neuron	Contour maps	Distributed representation of words	Transfer Learning	Image Captioning
S-2	SLO-1	McCulloch Pitts Neuron	Momentum based gradient descent	SVD for learning word representations	Need for Transfer Learning	Machine Translation
	SLO-2	Thresholding logic	Nesterov accelerated gradient descent	Continuous bag of words model	Deep Transfer Learning	Attention Mechanism
S-3	SLO-1	Perceptron	AdaGrad, RMSProp, Adam learning algorithm	Skip-gram model	Types of Deep Transfer learning	Attention over images
	SLO-2	Perceptron learning algorithm	Stochastic gradient descent	Hierarchical Softmax	Applications of Transfer learning	Hierarchical Attention
S 4-5 (LAB)	SLO-1	Apply MP Neuron and	Implement linear regression with	Implement skip gram model to	Transfer learning implementation	Neural Machine Translation with

	SLO-2	*perceptron to solve a binary classification problem*	*stochastic gradient descent.*	*predict words within a certain range before and after the current word.*	*using VGG16 model to classify images.*	*attention.*
S-6	SLO-1	*Proof of convergence of Perceptron learning algorithm*	*Mini-batch gradient descent*	*Introduction to Convolution Neural Networks*	*Sequence Learning Problems*	*Monte carlo Methods*
	SLO-2	*Representation power of a network of perceptrons*	*Bias Variance tradeoff*	*Kernel filters*	*Recurrent Neural Networks*	*Local Independencies in a Markov Network*
S-7	SLO-1	*Activation functions- Sigmoid, tanh, ReLU, leaky ReLU*	*Overfitting in deep neural networks*	*The convolution operation with filters*	*Backpropagation through time*	*Joint Distributions*
	SLO-2	*Sigmoid neuron*	*Hyperparameter tuning*	*padding and stride*	*Unfolded RNN*	*The concept of a latent variable*
S-8	SLO-1	*Gradient descent learning algorithm*	*Regularization: L2 regularization*	*Multiple Filters*	*The problem of exploding and vanishing Gradients*	*Restricted Boltzmann Machines*
	SLO-2	*Representation power of multilayer Network of Sigmoid Neurons*	*Dataset Augmentation and Early stopping*	*Max pooling and non-linearities*	*Seq to Seq Models*	*RBMs as Stochastic Neural Networks*
S 9-10 (LAB)	SLO-1	*Apply sigmoid neuron to solve a real-world classification / regression problem*	*Implement linear regression with stochastic mini-batch gradient descent and compare the results with previous exercise.*	*Implement LeNet for image classification*	*Building a RNN to perform Character level language modeling.*	*Case study on Scene Understanding using RBMs*
	SLO-2					
S-11	SLO-1	*Representation power of function: Complex functions in real world examples*	*Dimensionality reduction*	*Classic CNNs architecture- The ImageNet challenge*	*How gates help to solve the problem of vanishing gradients*	*Unsupervised Learning with RBMs*
	SLO-2	*Feedforward Neural Networks*	*Principal Component Analysis*	*Understanding Alex Net architecture*	*Long-Short Term Memory architectures*	*Setting up a Markov Chain for RBMs*
S-12	SLO-1	*Learning parameters, output and loss functions of FFN Networks*	*Singular value decomposition*	*ZFNet*	*Dealing with exploding gradients*	*Training RBMs using Gibbs Sampling*
	SLO-2	*Backpropagation learning algorithm*	*Autoencoders*	*The intuition behind GoogleNet*	*Gated Recurrent Units*	*Training RBMs using Contrastive Divergence*
S-13	SLO-1	*Applying chain rule across in a neural network*	*Relation between PCA and Autoencoders*	*Average pooling*	*Introduction to Encoder Decoder Models*	*Generative Adversial Networks- Architecture*
	SLO-2	*Computing partial derivatives w.r.t a weight*	*Regularization in Autoencoders*	*Residual CNN-ResNet architecture*	*Applications of Encoder Decoder Models*	*Generative Adversial Networks- Applications*
S 14-15 (LAB)	SLO-1	*Build a FFN Network to solve a Multi- class classification problem*	*Optimizing neural networks using L2 regularization, Dropout, data augmentation and early stopping.*	*Implement ResNet for detecting Objects.*	*Build a LSTM network for Named Entity recognition.*	*Case study on generating examples for Image dataset using Generative Adversial Networks*
	SLO-2					

Learning Resources	*1.Charu C. Aggarwal, Neural Networks and Deep Learning, Springer, 2018.* *2.Eugene Charniak, Introduction to Deep Learning, MIT Press, 2018.* *3.Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, MIT Press, 2016.* *4.Michael Nielsen, Neural Networks and Deep Learning, Determination Press, 2015.* *5.Deng & Yu, Deep Learning: Methods and Applications, Now Publishers, 2013.*

Learning Assessment			
	Bloom's	Continuous Learning Assessment (50% weightage)	Final Examination (50% weightage)

	Level of Thinking	CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		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	Experts from Higher Technical Institutions	Internal Experts
Dr. Marriappan Vaithilingam, Senior Director of Engineering, Fresh works	Dr. Lathaparthiban, Pondicherry University	Dr.S.K.Lavanya, SRMIST

Course Code	18AIC302J	Course Name	Web programming for Artificial Intelligence	Course Category	C	Professional Core Courses	L	T	P	C
							3	0	2	4

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

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

			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)		Engineering 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
CLR-1 :	Understand the fundamental elements of HTML CSS to build a web application																				
CLR-2 :	Learn the fundamentals of client-side validation using JavaScript, jQuery, and AJAX																				
CLR-3 :	Understand the application of different JavaScript framework																				
CLR-4 :	Learn the Architecture and development of MVC model using Django																				
CLR-5 :	Understand the principle and practices for Web Scrapping																				
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																				
CLO-1 :	Design dynamic websites that meet specified needs and interests which is write well-structured, easily maintained, standards-compliant, accessible HTML code.		3	80	75		H	H	H		H			L	M	M	L	M	M	M	H
CLO-2 :	Design a dynamic web page with validation using JavaScript objects, AJAX and by applying different event handling mechanisms		3	80	80		H	H	H		H			L	M	M	L	M	M	M	H
CLO-3 :	Design Application using java script frameworks		3	75	80		H	H	H		H			L	M	M	L	M	M	M	H
CLO-4 :	Design Dynamic HTTP API using Django		3	75	80		H	H	H		H			L	M	M	L	M	M	M	H
CLO-5 :	Create scrappers to extract contents from web documents		3	75	75		H	H	H		H			L	M	M	L	M	M	M	H

Duration (hour)		15	15	15	15	15
S-1	SLO-1	HTML CSS: Web Fundamentals- Languages for the Web	Java Script: Introduction	Frameworks - Introduction	Django - MVC: Web Frameworks	Introduction - Web Crawling Strategies
	SLO-2		Basic Syntax – Structure of JS			
S-2	SLO-1	HTML Basics	Data Types - Variables	Angular JS - Introduction	Python Django - Introduction	Creating Basic Scraper using scrapy
	SLO-2	HTML Building Blocks	Control Structures	Expression		
S-3	SLO-1	Tables, Forms and its	Arrays	Modules	MVC Architecture	Creating Basic Scraper using scrapy

	SLO-2	*elements*	*Functions*	*Data Binding*		
S4-S5	SLO-1	*Lab1 : Demonstrate the various HTML Controls*	*Lab4: Validating the Web site using JS*	*Lab7: Validating the Web site using Angular JS*	*Lab10: Simple website using Django Framework*	*Lab13; Simple Web scrapper*
	SLO-2					
S 6	SLO-1	*Frames, iFrame*	*Java Script Events*	*Events*	*Environment Setup - Project Structure*	*Extracting data from pages*
	SLO-2			*Controllers - Filters*		
S-7	SLO-1	*HTML5 Controls*	*DOM Handling*	*Services*	*Building Block Django*	*Storing and process Documents and Requests*
	SLO-2		*JQuery Introduction*	*Validations*		
S-8	SLO-1	*CSS and its Types*	*Selectors*	*Node js – Introduction*	*Example Django Project*	*Storing and process Documents and Requests*
	SLO-2	*Box Model*	*Events*	*Node Core-*		
S9-s10		*Lab2 : Styling the page using different Style sheet approaches*	*Lab 5: Demonstration of Various Java Script Events*	*Lab8: Validation of Server side application using Node js*	*Lab 11: Creating a website using MVC pattern*	*Lab 14 : Illustration of information extraction using web scrapper*
S-11	SLO-1	*Page Layout*	*Effects*	*Node - modules*	*Building HTTP APIs With Django REST Framework*	*Techniques for extracting Data*
	SLO-2	*CSS Selectors*	*DOM Manipulation*			
S-12	SLO-1	*Styling Web Page -*	*AJAX – Introduction -Asynchronous - XMLHTTPRequest*	*File System*	*Databases using Django*	*Crawling Multiple Pages*
	SLO-2	*Responsive Design -*		*Automation and Deployment*		
S-13	SLO-1	*CSS Frameworks - Introduction*	*Working of AJAX request*	*Automation and Deployment*	*Databases using Django*	*Example Web Scrapper*
	SLO-2	*Bootstrap*	*Example AJAX Request*			
S-14-S15	SLO-1	*Lab3 : Creation of web page using Simple Bootstrap*	*Lab6 : Forwarding the Client Request using AJAX*	*Lab 8: Deployment of web application using frameworks*	*Lab12 : Integration of Database to Django project*	*Lab 5: Creation of web scrapper Application*
	SLO-2					

Learning Resources	1. *HM Deitel-Deitel & Associates, Inc. Internet & world wide web: How to program. Pearson Education India, 2007.* 2. *JavaScript; 6th Edition; Sasha Vodnik and Don Gosselin; Cengage Learning; 2015 (ISBN 978-1-305-07844-4)* 3. *Felke-Morris, Terry. Basics of web design: HTML5 & CSS3. Pearson, 2014.;* 4. *Dayley, Brad, Brendan Dayley, and Caleb Dayley. Learning Angular: A Hands-on Guide to Angular 2 and Angular 4. Addison-Wesley Professional, 2017.* 5. *Mead, Andrew. Learning Node. js Development: Learn the fundamentals of Node. js, and deploy and test Node. js applications on the web. Packt Publishing Ltd, 2018.* 6. *Wandschneider, Marc. Learning Node. js: a hands-on guide to building Web applications in JavaScript. Addison-Wesley Professional, 2016.* 7. *Python Django Web Development: The Ultimate Django web framework guide for Beginners Kindle Edition by Willian Jordon* 8. *https://www.scrapingbee.com/blog/crawling-python/#web-crawling-with-scrapy* 9. *https://www.digitalocean.com/community/tutorials/how-to-crawl-a-web-page-with-scrapy-and-python-3*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		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	Experts from Higher Technical Institutions	Internal Experts
Dr. Marriappan Vaithilingam, Senior Director of Engineering, Fresh works	Dr. Lathaparthiban, Pondicherry University	Mr.C.Arun, SRM Institute of Science and Technology

Course Code	18AIC303T	Course Name	Formal Languages and Automata Theory	Course Category	C	Professional Core Courses	L	T	P	C
							3	0	0	3

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

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

			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)		Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design,	Modern Tool Usage	Society & Culture	Environment &	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLR-1 :	Utilize the mathematics and engineering principles for the basics of Formal Language and Acquire knowledge of Finite Automata.		1	2	3		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-2 :	Acquire knowledge of Context free Grammar and simplify using normal forms																				
CLR-3 :	Gain knowledge to push down automata and apply it with CFL																				
CLR-4 :	Analyze the methods of turning machine design.																				
CLR-5 :	Understand the methods of computational complexity																				
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																				
CLO-1 :	Acquire the knowledge of mathematics and engineering principles for the basics of Formal Language and design Finite Automata with Regular Language		1	75	80		M	H	H	H	L	-	-	-	L	L	-	H	-	-	-
CLO-2 :	Acquire knowledge of Context free Grammar and simplify using normal forms		1	80	80		M	H	M	H	L	-	-	-	M	L	-	H	-	-	-
CLO-3 :	Understand the concepts of CFL and push down automata.		1	75	80		M	H	H	H	L	-	-	-	M	L	-	H	-	-	-
CLO-4 :	Apply the knowledge to turning machine design and its construction methods.		3	80	80		H	H	H	H	L	-	-	-	M	L	-	H	-	-	-
CLO-5 :	Analyze the computational and acceptor machines using FA, PDA and Turing machines and their complexities.		3	80	75		L	H	-	H	L	-	-	-	L	L	-	H	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Introduction to Automaton	Regular Expressions	Pushdown Automata: Definitions Moves	Turing Machines: Introduction	Undecidability: Basic definitions
	SLO-2	Mathematical concepts	Problems related to regular expressions	Instantaneous descriptions	Formal definition of Turing machines, Instantaneous descriptions	Decidable problems
S-2	SLO-1	Formal Languages: Strings, Languages, Properties	Regular Languages : Equivalence of Finite Automata and Regular Languages	Deterministic pushdown automata	Turing Machine as Acceptors	Examples of undecidable problems and Problems
	SLO-2	Finite Automata :Deterministic Finite Automata	Problems related to Equivalence of Finite			

			Automata and Regular Languages and Regular Grammars			
S-3	**SLO-1**	*Deterministic Finite Automata*	*Properties of Regular Languages: Closure Properties*	*Problems related to DPDA*	*Problems related to turning machine as Acceptors*	*Rice's Theorem*
	SLO-2	*Problems related to Deterministic Finite Automata*				
S 4	**SLO-1**	*Nondeterministic Finite Automata*	*Pumping Lemma, problems on pumping Lemma*	*Non - Deterministic pushdown automata*	*Turing Machine as a Computing Device*	*Undecidable problems about Turing Machine- Post's Correspondence Problem*
	SLO-2			*Problems related to NDPDA*		
S-5	**SLO-1**	*Finite Automaton with Є-moves*	*Grammars: Introduction: Types of Grammar*	*Pushdown automata to CFL Equivalence*	*Problems related to turning Turing Machine as a Computing Device*	*Problems related to Post's Correspondence Problem*
	SLO-2	*Problems related to Nondeterministic Finite Automata*	*Context Free Grammars and Languages*	*Problems related to Equivalence of PDA to CFG*		
S-6	**SLO-1**	*Finite Automaton with Є-moves*	*Derivations, Ambiguity*	*CFL to Pushdown automata Equivalence*	*Techniques for Turing Machine Construction*	*Properties of Recursive and Recursively enumerable languages*
	SLO-2	*Problems related to Finite Automaton with Є- moves*	*Problems related to Context free Grammar*			
S-7	**SLO-1**	*Equivalence of NFA and DFA*	*Simplification of CFG: Elimination of Useless Symbols, Simplification of CFG : Unit productions*	*Problems related to Equivalence of CFG to PDA*	*Considering the state as a tuple Considering the tape symbol as a tuple*	*Introduction to Computational Complexity: Definitions*
	SLO-2	*Problems related Equivalence of NDFA and DFA*	*Simplification of CFG : Null productions*		*Checking off symbols*	*Time and Space complexity of TMs*
S-8	**SLO-1**	*Equivalence of NDFA's with and without Є- moves*	*Problems related to Simplification of CFG*	*Pumping lemma for CFL*	*Modifications of Turing Machine*	*Complexity classes: Class P, Class NP*
	SLO-2	*Problems related Equivalence of NDFA's with and without Є-moves*	*Chomsky normal form, Problems related to CNF*		*Multi-tape Turing Machine*	*Complexity classes: Introduction to NP Hardness*
S-9	**SLO-1**	*Minimization of DFA*	*Greiback Normal form*	*Problems based on pumping Lemma*	*Non-Deterministic Turing Machine*	*NP Completeness*
	SLO-2	*Problems related to Minimization of DFA*	*Problems related to GNF*			

Learning Resources	*1.Hopcroft J.E., Motwani R. and Ullman J.D, "Introduction to Automata Theory, Languages and Computations", Third Edition, Pearson Education, 2008.* *2.Michael Sipser, "Introduction to the Theory of Computation" Third Edition, Cengage Learning, 2013.* *3.P. Linz.Introduction to Formal Languages and Automata, 6th edition, Jonesand Barlett Learning, 2017* *4.Kamala Krithivasan, Rama.R," Introduction to Formal Languages, Automata Theory and Computation", Pearson Education India, 01-Sep-2009.* *5.John.C.Martin, "Introduction to Languages and the Theory of Computation" McGraw-Hill Education, 2010.*

Learning Assessment						
	Bloom's Level of	Continuous Learning Assessment (50% weightage)				Final Examination (50% weightage)
		CLA – 1 (10%)	CLA – 2 (15%)	CLA – 3 (15%)	CLA – 4 (10%)#	

	Thinking	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
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 Industry	Experts from Higher Technical Institutions	Internal Experts
Mr. Soundararajan Dhakshinamoorthy, Principle Software Engineer,Technology Leadership, Optum Insights India Pvt Ltd., Chennai.	*Dr. Udendran, Dept. of CSE., Bharathidasan University, Tiruchirappalli*	Mr. S. Joseph James, SRMIST

Course Code	18AIP101L	Course Name	MOOC 1 (To be undergone in the prescribed semester only as per the curriculum)	Course Category	P	Project Work, Seminar, Internship In Industry / Higher Technical Institutions (P)	L	T	P	C
							0	0	2	1

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Artificial Intelligence	Data Book / Codes/Standards	As exposed to during the duration of internship		

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1 :	Provide an exposure to the students on the practical application of theoretical concepts in an industry or research institute

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:
CLO-1 :	Gain confidence to carry out supervisory, managerial, and design roles in an industrial context.

Learning Assessment			
Continuous Learning Assessment	Assessment tool	Final review	
	Weightage	Training Report	Presentation *
		75%	25%

*Student has to be present for the presentation for assessment. Otherwise, it will be treated as non-appearance for the examination with final grade as 'Ab'

Course Code	18AIP102L	Course Name	Industrial Training 1 (To be undergone in the prescribed semester only as per the curriculum)	Course Category	P	Project Work, Seminar, Internship In Industry / Higher Technical Institutions (P)	L	T	P	C
							0	0	2	1

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Artificial Intelligence	Data Book / Codes/Standards	As exposed to during the duration of internship		

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1 :	Provide an exposure to the students on the practical application of theoretical concepts in an industry or research institute

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:
CLO-1 :	Gain confidence to carry out supervisory, managerial, and design roles in an industrial context.

Learning Assessment			
Continuous Learning Assessment	Assessment tool	Final review	
	Weightage	Training Report	Presentation *
		75%	25%

*Student has to be present for the presentation for assessment. Otherwise, it will be treated as non-appearance for the examination with final grade as 'Ab'

Course Code	18AIP103L	Course Name	*Seminar 1 (To be undergone in the prescribed semester only as per the curriculum)*	Course Category	*P*	*Project Work, Seminar, Internship In Industry / Higher Technical Institutions (P)*	L	T	P	C
							0	0	2	1

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Artificial Intelligence*	**Data Book / Codes/Standards**	*As applicable*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1 :	*Identify an area of interest within the program or a related one (multidisciplinary), carry out a literature survey on it, gain understanding and present the same before an audience.*

Course Learning Outcomes (CLO):	**At the end of this course, learners will be able to:**
CLO-1 :	*Carry out a self-study of an area of interest and communicate the same to others with clarity.*

Learning Assessment			
Continuous Learning Assessment	Assessment tool	Presentation	
	Weightage	Presentation material	Presentation skills / ability to answer questions / understanding of the topic*
		60%	40%

*Student has to be present for the presentation for assessment. Otherwise it will be treated as non-appearance for the examination with final grade as 'Ab'

Course Code	18AIC304J	Course Name	Reinforcement Learning Techniques	Course Category	C	*Professional Core Courses*	L	T	P	C
							2	0	2	3

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

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

			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)		1 Engineering Knowledge	2 Problem Analysis	3 Design & Development	4 Analysis, Design, Research	5 Modern Tool Usage	6 Society & Culture	7 Environment &	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
CLR-1:	*Introduce a range of topics related to Reinforcement Learning and probability concepts*																				
CLR-2:	*Gain knowledge on Markov Decision Process*																				
CLR-3:	*Understand the dynamic programming methods of RL*																				
CLR-4:	*Know about the Monte Carlo Prediction and Time Difference Learning*																				
CLR-5:	*Gain knowledge on Function Approximation methods and Q-learning*																				
Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*																				
CLO-1:	*Understand different terminologies of RL and Concepts of Probability*		*2*	*85*	*75*		*M*	*L*	*-*	*-*	*L*	*-*	*-*	*-*	*-*	*-*	*-*	*H*	*H*	*H*	*H*
CLO-2:	*Illustrate Markov Decision Process and Bellman Equation for learning*		*2*	*75*	*70*		*H*	*H*	*M*	*M*	*M*	*-*	*-*	*-*	*-*	*-*	*-*	*H*	*H*	*H*	*H*
CLO-3:	*Apply dynamic programming techniques on Markov decision process and Monte Carlo methods*		*2*	*80*	*70*		*H*	*H*	*M*	*M*	*M*	*-*	*-*	*-*	*-*	*-*	*-*	*L*	*H*	*H*	*H*
CLO-4:	*Implement Time difference Learning for real world problems*		*2*	*80*	*70*		*H*	*H*	*M*	*M*	*M*	*-*	*-*	*-*	*-*	*-*	*-*	*M*	*H*	*H*	*H*
CLO-5:	*Apply Approximation methods of learning and Q-Learning Technique*		*2*	*75*	*70*		*H*	*H*	*M*	*M*	*M*	*-*	*-*	*-*	*-*	*-*	*-*	*M*	*H*	*H*	*H*

Duration (hour)		*15*	**15**	*15*	*15*	*15*
S-1	**SLO-1**	*Introduction to Reinforcement Learning*	*Markov Decision Process*	*Overview of dynamic programing for MDP*	*Monte Carlo Prediction*	*Getting started with the function approximation methods*
	SLO-2	*Examples*	*The Agent–Environment Interface*		*Monte Carlo Estimation of Action Values*	
S-2	**SLO-1**	*Elements of Reinforcement Learning - Limitations and Scope*	*Goals and Rewards– Returns*	*Definition and formulation of planning in MDPs*	*Monte Carlo Control*	*Revisiting risk minimization*
	SLO-2		*Unified Notation for Episodic and Continuing Tasks*			*gradient descent from Machine Learning*

S-3	**SLO-1**	*Tic-Tac-Toe example*	*The Markov Property*	*principle of optimality*	*Off-policy Prediction via Importance Sampling*	*Gradient MC and Semi-gradient TD(0) algorithms*
	SLO-2	*History of Reinforcement Learning*	*Markov Decision Processes*	*Policy Evaluation*	*Incremental Implementation*	
S 4-5 (LAB)	**SLO-1**	*LAB 1: Installation of Code Standards and Libraries used in RL (Python/Keras/Tensorflow)*	*LAB 4: Dynamic programming algorithms for solving MDPs.*	*Lab 7: Monte Carlo Prediction*	*Lab 10: Q-Learning (Off Policy TD Learning)*	*Lab 13: Policy Gradient: REINFORCE with Baseline*
	SLO-2					
S-6	**SLO-1**	*Probability concepts*	*Value Functions*	*Policy Improvement*	*Off-Policy Monte Carlo Control*	*Linear Methods*
	SLO-2	*Axioms of probability*				
S-7	**SLO-1**	*Concepts of random variables*	*Optimal Value Functions*	*Policy Iteration*	*Temporal-Difference Learning: TD Prediction*	*Eligibility trace for function approximation*
	SLO-2					
S-8	**SLO-1**	*PMF, PDFs, CDFs, Expectation*	*Optimality and Approximation*	*Value Iteration*	*Advantages of TD Prediction Methods*	*Control with function approximation*
	SLO-2				*Optimality of TD(0)*	
S 9-10 (LAB)	**SLO-1**	*Lab 2: Implement Tic-tac-toe problem*	*Lab 5: Dynamic Programming: Policy Evaluation and Policy Iteration*	*Lab 8: Monte Carlo Off-Policy Control with Importance Sampling*	*Lab 11:Q-Learning with Linear Function Approximation*	*Lab 14: Policy Gradient: Actor Critic with Baseline*
	SLO-2					
S-11	**SLO-1**	*Concepts of joint and multiple random variables*	*Bellman expectation equations*	*Generalized Policy Iteration*	*TD(1)*	*Least squares, Experience replay in deep Q-Networks*
	SLO-2			*Efficiency of Dynamic Programming*	*TD(λ)*	
S-12	**SLO-1**	*joint, conditional and marginal distributions*	*Bellman optimality equations*	*Banach fixed point theorem*	*Sarsa: On-Policy TD Control*	*Naive REINFORCE algorithm*
	SLO-2	*Correlation and independence*				*Bias and variance in Reinforcement Learning*
S-13	**SLO-1**	*An-Armed Bandit Problem*	*Markov Reward Process*	*proof of convergence of policy evaluation and value iteration algorithms*	*Q-Learning: Off-Policy TD Control*	*Actor–Critic Methods*
	SLO-2	*Action-Value Methods.*			*unified view of DP, MC and TD evaluation methods*	
S 14-15 (LAB)	**SLO-1**	*Lab 3: Implement Armed Bandit Problem*	*Lab 6:Dynamic Programming: Policy Improvement and Value Iteration*	*Lab 9: SARSA (On Policy TD Learning)*	*Lab 12: Deep Q-Learning for Atari Games*	*Lab 15: Policy Gradient: Actor Critic with Baseline for Continuous Action Spaces*
	SLO-2					

Learning Resources	1. Richard S. Sutton and Andrew G. Barto, "Reinforcement learning: An introduction", Second Edition, MIT Press, 2019 2. Algorithms for Reinforcement learning, by Csaba Szepesvari, Morgan & Claypool Publishers, 2010. 3. Probability, Statistics, and Random Processes for Electrical Engineering, 3rd Edition, Alberto Leon-Garcia, 2009 4. "Machine Learning: A Probabilistic Perspective", Kevin P. Murphy, 2012

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		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	Experts from Higher Technical Institutions	Internal Experts
Mr. Soundararajan Dhakshinamoorthy, Principle Software Engineer, Technology Leadership, Optum Insights India Pvt Ltd., Chennai.	*Dr. Udendran, Dept. of CSE., Bharathidasan University, Tiruchirappalli*	Mr. S. Joseph James, SRMIST

Course Code	18AIC305T	Course Name	*Inferential Statistics and Predictive Analytics*	Course Category	*C*	*Professional Core Courses*	L	T	P	C
							2	0	0	2

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

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

CLR-1 :	To introduce inferential statistics and descriptive statistics		1	2	3		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-2 :	To understand elements of probability and various distribution functions																				
CLR-3 :	To perform hypothesis testing																				
CLR-4 :	*To analyze data using different techniques mentioned in the course*																				
CLR-5 :	*To infer the results of various predictive analytics models*																				
Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)		Engineering 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 :	Demonstrate knowledge of inferential statistics and descriptive statistics		*1*	*85%*	*80%*		*M*	*M*	*M*	-	*L*	*H*	*H*	*H*	*H*	*H*	*L*	*H*	*H*	*L*	*L*
CLO-2 :	Choose appropriate techniques for the tasks.		*1*	*80%*	*75%*		*M*	*H*	*M*	-	*M*	*H*	*H*	*H*	*H*	*H*	*L*	*H*	*H*	*L*	*M*
CLO-3 :	*Interpret the results, gain insight and recommend possible actions.*		*2*	*85%*	*80%*		*M*	*M*	*M*		*M*	*H*	*H*	*H*	*H*	*H*	*L*	*H*	*H*	*L*	*M*
CLO-4 :	*Measure model performance with appropriate metrics measurements.*		*2*	*85%*	*80%*		*M*	*H*	*M*	-	*M*	*H*	*H*	*H*	*H*	*H*	*L*	*H*	*H*	*L*	*M*
CLO-5 :	*Analyze data using different techniques mentioned in the course.*		*3*	*80%*	*75%*		*M*	*H*	*M*	-	*M*	*H*	*H*	*H*	*H*	*H*	*L*	*H*	*H*	*L*	*M*

Duration (hour)		*6*	*6*	*6*	*6*	*6*
S-1	**SLO-1**	*Introduction to statistics: Data Collection and Descriptive statistics*	Elements of Probability	Distributions of Sampling Statistics	*Simple Linear Regression*	*Predictive Analytics Models*
	SLO-2	*Inferential Statistics and Probability Models*		Central limit Theorem		*Challenges and limitations*
S-2	**SLO-1**	Populations and Samples	Conditional Probability	Sample variance	*Multiple Linear Regression*	*Case Study:*
	SLO-2	A Brief History of Statistics	Bayes Formula and Bayesian Analysis	Sample Distributions from a Normal population and a finite population		*Classification predictive analytics model*
S-3	**SLO-1**	Introduction to Descriptive Statistics: Describing Datasets	*Random Variables: Types*	Hypothesis testing	*Analysis of Variance (ANOVA)*	*Case Study:*
	SLO-2		Jointly Distributed Random Variables	*Significance Levels*	*One Factor Analysis of Variance (ANOVA)*	*Clustering predictive analytics model*

S 4	**SLO-1**	Summarizing Datasets	Expectation	*Tests concerning the mean of a normal population*	*Two factor Analysis of Variance (ANOVA)*	*Case Study:*
	SLO-2		*Variance and covariance*	*Case Study*		*Forecasting predictive analytics model*
S-5	**SLO-1**	*Chebyshev's Inequality*	Special random Variables: Bernoulli and Binomial Random Variables	*Testing the equality of means of two normal population*	*Two-way analysis of variance with interaction*	*Case Study:*
	SLO-2		*Poisson, Hypergeometric, Uniform, Normal and Exponential random Variables*	*Case Study*		*Outliers predictive analytics model*
S-6	**SLO-1**	*Normal Datasets*	*The Gamma Distributions*	*Hypothesis testing concerning variance of a population*	*Goodness of fit tests*	*Case Study:*
	SLO-2	*Paired Datasets and the Sample Correlation Coefficient*	*Distributions arising from the Normal, Logistics Distributions*			*Time series predictive analytics model*

Learning Resources	1. Ross, Sheldon M. Introduction to probability and statistics for engineers and scientists. Academic Press, 2020. 2. Siegel, Eric. Predictive analytics: The power to predict who will click, buy, lie, or die. Vol. 10. Hoboken: Wiley, 2013. 3. *Cordoba, Alberto. Understanding the predictive analytics lifecycle. John Wiley & Sons, 2014.* 4. *Geraghty, M. Inferential Statistics and Hypothesis Testing, A Holistic Approach. Supplementary Material for an Introductory Lower Division Course in Probability (2014).* 5. *Asadoorian, Malcolm O., and Demetrius Kantarelis. Essentials of inferential statistics. University Press of America, 2005.* 6. *Gravetter, Frederick J., Larry B. Wallnau, Lori-Ann B. Forzano, and James E. Witnauer. Essentials of statistics for the behavioral sciences. Cengage Learning, 2020.* 7. *Kuhn, Max, and Kjell Johnson. Applied predictive modeling. Vol. 26. New York: Springer, 2013.*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
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 Industry	Experts from Higher Technical Institutions	Internal Experts
Mr. Soundararajan Dhakshinamoorthy, Principle software Engineer Technology Leadership Optum Insights India Pvt Ltd.,Chennai	Dr. S. Muthuraj Kumar, Anna University	Dr. A. Alice Nithya, SRMIST

Course Code	18AIC306J	Course Name	Design of Artificial Intelligence Products	Course Category	C	Professional Core	L	T	P	C
							2	0	2	3

Pre-requisite Courses	Artificial Intelligence, Machine Learning, Deep Learning	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Artificial Intelligence	Data Book / Codes/Standards	Nil		

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

		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	1 Engineering	2 Problem Analysis	3 Design &	4 Analysis, Design,	5 Modern Tool Usage	6 Society & Culture	7 Environment &	8 Ethics	9 Individual & Team	10 Communication	11 Project Mgt. & Finance	12 Life Long Learning	13 PSO - 1	14 PSO - 2	15 PSO – 3
CLR-1 :	Understand the fundamental concepts of Design of AI products																		
CLR-2 :	Explore the concepts of AI applied to issues in medical field and to develop solution model																		
CLR-3 :	Explain the dynamics of Gaming and apply AI to optimize the possible outcome																		
CLR-4 :	To learn the Artificial Intelligence concepts required to build computer vision application																		
CLR-5 :	To explore the concepts, methods and application of Artificial Intelligence and Robotics																		
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																		
CLO-1 :	Explore principles related to AI Design and to develop AI products	3	85	80	H	H	H	H	L	-	-	-	-	-	-	H	H	M	M
CLO-2 :	Design and Develop AI based solution to Healthcare industry	3	85	80	H	H	H	H	H	L	L	L	M	-	-	H	H	H	H
CLO-3 :	Explore AI techniques to apply on Gaming to optimize the result	3	85	80	H	H	H	H	H	L	-	L	M	-	-	H	H	H	H
CLO-4 :	Develop practical skills necessary to build computer vision applications	3	85	80	H	H	H	H	H	L	-	-	M	-	-	H	H	H	H
CLO-5 :	Apply Artificial Intelligent techniques in Robotics	3	85	80	H	H	H	H	H	L	-	L	M	-	-	H	H	H	H

Duration (hour)		12	12	12	12	12
S-1	SLO-1	What is AI? Risks and Benefits of AI	Overview of Application of AI in Disease Management - Disease Prognosis and Diagnosis .	Introduction to single agent Reinforcement learning	Fundamentals of Vision, Image Formation	Robots & Its Hardware
	SLO-2	How can AI help in a creative process?	AI in Identification of Biomarker of Disease	Learning Structure	Images without lenses: The pinhole camera	Sensing the world
S-2	SLO-1	Types of intelligence - Narrow , General and Super intelligence	Public Data Repositories	Value function	Lens systems	Producing motion, What kind of problem is robotics solving
	SLO-2	Training AI with Design	Review of Artificial Intelligence Techniques on Disease Data	Optimal Value function	Scaled orthographic projection, Light and shading , Color	Robotic Perception
S 3-4 (LAB)	SLO-1	Data preprocessing and annotation - Creation of datasets	Case Study: Parkinson's Disease Prediction	Implement regression model and find Least Square	Install necessary Face Recognition library in Python	Study all the hardware components required for obstacle detection
	SLO-2	Study on how Google is using Machine Learning for the smart Gmail reply.	Performance Validation of the Model .	Check generalization ability of the model	Implement simple model for Face Recognition using ready library functions	Use simple IR sensors to detect the obstacles and program the robot to follow or avoid it
S-5	SLO-1	AI Characteristics & Design Principles	Personalized Medicine .	Markov Decision Processes	Simple Image Features – Edges, Texture, Optical flow	Localization and mapping
	SLO-2	Machine Learning, the first step to AI	Artificial Intelligence in Personalized Medicine .	Markov Reward Processes	Segmentation of natural images	Supervised and unsupervised learning in robot perception
S-6	SLO-1	Types Of Machine Learning	Models of Artificial Intelligence Used in Personalized Medicine .	Temporal Difference Learning	Classifying Images	Planning and Control, Motion planning, Trajectory tracking control

	SLO-2	*Supervised Machine Learning Algorithms*	*Naïve Bayes Model .*	*Q-Learning ,Eligibility Traces*	*Image classification with convolutional neural networks*	*Optimal control*
S 7-8 (LAB)	**SLO-1**	*Implement Binary classification algorithm by applying suitable supervised learning algorithm*	*Case Study: AI-based smart prediction of clinical disease using Naive Bayes Algorithm*	*Solve 3 X3 Grid world problem*	*Use ImageNet / Cifar 10 Data set. Implement a simple model to classify images*	*Study hardware components of Wifi based robot to control remote item.*
	SLO-2	*Analyze the accuracy of the model with the help of confusion matrix*	*Analyze the performance of the model*	*Implement 3 X 3 magic square game*	Analyze the performance of the model	*Develop Wifi based robot to control remote item.*
S-9	**SLO-1**	*Unsupervised Machine Learning Algorithms*	*Prediction of COVID-19 Using AI - ML and AI in SARS-CoV-2 Treatment*	Matrix Games	Detecting Objects, *The 3D World*	*Planning Uncertain Movements*
	SLO-2	*Support Vector Machines*	*Forecasting Disease Using ML and AI Technology*	Nash Equilibria in Two-Player Matrix Games	*Using Computer Vision*	*Reinforcement Learning in Robotics*
S-10	**SLO-1**	*Hidden Markov Models*	*Methods Used in Predicting COVID-19*	*Gradient Ascent Algorithm*	*Understanding what people are doing, Linking pictures and words*	*Preference learning*
	SLO-2	*k-Means Clustering*	*Limitations of AI and ML in Healthcare*	*Policy Hill Climbing*	*Reconstruction from many views, Making pictures*	*Application Domains of Robots*
S11-12 (LAB)	**SLO-1**	*Analyze student performance using appropriate unsupervised machine learning algorithm*	*Case Study: Analyze history of covid cases and apply AI to predict the location which is more prone to covid attack*	*Simulate Grid game using suitable reinforcement approach.*	*Install Open CVV to implement project*	*Design Obstacle Detection Robot with Artificial vision*
	SLO-2	*Analyze the performance of the implemented model*	*Analyze the performance of the model*	*Analyze the results of the model*	Count total number of people present in picture using Open CVV	*Develop Autonomous Obstacle Detection Robot with Artificial vision*

Learning Resources	1. *Stuart J. Russell and Peter Norvig, Artificial Intelligence A Modern Approach, Fourth Edition, Pearson, 2020.* *2. Ankur Saxena, Shivani Chandra Artificial Intelligence and Machine Learning in Healthcare, Springer Nature Singapore, 2021* 1. *Howard M Schwartz, Multi-Agent Machine Learning: A Reinforcement Approach, ISBN: 978-1-118-36208-2, August 2014.* 2. *Joel Van Bodegraven, W.Artificial Intelligence Driven Design, awwwars.books, Brain Food, Volume 4.*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		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	Experts from Higher Technical Institutions	Internal Experts
Dr. Marriappan Vaithilingam, Senior Director of Engineering, Fresh works	*Dr. Udendran, Dept. of CSE., Bharathidasan University, Tiruchirappalli*	Dr.A.Revathi, SRMIST

Course Code	18AIP104L	Course Name	MOOC 2 (To be undergone in the prescribed semester only as per the curriculum)	Course Category	P	Project Work, Seminar, Internship In Industry / Higher Technical Institutions (P)	L	T	P	C
							0	0	2	1

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Artificial Intelligence	Data Book / Codes/Standards	As exposed to during the duration of internship		

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1 :	Provide an exposure to the students on the practical application of theoretical concepts in an industry or research institute

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:
CLO-1 :	Gain confidence to carry out supervisory, managerial, and design roles in an industrial context.

Learning Assessment			
Continuous Learning Assessment	Assessment tool	Final review	
	Weightage	Training Report	Presentation *
		75%	25%

*Student has to be present for the presentation for assessment. Otherwise, it will be treated as non-appearance for the examination with final grade as 'Ab'

Course Code	18AIP105L	Course Name	Industrial Training 2 (To be undergone in the prescribed semester only as per the curriculum)	Course Category	P	Project Work, Seminar, Internship In Industry / Higher Technical Institutions (P)	L	T	P	C
							0	0	2	1

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Artificial Intelligence	Data Book / Codes/Standards	As exposed to during the duration of internship		

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1 :	Provide an exposure to the students on the practical application of theoretical concepts in an industry or research institute

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:
CLO-1 :	Gain confidence to carry out supervisory, managerial, and design roles in an industrial context.

Learning Assessment			
Continuous Learning Assessment	Assessment tool	Final review	
	Weightage	Training Report	Presentation *
		75%	25%

*Student has to be present for the presentation for assessment. Otherwise, it will be treated as non-appearance for the examination with final grade as 'Ab'

Course Code	18AIP106L	Course Name	Seminar 2 (To be undergone in the prescribed semester only as per the curriculum)	Course Category	P	Project Work, Seminar, Internship In Industry / Higher Technical Institutions (P)	L	T	P	C
							0	0	2	1

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Artificial Intelligence	Data Book / Codes/Standards	As applicable		

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1 :	Identify an area of interest within the program or a related one (multidisciplinary), carry out a literature survey on it, gain understanding and present the same before an audience.

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:
CLO-1 :	Carry out a self-study of an area of interest and communicate the same to others with clarity.

Learning Assessment			
Continuous Learning Assessment	Assessment tool	Presentation	
	Weightage	Presentation material	Presentation skills / ability to answer questions / understanding of the topic*
		60%	40%

*Student has to be present for the presentation for assessment. Otherwise it will be treated as non-appearance for the examination with final grade as ‘Ab’

Course Code	18AIP107L/18AIP108L	Course Name	Project(Phase-1)/Internship (4-6weeks)	Course Category	P	*Project Work, Seminar, Internship In Industry / Higher Technical Institutions (P)*	L	T	P	C
							0	0	6	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	Nil	Progressive Courses	*Nil*
Course Offering Department	*Artificial Intelligence*	**Data Book / Codes/Standards**	*As exposed to during the duration of training*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1 :	*Provide an exposure to the students on the practical application of theoretical concepts in an industry or research institute*

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*
CLO-1 :	*Gain confidence to carry out supervisory, managerial, and design roles in an industrial context.*

Learning Assessment			
Continuous Learning Assessment	Assessment tool	Final review	
	Weightage	Training Report	Presentation *
		75%	25%

*Student has to be present for the presentation for assessment. Otherwise it will be treated as non-appearance for the examination with final grade as 'Ab'

Course Code	18AIP109L /18AIP110L	Course Name	Project(Phase-1I)/Semester Internship	Course Category	*P*	*Project Work, Seminar, Internship In Industry / Higher Technical Institutions (P)*	L	T	P	C
							0	0	2	1

Pre-requisite Courses	*Nil*	Co-requisite Courses	Nil	Progressive Courses	*Nil*
Course Offering Department	*Artificial Intelligence*	**Data Book / Codes/Standards**		*As applicable*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1 :	*Identify an area of interest within the program or a related one (multidisciplinary), carry out a literature survey on it, gain understanding and present the same before an audience.*

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*
CLO-1 :	*Carry out a self-study of an area of interest and communicate the same to others with clarity.*

Learning Assessment			
Continuous Learning Assessment	Assessment tool	Presentation	
	Weightage	Presentation material	Presentation skills / ability to answer questions / understanding of the topic*
		60%	40%

*Student has to be present for the presentation for assessment. Otherwise it will be treated as non-appearance for the examination with final grade as 'Ab'

Course Code	18AIE321T	Course Name	Optimization Techniques	Course Category	E	Professional Elective Course	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Artificial Intelligence	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 :	Understand the fundamentals of mathematical usage in optimization techniques																				
CLR-2 :	Learn the types of optimization algorithms																				
CLR-3 :	Understand the principles of unconstrained optimization																				
CLR-4 :	Learn the usage of linear programming																				
CLR-5 :	Understand the constrained and unconstrained algorithms																				
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)		Engineering 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 :	Acquire the fundamentals of mathematical usage in optimization techniques		1	80	85		H	H	H	H	H	-	-	-	-	-	-	-	-	-	-
CLO-2 :	Understand the types of optimization algorithms		2	75	80		H	H	H	H	H	-	-	-	-	-	-	-	-	-	-
CLO-3 :	Acquire the principles of unconstrained optimization		1	85	80		H	H	H	H	H	-	-	-	-	-	-	-	-	-	-
CLO-4 :	Acquire the usage of linear programming		1	80	75		H	H	H	H	H	-	-	-	-	-	-	-	-	-	-
CLO-5 :	Acquire the knowledge on constrained and unconstrained algorithms		1	75	85		H	H	H	H	H	-	-	-	-	-	-	-	-	-	-

Duration (hours)		9	9	9	9	9
S-1	SLO-1	methods of proof and some notation	Basics of Set-Constrained and Unconstrained Optimization	Unconstrained Optimization and Neural Networks	Introduction to Linear Programming, A Brief History of Linear Programming	Nonlinear Constrained Optimization, Problems with Equality Constraints
	SLO-2	methods of proof and some notation	Basics of Set-Constrained and Unconstrained Optimization			
S-2	SLO-1	vector spaces and matrices, real vector spaces	One-Dimensional Search Methods,	Single-Neuron Training	Simple Examples of Linear Programs,	Problem Formulation, Tangent and Normal Spaces,
	SLO-2	rank of a matrix	Golden Section, Fibonacci Search		Two-Dimensional Linear Programs	Lagrange Condition
S-3	SLO-1	linear equations,	Newton's Method,	Backpropagation Algorithm	Convex Polyhedra and Linear Programming,	Second-Order Conditions,
	SLO-2	inner products and norms	Secant Method		Standard Form Linear Programs	Minimizing Quadratics Subject to Linear Constraints
S 4	SLO-1	transformations, linear transformations	Gradient Methods, The Method of Steepest Descent,	Genetic Algorithms	Basic Solutions, Properties of Basic Solutions,	Problems with Inequality Constraints, Karush-Kuhn-Tucker Condition,

	SLO-2	*eigenvalues and eigenvectors*	*Analysis of Gradient Methods*		*A Geometric View of Linear Programs*	*Second-Order Conditions*
S-5	SLO-1	*orthogonal projections, quadratic forms,*	*Newton's Method, Analysis of Newton's Method,*	*Basic Description*	*Simplex Method, Solving Linear Equations,*	*Convex Optimization Problems,*
	SLO-2	*matrix norms*	*Levenberg-Marquardt Modification*		*Using Row Operations*	*Convex Functions*
S-6	SLO-1	*concepts from geometry, line segments,*	*Newton's Method for Nonlinear Least-Squares*	*Chromosomes and Representation Schemes*	*The Canonical Augmented Matrix,*	*Convex Optimization Problems*
	SLO-2	*hyperplanes and linear varieties*		*,*	*Updating the Augmented Matrix*	
S-7	SLO-1	*convex sets, neighborhoods,*	*Conjugate Direction Methods, the Conjugate Direction Algorithm, The Conjugate Gradient Algorithm,*	*Selection and Evolution*	*The Simplex Algorithm,*	*Algorithms for Constrained Optimization*
	SLO-2	*polytopes and polyhedra*	*The Conjugate Gradient Algorithm for Non-Quadratic Problems*		*Matrix Form of the Simplex Method*	
S-8	SLO-1	*elements of calculus, sequences and limits,*	*Quasi-Newton Method, Approximating the Inverse Hessian, The Rank One Correction Formula,*	*Analysis of Genetic Algorithms*	*The Two-Phase Simplex Method,*	*Projections, Projected Gradient Methods*
	SLO-2	*differentiability*	*The DFP Algorithm, The BFGS Algorithm*		*The Revised Simplex Method*	
S-9	SLO-1	*the derivative matrix, differentiation rules,*	*Recursive Least-Squares Algorithm,*	*Real-Number Genetic Algorithms*	*Duality, Khachiyan's Method,*	*Penalty Methods*
	SLO-2	*Taylor series*	*Kaczmarz's Algorithm*		*Affine Scaling Method, Karmarkar's Method*	

Learning Resources	1. *Edwin K.P. Chong, Stanislaw H. Zak, An Introduction to Optimization, Wiley-Interscience, Second edition* 2. *Dimitri P. Bertsekas, Nonlinear Programming, MIT, Second Edition*

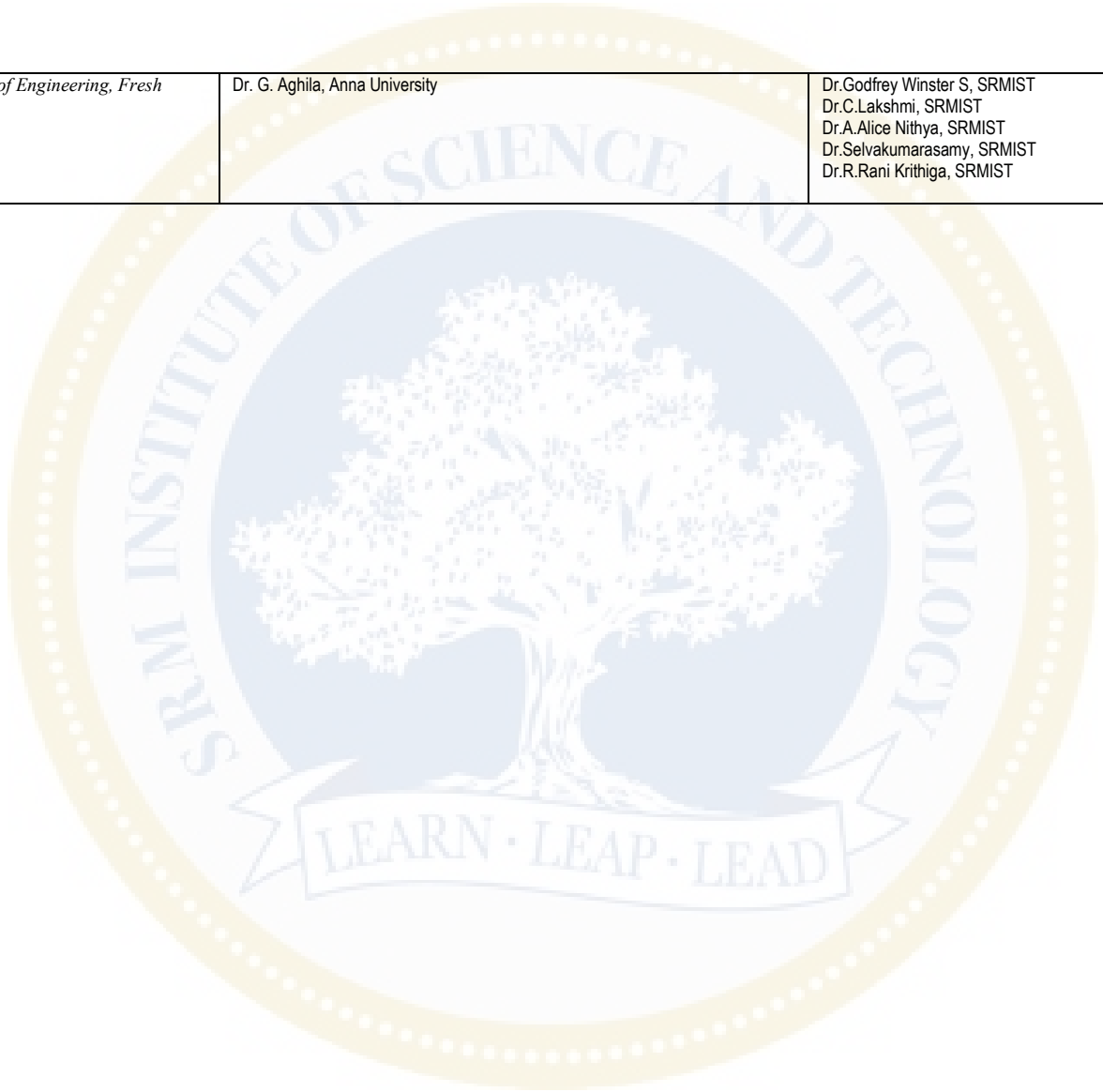
Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
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 Industry	Experts from Higher Technical Institutions	Internal Experts

Dr. Marriappan Vaithilingam, Senior Director of Engineering, Fresh works	Dr. G. Aghila, Anna University	Dr.Godfrey Winster S, SRMIST Dr.C.Lakshmi, SRMIST Dr.A.Alice Nithya, SRMIST Dr.Selvakumarasamy, SRMIST Dr.R.Rani Krithiga, SRMIST



Course Code	18AIE322T	Course Name	Stochastic Decision Making	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
CLR-1 :	Understand the basic concepts of the theory of stochastic decision processes	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-2 :	Understand the most important types of stochastic processes			
CLR-3 :	Understand the methods for describing and analyzing complex stochastic models.			
CLR-4 :	Understanding the notions of ergodicity, stationarity, stochastic integration for practical skills			
CLR-5 :	Understand the stochastic Integration and analyzing the queuing models			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning		
		1	2	3
CLO-1 :	Acquire the knowledge on the fundamentals of the theory of stochastic decision processes	2	80	85
CLO-2 :	Acquire the methods for describing and analyzing complex stochastic models.	2	75	80
CLO-3 :	Gain knowledge on Markov chains in real world scenarios.	2	85	80
CLO-4 :	Acquire the knowledge on notions of ergodicity, stationarity, stochastic integration practically	2	80	75
CLO-5 :	Acquire the knowledge on stochastic Integration and queuing models	2	75	85
		2	80	85

		Program Learning Outcomes (PLO)														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Engineering 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 :	Acquire the knowledge on the fundamentals of the theory of stochastic decision processes	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	Acquire the methods for describing and analyzing complex stochastic models.	H	H	-	-	H	-	-	-	-	-	-	-	-	-	-
CLO-3 :	Gain knowledge on Markov chains in real world scenarios.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	Acquire the knowledge on notions of ergodicity, stationarity, stochastic integration practically	-	H	-	-	H	-	-	-	-	-	-	-	-	-	-
CLO-5 :	Acquire the knowledge on stochastic Integration and queuing models	-	H	-	-	H	-	-	-	-	-	-	-	-	-	-
		-	H	-	-	H	-	-	-	-	-	-	-	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Introduction, Difference between deterministic and stochastic world	Definition of a Markov chain, Markovian property and Transition probabilities, Irreducibility and Steady-State probabilities.	Two definitions of a Brownian motion, The construction	Notion of ergodicity.	Application of the Itô formula to stochastic modelling
	SLO-2	Various fields of stochastics	Matrix representation of a Markov chain. Transition matrix.	Path properties	Notion of ergodicity examples	Ornstein-Uhlenbeck process. Application of the Itô formula to stochastic modelling.
S-2	SLO-1	Definition of a stochastic function and it types	Chapman-Kolmogorov equation	The Markov property	Ergodicity of wide-sense stationary processes	The Semi-Markov Decision Model
	SLO-2	Elementary problems	Calculation of n-step transition probabilities, limiting probabilities	The strong Markov property and applications	Ergodicity of wide-sense stationary processes	Algorithms for an Optimal Policy
S-3	SLO-1	Trajectories and finite-dimensional distribution	Classification of states, ergodicity, stationary distribution, transient MC	Continuous time martingales and applications	Definition of a stochastic derivative	Value Iteration and Fictitious Decisions

	SLO-2	Renewal process. Counting process	Random walk and gambler's ruin problem	The Skorokhod embedding	Continuity in the mean-squared sense	Optimization of Queues One-Step Policy Improvement
S-4	SLO-1	Convolution	Kolmogorov-Feller differential equations	Donsker's Theorem and applications	Stochastic integration	The M/G/1 Queue - The State Probabilities
	SLO-2	Calculation of an expectation of a counting process	Infinitesimal generator, Poisson process	From Markov chain to infinitesimal description	Different types of stochastic integrals.	The M/G/1 Queue - The Waiting-Time Probabilities
S-5	SLO-1	Limit theorems for renewal processes	birth-death process	Blackwell's example	Integrals of the type $\int f(t)\, dW_{t-1}$	The M/G/1 Queue - Busy Period Analysis
	SLO-2	Definition of a Poisson. Exact forms of the distributions of the renewal process and the counting process	Formulating arrival rates of a birth-death process	From infinitesimal description to Markov chain	Integrals of the type $\int f(t)\, dW_{t-1}$	The M/G/1 Queue - Work in System
S-6	SLO-1	Non-homogeneous Poisson processes	Formulating service rates of a birth-death process	Stationary measures, recurrence and transience	Ito formula	The GI /G/1 Queue GeneralizedErlangian Services
	SLO-2	Relation between renewal theory and non-homogeneous Poisson processes	Steady-state probabilities of a birth-death process	Two types of stationarity	(Stochastic) Integration by parts formula	Coxian-2 Services
S-7	SLO-1	Elements of the queuing theory. M/G/k systems	Stochastic Petri net, applications to queueing theory and communication networks.	Two types of stationarity	Stochastic differential equations	The GI /P h/1 Queue
	SLO-2	Compound Poisson processes	Applications of the Markov chains	Spectral density of a wide-sense stationary process	Diffusion processes	The P h/G/1 Queue
S-8	SLO-1	Stationary Processes: Weakly stationary processes	Random vector definition and main properties	Spectral density of a wide-sense stationary process	Ito processes	Two-moment Approximations
	SLO-2	Stationary Processes: Strongly stationary processes	Gaussian vector definition and main properties	Stochastic integration of the simplest type	Girsanov transformation	Multi-Server Queues with Poisson Input The M/D/c Queue
S-9	SLO-1	Moving average processes.	Connection between independence of normal random variables and absence of correlation	Moving-average filters	Black-Scholes model	The M/G/c Queue
	SLO-2	Auto regressive processes.	Definition of a Gaussian process. Covariance function	Moving-average filters	Vasicek model	The MX/G/c Queue

Learning Resources

1. *S.M. Ross, "Stochastic Processes", 2nd Edition, John Wiley & Sons, 1996.*
2. *S. Resnick, "Adventures in Stochastic Processes", Birkhauser, 1994.*
3. *A. Muller and D. Stoyan, "Comparison Methods for Stochastic Models and Risks", John Wiley & Sons 2002.*
4. *R.E. Barlow and F. Proschan, "Mathematical Theory of Reliability", 1965.*
5. *J. Medhi, Stochastic Processes,3rd Edition,NewAge International, 2009.*
6. *S Karlin and H M Taylor, A First Course in Stochastic Processes, 2nd edition, Academic Press, 1975.*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)				Final Examination (50% weightage)
		CLA – 1 (10%)	CLA – 2 (15%)	CLA – 3 (15%)	CLA – 4 (10%)#	

		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
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 Industry	Experts from Higher Technical Institutions	Internal Experts
1. Mr.V Vignesh, Team Leader, Tata Consultancy Services, ITPL, Bangalore	*1. Dr. Devi Kanniga, Jain University, Bangalore*	*Dr. V. Anbarasu, SRMIST*

Course Code	18AIE323T	Course Name	Information Theory and Coding	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	Define the basic concepts of information theory (entropy, channel capacity etc.)			
CLR-2 :	Llearn the principles and applications of information theory in communication systems			
CLR-3 :	Study various data compression methods and describe the most common such methods			
CLR-4 :	Understand various error control encoding and decoding techniques			
CLR-5 :	Understand the theoretical framework upon which error-control codes are built			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	Interpret the role of information theory and linear algebra in source coding and channel coding	2	80	85
CLO-2 :	Calculate entropy, joint entropy, relative entropy, conditional entropy, and channel capacity of a system	2	75	80
CLO-3 :	Differentiate between lossy and lossless compression techniques	2	85	80
CLO-4 :	Implement various error control techniques	2	80	75
CLO-5 :	Analyze the performance of error control codes	2	75	85
		2	80	85

Program Learning Outcomes (PLO)														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Engineering 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
H	H	M	-	M	-	L	-	-	-	-	M	L	M	L
M	L	M	-	M	-	L	-	-	-	-	M	L	M	L
M	H	M	-	M	-	L	-	-	-	-	M	L	M	L
M	H	M	-	M	-	L	-	-	-	-	M	L	M	L
M	H	M	-	M	-	L	-	-	-	-	M	L	M	L

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Introduction	Mutual Information	Shannon Fano coding	Image compression: READ, JPEG	RS codes
	SLO-2	Measure of information	Channel Capacity	Shannon Fano Elias coding	Video Compression: Principles-I,B,P frames	Burst error correction
S-2	SLO-1	Information content of message	Binary Symmetric Channel	Huffman coding	Motion estimation	Convolutional codes – Encoding and State
	SLO-2	Average Information content of symbols in Long Independent sequences	Binary Erasure Channel	Minimum variance Huffman coding	Motion compensation	Tree and Trellis diagrams
S-3	SLO-1	Average Information content of symbols in Long dependent sequences	Noise-Free Channel, Channel with independent I/O	Adaptive Huffman coding	H.261, MPEG standard	Maximum likelihood decoding of convolutional codes
	SLO-2	Markov Statistical Model of Information Sources	Cascaded channels	Arithmetic coding	Codes for error detection and correction	Maximum likelihood decoding of convolutional codes
S-4	SLO-1	Entropy and Information rate of Mark off Sources	repetition of symbols	Dictionary coding	Parity check coding	Viterbi algorithm

	SLO-2	Entropy: marginal, conditional, joint and relative entropies	Muroga's Theorem	LZ77, LZ78, LZW	Linear block codes	Viterbi algorithm
S-5	SLO-1	relation among entropies Mutual information	Binary asymmetric channel	ZIP coding	Error detecting and correcting capabilities	Sequential decoding
	SLO-2	information rate	Shannon theorem	Channel coding	Generator and Parity check matrices	Stack algorithm
S-6	SLO-1	channel capacity	Source coding – Encoding techniques	Channel coding theorem for DMC	Standard array and Syndrome decoding	Interleaving techniques
	SLO-2	redundancy and efficiency of channels	Purpose of encoding	Perceptual coding, Masking techniques	Hamming codes Cyclic codes	Block and convolutional interleaving
S-7	SLO-1	Communication Channels	Instantaneous codes	Psychoacoustic model	Generator polynomial	Coding and interleaving applied to CD digital audio system
	SLO-2	Channel Models	Construction of instantaneous codes	MEG Audio layers I,II,III, Dolby AC3	Generator and Parity check matrices	CIRC encoding and decoding
S-8	SLO-1	Channel Matrix	Kraft's inequality	Channel Vocoder	Encoding of cyclic codes	Interpolation and muting
	SLO-2	Joint probability Matrix	Coding efficiency and redundancy	Linear Predictive Coding	Syndrome computation and error detection	ARQ – Types of ARQ
S-9	SLO-1	Binary Symmetric Channel	Source coding theorem	Image and Video Formats – GIF, TIFF	Decoding of cyclic codes	Performance of ARQ
	SLO-2	System Entropies	Construction of basic source codes	SIF, CIF, QCIF	BCH codes	Probability of error and throughput

Learning Resources	1. *T. M. Cover, J. A. Thomas, "Elements of information theory", Wiley 2nd edition, 2006* 2. *Reza, "An Introduction to Information Theory", Dover Publications Kindle edition, 2012* 3. *R. W. Hamming, "Coding and information theory," Prentice Hall Inc, 1998* 4. *Gravano Salvatore, "Error Correcting Codes" , Oxford University Press, 2nd Ed., 2009*	5. *Ranjan Bose, "Information Theory and Coding", TMH, 2 nd Edition, 2009* 6. *R. Hill, "A First Course in Coding Theory", Oxford University Press, 1st Edition, 1990* 7. *R. J. McEliece, The Theory of Information and Coding, Cambridge Uinversity Press, Student edition (15 July 2004)* 8. *R. Togneri, C.J.S deSilva, Fundamentals of Information Theory and Coding Design, Taylor and Francis, 2003.*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
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 Industry	Experts from Higher Technical Institutions	Internal Experts
1. Ms.Aparna, Associate Consultant, Geetanjali Park, Tata Consultancy Services, Kolkata	*1. Dr. Senduru Srinivasulu, Associate Professor, Sathyabama Institute of sciences and Technology, Chennai*	*Dr. V. Anbarasu, Associate Professor, SRMIST*

Course Code	18AIE324T	Course Name	Cognitive Science & Analytics	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Artificial Intelligence	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 :	Understand the basic concepts of cognitive science Psychology and Neuroscience		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)		Engineering 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 :	State the role of Natural Language Processing in Cognitive Analytics and represent knowledge																				
CLR-3 :	Learn different tools and services of Cognalytics model																				
CLR-4 :	Describe business implications of Cognitive Science to build application																				
CLR-5 :	Learn future directions of Cognitive science and Analytics																				
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																				
CLO-1 :	Know foundations of Cognitive Science, Psychology and Neuroscience		3	85	80		H	M	M	M	-	L		M			M	M	H	M	M
CLO-2 :	Understand knowledge representation and role of Natural Language processing in Cognitive Analytics		3	85	80		H	H	H	H	M	M		M			M	M	H	M	M
CLO-3 :	Understand Online Analytical Processing Tools and its applications		3	85	80		H	H	H	H	H	M		M			H	M	H	H	H
CLO-4 :	Build cognitive based solution considering the business implications		3	85	80		H	H	H	H	H	M		M			H	M	H	H	H
CLO-5 :	Apply principles of cognitive analytics to different application domain		3	85	80		H	H	H	H	H	M		M			H	M	H	H	H

Duration (hour)		9	9	9	9	9
S-1	SLO-1	***Foundation of cognitive Science:*** *Cognitive Science- Interdisciplinary Endeavor*	***Role of NLP & Knowledge Representation*** *: Role of NLP in Cognitive System*	***Cognitive Analytics*** *: Evolution of Analytics - Multiple Perspectives*	***Business Implications & Building cognitive application*** *: Preparing for change*	***Applications of Cognitive Analytics*** *: Building cognitive health care application: Foundation*
	SLO-2	*Levels of Explanation*	*Importance of Context*	*Analytics Evolution*	*Advantages of new disruptive models*	*Constituents in healthcare ecosystem*
S-2	SLO-1	*How Psychology Is Organized*	*Connecting Words for Meaning*	*Data Warehouses and Data Marts*	*Knowledge meaning to business,*	*Learning from patterns in healthcare Data,*
	SLO-2	*How Neuroscience Is Organized*	*Understanding Linguistics*	*ROLAP, MOLAP, HOLAP*	*Difference with a cognitive systems approach*	*Cognitive applications across the health care eco system*
S-3	SLO-1	*The Challenge of Cognitive Science*	*Language Identification and Tokenization*	*Knowledge Discovery & Visual Analytics*	*Meshing data together differently*	*Starting with a Cognitive Application for Healthcare*
	SLO-2	*What Makes a System Cognitive?*	*Syntax and Syntactic Analysis*	*Cognitive Analytics*	*Using business knowledge to plan for the future*	*Using Cognitive Applications to Improve Health and Wellness*
S 4	SLO-1	*Gaining Insights from Data*	*Techniques for Resolving Structural Ambiguity*	*Types of learning*	*Answering business questions in new ways*	*Welltok's Solution*
	SLO-2	*Artificial Intelligence as the*	*Importance of Hidden Markov*	*Machine learning algorithms*	*Building business specific solutions*	*Enhance the Electronic Medical*

		Foundation of Cognitive Computing	*Models*			*Record using cognitive application*
S-5	**SLO-1**	*understanding cognition*	*Semantic Web*	*Cognitive Analytics – A Coveted Goal*	*Making cognitive computing a reality*	*Improve clinical teaching using cognitive application*
	SLO-2	*The Elements of a Cognitive System*	*Applying NLP Technologies to Business Problems*	*Architecture for Cognitive Analytics*	*Cognitive application changing the market*	*Cognitive Computing Applications in Education and Learning - Introduction*
S-6	**SLO-1**	*Data Analytics Services*	*Knowledge Representation*	*Implementing Cognalytics - Layer wise implementation*	*Process of Building a Cognitive Application - Emerging cognitive platform*	*Educational Data Mining*
	SLO-2	*Bringing Data into the Cognitive System*	*Defining Taxonomies and Ontologies*	*Data Integration tools- overview of High-Level Data Services Layer*	*Understanding intended users and their attributes*	*Learning Analytics*
S-7	**SLO-1**	*Machine Learning - Finding Patterns in Data*	*Explaining How to Represent Knowledge*	*Cognitive Analytics Layer*	*Defining the objective*	Architecture for personalized learning
	SLO-2	*Machine Learning Algorithms*	*Models for Knowledge Representation*	*Cognitive Analytics applications*	*Defining the domain*	*Sample Geometric word problem*
S-8	**SLO-1**	*Hypotheses Generation*	*Simple Trees*	*BCI and Assistive Technologies*	*Questions and exploring insights*	*Intelligent Tutoring Systems*
	SLO-2	*Hypothesis Scoring*	*The Semantic Web*	*New generation of BCI assistive devices*	*Creating and Refining the orpora*	*Clustering and Student Modeling*
S-9	**SLO-1**	*Presentation and Visualization Services*	*The Importance of Persistence and State*	*Hybrid BCI*	*Refining and Expanding the Corpora*	*Predicting Student Performance*
	SLO-2	*Infrastructure*	*Implementation Considerations*	*Current trends and Research issues in cognitive analytics*	*training and testing*	*Affect Detection and Student Engagement*

Learning Resources	1. *Judith Hurwitz, Marcia Kaufman, Adrian Bowles, Cognitive Computing and Big Data Analytics, Wiley Publications, 2015* 2. *Vijay V Raghavan,Venkat N.Gudivada, Venu Govindaraju, C.R. Rao, Cognitive Computing: Theory and Applications: Volume 35 (Handbook of Statistics),chapter 5&9, 2016* 3. *Jose Luis Bermúdez, Cognitive Science -An Introduction to the Science of the Mind, Cambridge University Press 2020*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40%*	-	*30%*	-	*30%*	-	*30%*	-	*v*	-
	Understand										
Level 2	Apply	*40%*	-	*40%*	-	*40%*	-	*40%*	-	*20%*	-
	Analyze										
Level 3	Evaluate	*20%*	-	*30%*	-	*30%*	-	*30%*	-	*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	Experts from Higher Technical Institutions	Internal Experts
Mr. Soundararajan Dhakshinamoorthy, Principle software Engineer, Tech Leadership, Optum Insights India Pvt Ltd., Chennai	Dr. G. Aghila, Anna University	Dr.A.Revathi, SRMIST

Course Code	18AIE325T	Course Name	Internet of Things Architecture and Protocols	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Artificial Intelligence	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 Architectural Overview of IoT		1	2	3		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-2 :	Learn the IoT Reference Architecture and RealWorld Design Constraints		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)		Engineering 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-3 :	Understand the various IoT Protocols (Datalink, Network, Service)																				
CLR-4 :	Know about the transport and session layer																				
CLR-5 :	Identify the application of IoT																				
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																				
CLO-1 :	Comprehend the importance of IoT and its model		3	80	70		H	-	-	H	M	-	-	-	M	L	-	H	-	-	-
CLO-2 :	Understand the different view of IoT Architecture and models		3	85	75		H	-	-	H	M	-	-	-	M	L	-	H	-	-	-
CLO-3 :	Analyze various IoT Protocols.		3	75	70		H	-	-	H	M	-	-	-	M	L	-	H	-	-	-
CLO-4 :	Apply IP based protocols and security protocols for IoT		3	80	80		H	-	-	H	M	-	-	-	M	L	-	H	-	-	-
CLO-5 :	Design IoT-based systems for real-world problems.		3	75	75		H	-	-	H	M	-	-	-	M	L	-	H	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Overview of IoT Architecture	State of the art architectures: European Telecommunications Standards Institute M2M/oneM2M-High level architecture, service capabilities	IoT protocol stack	Transport layer of IoT	Service layer of IoT
	SLO-2	Design principles and capabilities	European Telecommunications Standards Institute M2M/oneM2M-Interfaces and resource management	PHY/MAC Layer: 3GPP Machine type Communication	Transmission Control Protocol	One M2M protocol
S-2	SLO-1	IoT outline architecture	Architecture in the view of telecommunication sector	PHY/MAC Layer: IEEE 802.11	Multipath TCP	ETSI M2M high level architecture
	SLO-2	Standards considerations	IETF architecture, Open Geospatial Consortium architecture	IEEE 802.15	User Datagram Protocol	ETSI M2M standard

S-3	**SLO-1**	*Fundamentals of IoT and M2M devices: Devices and gateways*	*Archtevture and Reference model for IoT*	*Wireless HART*	*Datagram Congestion Control Protocol*	*Device Management*
	SLO-2	*Local and wide area networking*	*IoT domain model*	*ZWave,*	*Stream Control Transmission* Protocol	*Open Mobile Alliance*
S 4	**SLO-1**	*Managing data in IoT*	*Informational model*	*Bluetooth Low Energy*	*Transport layer security protocol*	*Application protocols for IoT*
	SLO-2	*Considerations for M2M data*	*Functional model: device and communication functional group*	*Zigbee Smart Energy,*	*Datagram Transport Layer Security*	*CPE WAN Management Protocol*
S-5	**SLO-1**	*Business processes in IoT*	*Functional model: IoT service, virtual entity, IoT service organization functional groups*	*DA SH7*	*Session layer in IoT*	*Embedded Binary HTTP*
	SLO-2	*Distributed business processes and considerations*	*Functional model: IoT process management, management, security, application and modular functional groups*	*Network Layer-IPv4, IPv6*	*Hyper Text Transfer Protocol*	*Simple Network Management Protocol*
S-6	**SLO-1**	*Every Thing as a Service*	*Communicational model*	*6LoWPAN*	*Constrained Application Protocol*	*Security monitoring of IoT communication using flows*
	SLO-2	*Deployment models*	*Security model*	*IPv6 over the TSCH mode of IEEE 802.15. 4*	*Security in COAP*	*Internet Protocol Flow Information Export*
S-7	**SLO-1**	*M2M and IoT Analytics*	*Functional view: device, communication, IoT service, virtual entity, IoT service organization functional group*	*Neighbor Discovery protocol*	*Extensible Messaging and Presence Protocol (XMPP)*	*Domain Name Systems*
	SLO-2	*Considerations and purpose*	*Functional view: : IoT process management, management, security, application and modular functional groups*	*Dynamic Host Configuration Protocol*	*Example application using XMPP*	*Network Time Protocol*
S-8	**SLO-1**	*Analytics Architecture*	*Information view: information description*	*Internet Control Message Protocol*	*Advanced Message Queuing Protocol (AMQP)*	*Remote access through SSH*
	SLO-2	*Methodology*	*Information flow and lifecycle, handling of information*	*Routing Protocol for LLN*	*AMQ model*	*Device Language Message Specification*
S-9	**SLO-1**	*Knowledge Management: Reference architecture*	*Deployment and operational view*	*Cognitive RPL*	Message Queuing Telemetry Transport (MQTT)	*MODBUS as IoT protocol*
	SLO-2	*Retrieval layer*	*Relevant architectures*	*Channel-Aware Routing Protocol*	*MQTT brokers*	*Modbus RTU and Modbus ASCII*

Learning Resources	1. *Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, StamatisKarnouskos, David Boyle, "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", 1st Edition, Academic Press, 2014.* 2. *Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6: The EvolvingWorld of M2M Communications", ISBN: 978-1-118-47347-4, Willy Publications ,2016*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
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 Industry	Experts from Higher Technical Institutions	Internal Experts
S.Karpagam, Tata Consultancy Services,Chennai	Prabha Selvaraj, School of Computer Science and Engineering, VIT-AP University, Amaravati, India	Dr.P.Kanmani, SRMIST

Course Code	18AIE326T	Course Name	Intelligent Autonomous Systems	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Artificial Intelligence	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 :	Understand the fundamentals of Robots		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)		Engineering 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 :	Learn the types of Robots																				
CLR-3 :	Understand the principles of Computer Vision																				
CLR-4 :	Learn the application of image matching																				
CLR-5 :	Understand the application Arm and mobile robot																				
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																				
CLO-1 :	Understand the fundamentals of Robots		2	80	85		H	H	H	-	L	-	-	-	-	-	-	L	L	-	L
CLO-2 :	Learn the types of Robots		2	75	80		H	H	H	-	L	-	-	-	-	-	-	L	L	-	L
CLO-3 :	Understand the principles of Computer Vision		2	85	80		H	H	H	-	L	-	-	-	-	-	-	L	M	-	M
CLO-4 :	Learn the application of image matching		2	80	75		H	H	H	-	L	-	-	-	-	-	-	L	M	-	M
CLO-5 :	Understand the application Arm and mobile robot		2	75	85		H	H	H	-	L	-	-	-	-	-	-	L	M	-	M

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Foundations - Representing Position and Orientation	Robot Arm Kinematics, Describing a Robot Arm, Forward Kinematics	Computer Vision - Light and Color, Spectral Representation of Light	Image Feature Extraction, Region Features	Vision-Based Control
	SLO-2	Representing Pose in 2-Dimensions	Inverse Kinematics	Color	Classification	Position-Based Visual Servoing
S-2	SLO-1	Representing Pose in 3-Dimensions	Trajectories	Color Constancy, White Balancing, Color Change Due to Absorption, Gamma	Representation	Image-Based Visual Servoing
	SLO-2	Time and Motion	Joint Angle Offsets	Image Formation	Description	Camera and Image Motion
S-3	SLO-1	Trajectories	Determining Denavit-Hartenberg Parameters	Camera Calibration, Homogeneous Transformation Approach	Line Features	Controlling Feature Motion

	SLO-2	*Time Varying Coordinate Frames*	*Modified Denavit-Hartenberg Notation*	*Decomposing the Camera Calibration Matrix*	*Point Features, Classical Corner Detectors*	*Depth, Performance Issues*
S 4	SLO-1	*Mobile Robot Vehicles*	*Application: Drawing*	*Pose Estimation, Camera Calibration Toolbox*	*Scale-Space Corner Detectors*	*Using Other Image Features*
	SLO-2	*Mobility*	*Application: a Simple Walking Robot*	*Non-Perspective Imaging Models, Fisheye Lens Camera*	*Using Multiple Images, Feature Correspondence*	*Line Features*
S-5	SLO-1	*Car-like Mobile Robots*	*Velocity Relationships, Manipulator Jacobian*	*Catadioptric Camera, Spherical Camera*	*Geometry of Multiple Views*	*Circle Features*
	SLO-2	*Flying Robots*	*Resolved-Rate Motion Control*	*Unified Imaging*	*The Fundamental Matrix*	*Advanced Visual Servicing*
S-6	SLO-1	*Navigation - Reactive Navigation*	*Force Relationships*	*Mapping Wide-Angle Images to the Sphere*	*The Essential Matrix, Estimating the Fundamental Matrix*	*XY/Z-Partitioned IBVS*
	SLO-2	*Map-Based Planning*	*Inverse Kinematics: a General Numerical Approach*	*Synthetic Perspective Images*	*Planar Homography*	*IBVS Using Polar Coordinates*
S-7	SLO-1	Localization	*Dynamics and Control*	*Image Processing, Obtaining an Image*	*Stereo Vision*	IBVS for a Spherical Camera
	SLO-2	*Dead Reckoning*	*Equations of Motion*	*Monadic Operations*	*Structure and Motion*	
S-8	SLO-1	*Using a Map*	*Drive Train*	*Diadic Operations*	*Structure and Motion*	*Arm-Type Robot*
	SLO-2	*Creating a Map*	*Forward Dynamics*	*Spatial Operations*	*Perspective Correction*	
S-9	SLO-1	*Localization and Mapping*	*Manipulator Joint Control*	*Mathematical Morphology*	*Mosaicing*	Mobile Robot
	SLO-2	*Monte-Carlo Localization*	*Rigid-Body Dynamics Compensation, Flexible Transmission*	*Shape Changing*	*Image Matching and Retrieval, Image Sequence Processing*	*Aerial Robot*

Learning Resources	1. Peter Corke, "Robotics, Vision and Control Fundamental Algorithms in MATLAB", Springer-Verlag Berlin Heidelberg 2011 2. Sebastian Thrun, Wolfram Burgard, Dieter Fox: Probabilistic Robotics. MIT Press, 2005

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
Level 2	Apply Analyze	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
Level 3	Evaluate Create	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-

	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	Experts from Higher Technical Institutions	Internal Experts
Dr. Marriappan Vaithilingam, Senior Director of Engineering, Fresh works	*Dr. Udendran, Dept. of CSE., Bharathidasan University, Tiruchirappalli*	Dr. S. Godfrey Winster, SRMIST

Course Code	18AIE327T	Course Name	INTELLIGENCE OF BIOLOGICAL SYSTEM	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

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

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

		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	1 Engineering 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
CLR-1 :	Introduce the basic concepts in cell biology																		
CLR-2 :	understanding about the basic cellular process																		
CLR-3 :	Design the basic concepts about the cell intelligence																		
CLR-4 :	Identify DNA to maintain various rhythms associated with the body.																		
CLR-5 :	State of the art computational algorithms to understand DNA encodings.																		
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																		
CLO-1 :	*Understand the challenges of* basic concepts in cell biology	1	80	70	H	L	L	M	H	L	M	H	-	-	-	-	L	M	L
CLO-2 :	*Analyze the* basic cellular process	1	85	75	L	H	M	M	-	L	M	L	-	-	-	-	L	M	L
CLO-3 :	*Identify the* basic concepts about the cell intelligence	1	85	75	H	M	-	L	-	L	L	H	L	-	L	L	L	L	M
CLO-4 :	*Design* DNA to maintain various rhythms associated with the body.	2	80	70	M	-	H	H	M	M	L	M	L	M	L	L	M	L	M
CLO-5 :	*Implementation* of the art computational algorithms to understand DNA encodings.	2	85	75	H	H	M	M	H	M	L	H	-	M	-	L	M	L	M

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Classification of biological macromolecules	DNA replication	Frequent words in Vibrio cholera	Bioinformatics downstream analysis-enrichment	Metabolic Modelling, Analysis and Protein Bioinformatics and Analysis
	SLO-2					
S-2	SLO-1	Cellular Structures	genome	encodings in DNA to maintain circadian rhythm	pathways,	Metabolite and protein networks/charts
	SLO-2					
S-3	SLO-1	Cellular Energy Production and Utilization	hidden messages in the genome	Hunting for Regulatory Motifs	Clustering and PCA.	protein sequences and 3D structure
	SLO-2					
S 4	SLO-1	The Cell Cycle and Cell Division	Python Programming for Bioinformatics	Motif Finding	transcriptomics and epigenomics	network analysis
	SLO-2					
S-5	SLO-1	Meiosis and Formation of Gametes	packages for Bioinformatics	Scoring Motifs	Overview of Available Databases, Resources, and Software. Alignment tools	pathways,
	SLO-2					

S-6	**SLO-1**	Protein Synthesis	Finding Replication Origins	Greedy Motif Search	Bioconductor	Modelling and flux analysis.
	SLO-2					
S-7	**SLO-1**	Gene Expression and Mutation	DnaA boxes	Randomized Motif Search	Github, IPA, STRING	Genome Alignment, Bioinformatics data processing
	SLO-2					
S-8	**SLO-1**	Evolution Patterns	Counting words	Gibbs Sampling	cytoscape, NAR databases	pipelines for RNA-seq, DNA methylation,
	SLO-2					
S-9	**SLO-1**	Evolution Patterns Processes	The Frequent Words Problem	Gibbs Sampling	tools, and software, Google Scholar	microRNA, ATAC-seq, and Chip-Seq
	SLO-2					

Learning Resources	1. Ryan Rogers, Cell and Molecular Biology for Environmental Engineers, Momentum Press Engineering, 2018. 2. Gabi Nindl Waite, Lee R. Waite, Applied Cell and Molecular Biology for Engineers, McGraw Hill Publishers, 2007. 3. Philip Compeau and PavelPevzener, Finding Hidden Messages in DNA, Active Learning Publishers 2015.

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
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 Industry	Experts from Higher Technical Institutions	Internal Experts
Dr. Marriappan Vaithilingam, Senior Director of Engineering, Fresh works	*Dr. Udendran, Dept. of CSE., Bharathidasan University, Tiruchirappalli*	Dr.S.Selvakumara Samy Mrs.Sasi Rekha Shankar

Course Code	18AIE328T	Course Name	Marketing Analytics	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*ARTIFICIAL INTELIGENCE*	**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 :	Apply their understanding to identify and measure the pricing of market and customer preference		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)		Engineering 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 :	Identify ways to analyse market data using various statistical methods to fix pricing																				
CLR-3 :	Perform consumer and market analytics to adopt ways to retain customers																				
CLR-4 :	Perform text and sentiment analysis to adapt recommendation engine for digital marketing																				
CLR-5 :	Analyse the social media analytics and its impact on pricing, marketing and privacy																				
Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*																				
CLO-1 :	Demonstrate knowledge and critical understanding of the role and value of information, performance measurement and customer / competitor insights in marketing.		1	*80*	*85*		*M*	*M*	*M*	*M*	*M*	-	-	-	*M*	*L*	-	*H*	*H*	*M*	*H*
CLO-2 :	Understand the organisational and discursive processes through which data is translated into marketing practices.		1	*75*	*80*		*H*	*H*	*H*	*H*	*H*	-	-	-	*H*	*L*	-	*H*	*H*	*H*	*H*
CLO-3 :	Use IT for marketing applications and to support information retrieval, data analysis and communication.		1	*85*	*80*		*M*	*H*	*M*	*H*	*M*	-	-	-	*M*	*L*	-	*H*	*M*	*H*	*M*
CLO-4 :	Explore the international and ethical dimensions of marketing analytics.		2	*80*	*75*		*M*	*H*	*M*	*H*	*M*	-	-	-	*M*	*L*	-	*H*	*M*	*H*	*M*

CLO-5 :	Explore the applications of various statistical and data mining techniques to predict market based on customer	2	75	85		H	H	H	H	H	-	-	-	H	L	-	H	H	H	H

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Introduction to marketing analytics, predictive analytics, and Big Data	Positioning	Consumer Analytics	Text Mining for marketing analysis	Social media analytics
	SLO-2					
S-2	SLO-1	What consumer wants	Causal inference with market data	Discrete Choice Models	Text Mining Algorithms for market analysis	Methodology: Interaction and control variables
	SLO-2	Basics of a statistical software package: How to import, clean, and manipulate data for analysis				Application: Social media analytics
S-3	SLO-1	Linear regression for prediction	Casual Inference - Methodology: Difference-in-differences Application: Various (focused more on methodology)	RFM Analysis	Sentiment Analytics for market analysis	Collaborative Filtering, Text Mining, and Marketing Analytics
	SLO-2					
S 4	SLO-1	Price elasticity and pricing strategy		Market Basket analysis	Pricing Analytics: New Product Pricing	
	SLO-2	Intertemporal dynamics				
S-5	SLO-1	Methodology: Empirical identification	Demand Forecasting and Pricing			Dynamic auctions

	SLO-2	Application: Price promotion		Customer Churn and Customer Lifetime Value	Recommendation Engine and retail analytics	
S-6	SLO-1	Dynamic pricing	Regression Basics Methodology: Coefficient interpretation, model building Application: Pricing & Advertising	Consumer Perception	Digital Analytics : Online Advertising Analytics	Methodology: Auctions, experiments
	SLO-2	Methodology: Model-building & optimization Application: Ride-sharing & seat-booking platforms				Application: Entertainment Venues
S-7	SLO-1	Interpretation & Consumer Segmentation	Dynamic pricing	Consumer Preference	Advertising models	Discrete choice models
	SLO-2					
S-8	SLO-1	Segmentation through customer analytics	Dynamic pricing - Methodology: Model-building & optimization Application: Ride-sharing & seat-booking platforms	Customer Portfolio Management	Causality and experimentation	Methodology: Logistic regression, logit choice model
	SLO-2					Application: Database marketing
S-9	SLO-1	Targeting through customer analytics	Marketing Mix Models	Customer Acquisition	Methodology: Causation, experiments	Information privacy and related ethical issues/implications
	SLO-2			Customer Retention	Application: Online A/B testing	

Learning Resources	1. *Lilien, Gary L., Arvind Rangaswamy, and Arnaud de Bruyn (2017), Principles of Marketing Engineering and Analytics, 3 rd edition, State College, PA: DecisionPro, Inc.* 2. *Ron Kohavi, Diane Tang, Ya Xu, Trustworthy Online Controlled Experiments: A Practical Guide to A/B Testing, Cambridge University Press, 2020.* 3. *Wayne L. Winston, Marketing Analytics: Data-Driven Techniques with Microsoft Excel, Wiley, 2014.* 4. *Mastering `Metrics – The Path from Cause to Effect, Joshua D. Angrist, Jorn-steffen Pischke, Princeton University Press, 2015.* 5. *Principles of Marketing Engineering, 2nd Edition, by Gary Lilien, Arvind Rangaswamy and Arnaud De Bruyn (DecisionPro, Inc. 2012), ISBN: 978-0985764807* 6. *Database Marketing: Analyzing and Managing Customers, by Robert C. Blattberg, Byung-Do Kim, and Scott A. Neslin (Springer, 2009), ISBN: 978-1441903327* 7. *Mike Grigsby, Marketing Analytics: A Practical Guide to Improving Consumer Insights Using Data Techniques, Kogan Page,2018*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
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 Industry	Experts from Higher Technical Institutions	Internal Experts
Soundararajan Dhakshinamoorthy, Principle software Engineer, Technology Leadership, OptumInsights India Pvt Ltd., Chennai	Dr. Lathaparthiban, Pondicherry University	Mrs.Sasi Rekha Sankar, SRMIST.

Course Code	18AIE329T	Course Name	INFORMATION RETRIEVAL	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

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

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

		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	1 Engineering Knowledge	2 Problem Analysis	3 Design & Development	4 Analysis, Design,	5 Modern Tool Usage	6 Society & Culture	7 Environment &	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
CLR-1 :	Understand the overview of Information Retrieval																		
CLR-2 :	Introduce students about insights of Boolean retrieval model, Vector space model, Latent semantic indexing, XML and Image retrieval model																		
CLR-3 :	Acquire comprehensive details about various Evaluation methods																		
CLR-4 :	Utilize the concept of information retrieval techniques																		
CLR-5 :	*Implement an overview of search strategy*																		
Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*																		
CLO-1 :	*Demonstrate the different information retrieval models*	*1*	*80*	*70*	*H*	*H*	*H*	*H*	*H*	*H*	*-*	*H*	*H*	*H*		*H*	*H*	*H*	*H*
CLO-2 :	*Design techniques to index and information retrieval*	*1*	*80*	*75*	*H*	*L*	*M*	*H*	*L*	*H*	*-*	*H*	*L*	*H*	*M*	*H*	*H*	*H*	*H*
CLO-3 :	*Analyze information retrieval models*	*2*	*85*	*75*	*H*	*H*	*H*	*H*	*H*	*H*	*-*	*H*	*L*	*H*	*M*	*H*	*H*	*H*	*H*
CLO-4 :	Apply information retrieval techniques	*2*	*80*	*70*	*H*	*H*	*H*	*H*	*H*	*M*	*-*	*H*	*L*	*H*	*M*	*H*	*H*	*H*	*H*
CLO-5 :	*Implement the search strategy concept*	*2*	*85*	*70*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*

Duration (hour)		Introduction to Information Retrieval, Dictionary and Postings	Tolerant Retrieval, Term Weighting and Vector Space Model	Text Classification and Text Clustering	Query Expansion and Feedback, Probabilistic Models	Latent Semantic Indexing, XML Indexing and Search, Content Based Image Retrieval
S-1	**SLO-1**	Information Retrieval Process	Wild card queries,	The text classification problem	Relevance feedback: Rocchio algorithm	Eigen vectors,
	SLO-2			Naive Bayes text classification		
S-2	**SLO-1**	Indexing	Permuterm index	k- nearest neighbors	Probabilistic relevance feedback	Singular value decomposition,
	SLO-2	Information Retrieval Model	Bigram index			
S-3	**SLO-1**	Boolean Retrieval Model	Spelling correction	Support Vector Machine	Probability ranking principle	Low rank approximation,
	SLO-2		Forms of Spelling Correction			
S 4	**SLO-1**	Boolean Model vs Ranked Retrieval	Edit distance	Feature Selection	Binary Independence Model	Problems with Lexical Semantics
	SLO-2					
S-5	**SLO-1**	Tokenization, stop words	Phonetic Correction	Vector Space Clustering	Bayesian network for text retrieval	Data vs. Text-centric XML,

	SLO-2					
S-6	SLO-1	Normalization	Precision, Recall,	K means Algorithm	Evaluation of relevance feedback strategies	Text-Centric XML retrieval, Structural terms
	SLO-2		F-measure, E-measure			
S-7	SLO-1	Stemming	Normalized recall,	Hierarchical Clustering	Pseudo relevance and indirect relevance feedback	Introduction to content Based Image retrieval, Challenges in Image retrieval,
	SLO-2	Lemmatization				
S-8	SLO-1	Positional Postings	Evaluation problems	DBSCAN algorithm	Query Expansion and its types,	Image representation
	SLO-2	Phrase Queries			Query drift	
S-9	SLO-1			PAM and PAMK	Global methods for Query reformulation	Indexing and retrieving images,
	SLO-2			EM Algorithm		Relevance feedback

Learning Resources	1. Christopher D. Manning, Prabhakar Raghavan and Hinrich Schütze, Introduction to Information Retrieval, Cambridge University Press. 2008. http://nlp.stanford.edu/IR-book/information-retrieval-book.html 2. Natural Language Processing And Information Retrieval by Tanveer Siddiqui and U. S. Tiwary 3. ChengXiang Zhai, Statistical Language Models for Information Retrieval (Synthesis Lectures Series on Human Language Technologies), Morgan & Claypool Publishers, 2008 4. http://www.morganclaypool.com/doi/abs/10.2200/S00158ED1V01Y200811HLT 001

earning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40%*		*30%*		*30%*		*30%*		*3%*	
	Understand										
Level 2	Apply	*40%*		*40%*		*40%*		*40%*		*40%*	
	Analyze										
Level 3	Evaluate	*20%*		*30%*		*30%*		*30%*		*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	Experts from Higher Technical Institutions	Internal Experts
Soundararajan Dhakshinamoorthy, Principle software Engineer, Technology Leadership, O India Pvt Ltd., Chennai	Dr. Lathaparthiban, Pondicherry University	Mrs. Anupama C G, SRMIST

Course Code	18AIE330T	Course Name	TEXT PROCESSING	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Compiler Design	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Artificial Intelligence	Data Book / Codes/Standards	Nil		

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

		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design.	Modern Tool Usage	Society & Culture	Environment &	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
CLR-1:	Learn the fundamentals of text language processing																		
CLR-2:	Understand the use of CFG and PCFG in NLP																		
CLR-3:	Design the role of semantics of sentences and pragmatics																		
CLR-4:	Apply the NLP techniques to IR applications																		
CLR-5:	Implement an application that uses different aspects of language text processing																		
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																		
CLO-1:	Apply text language processing and its basic algorithms	1	85	75	-	L	H	-	-	L	-	-	-	L	-	L	L	-	L
CLO-2:	Design the concepts of information retrieval	1	85	75	M	L	H	M	-	L	-	-	-	L	-	M	L	L	L
CLO-3:	Implement a rule-based system to tackle morphology/syntax of a language	2	85	75	M	L	M	-	-	L	-	M	-	L	-	M	L	L	L
CLO-4:	Understand a tag set to be used for statistical processing for real-time applications	2	80	70	M	L	H	M	-	L	-	M	-	L	-	M	L	L	L
CLO-5:	Compare and contrast the use of different statistical approaches for different types of NLP applications	2	85	75	-	L	H	M	-	L	-	M	-	L	-	M	L	L	L

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Natural Language Processing	Information Retrieval architecture	Categorization	Multilinguality	Machine Translation
	SLO-2	Linguistic Background				
S-2	SLO-1	Spoken language input and output Technologies	Indexing- Storage	Extraction based Categorization	Multilingual Information Retrieval and Speech processing	Transfer Metaphor
	SLO-2					
S-3	SLO-1	Written language Input	Compression Techniques	Clustering- Hierarchical Clustering	Multimodality	Interlingua and Statistical Approaches
	SLO-2					
S 4	SLO-1	Mathematical Methods	Retrieval Approaches	Document Classification and routing	Text and Images	Discourse Processing
	SLO-2					

S-5	**SLO-1** **SLO-2**	*Statistical Modeling and Classification Finite State methods Grammar for Natural Language Processing*	*Evaluation*	*Finding and organizing answers from Text search*	*Modality Integration*	*Dialog Agents*
S-6	**SLO-1** **SLO-2**	*Parsing*	*Search engines*	*Use of categories and clusters for organizing retrieval results*	*Transmission and Storage*	*Conversational Agents*
S-7	**SLO-1** **SLO-2**	*Semantic and Logic Form*	*Commercial search engine features*	*Text Categorization*	*Speech coding*	*Natural Language Generation*
S-8	**SLO-1** **SLO-2**	*Ambiguity Resolution*	*Performance Measures*	*Efficient Summarization using Lexical Chains*	*Evaluation of systems*	*Surface Realization*
S-9	**SLO-1** **SLO-2**	*Semantic Interpretation*	*Information Extraction*	*Pattern Extraction*	*Human Factors and user Acceptability*	*Discourse Planning*

Learning Resources	1. Daniel Jurafsky, James H. MartinSpeech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech, Pearson Publication, 2014. 2. Steven Bird, Ewan Klein and Edward Loper, Natural Language Processing with Pythonll, First Edition, OReilly Media, 2009. 3. Breck Baldwin, Language Processing with Java and LingPipe Cookbook, Atlantic Publisher, 2015. 4. Richard M Reese, Natural Language Processing with Javall, OReilly Media, 2015. 5. Nitin Indurkhya and Fred J. Damerau, Handbook of Natural Language Processing, Second Edition, Chapman and Hall/CRC Press, 2010. 6. Tanveer Siddiqui, U.S. Tiwary, Natural Language Processing and Information Retrieval, Oxford University Press, 2008 7. Michael W. Berry "Survey of Text Mining: Clustering, Classification and Retrieval", Springer Verlag, 2003.

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
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 Industry	Experts from Higher Technical Institutions	Internal Experts
Mr.Soundararajan Dhakshinamoorthy, Principle software Engineer, Technology Leadership, OptumInsights India Pvt Ltd., Chennai	Dr. Lathaparthiban, Pondicherry University	*Dr. A. Suresh, SRMIST* *Dr. M. Baskar, SRMIST* *Dr. J. Ramkumar, SRMIST*

Course Code	18AIE33IT	Course Name	Advanced Social, Text and Media Analytics	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

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

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

			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)		1 Engineering 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
CLR-1 :	Introduce the concept of social media analytics and understand its significance.																				
CLR-2 :	Gain knowledge in social media text analytics.																				
CLR-3 :	Develop skills on advanced social media data modeling for monitoring consumers, competitors and glean consumer insights.																				
CLR-4 :	Acquire knowledge in Social Tagging.																				
CLR-5 :	Empathize with the topics and semantics of the multimedia files in the context of network structure.																				
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																				
CLO-1 :	Understand the fundamentals of social media analytics.		1	80	80		M	M	M	M	M	-	-	-	M	L	-	H	H	M	H
CLO-2 :	Explore various approaches to mine text in social networks.		2	80	85		M	H	M	H	M	-	-	-	M	L	-	H	M	H	M
CLO-3 :	Apply various text analytics to social media.		3	85	80		H	H	H	H	H	-	-	-	H	L	-	H	H	H	H
CLO-4 :	Compare different user tagging techniques and its applications.		2	85	80		M	M	M	H	H	-	-	-	M	L	-	H	M	H	M
CLO-5 :	Analyze how multimedia datasets are organized in a structural way incorporating rich information such as semantic ontology and geographical maps.		3	80	85		M	H	H	H	H	-	-	-	H	L	-	H	H	M	M

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Data Identification- Looking for data in all the right places	Social Media	Text Mining in Social Networks Keyword search	An Overview of Social Tagging	Multimedia Information Networks in Social Media
	SLO-2	Attributes of data-Structure, Language, Region	Motivations for Data Mining in Social Media	Query Semantics and Answer Ranking	Problems with Metadata Generation and Fixed Taxonomies	Links from Semantics: Ontology-based Learning
S-2	SLO-1	Type of content, Venue, Time, Ownership of Data	Data Mining Methods for Social Media	Keyword search over XML and relational data	Folksonomies as a solution	Links from Community Media
	SLO-2	Casting a Net	Data Representation	Keyword search over graph data	Different User tagging motivations	Retrieval Systems for Community Media
S-3	SLO-1	Regular expressions	Data Mining-A process	Classification Algorithms	Kinds of Tags	Recommendation Systems for Community Media
	SLO-2	Looking for right subset of people-Sentiment, location,	Social Networking Sites	Clustering Algorithms	Categorizers vs Describers	Network of Personal Photo Albums-Actor centric Nature of personal

		Language, Age, Gender				*Collections*
S 4	**SLO-1**	*Profession, Eminence, Role, Specific People or Groups*	*The Blogosphere*	*Transfer Learning in Heterogenous Networks*	*Linguistic Classification of Tags*	*Quality Issues in Personal Collections*
	SLO-2	*Social Data: Structured Vs Unstructured*	*Ethnography and Netnography*	*Influence Related Statistics*	*Game-based Tagging*	*Time and Location Themes in Personal Collections*
S-5	**SLO-1**	*Social media as Big Data*	*Event Maps*	*Edge Measures*	*Tag Generation Models-Plya Urn Generation Model*	*Content Overlap in Personal Collections*
	SLO-2	*Identifying Data in Social Media: Professional Networking Sites*	*Text analytics in social media*	*Node Measures*	*Language Model*	*Network of Geographical Information-Semantic Annotation*
S-6	**SLO-1**	*Social sites, Information Sharing Sites*	*Distinct aspects of text in social media- A general framework for text analytics*	*Social Similarity and Influence*	*Tag analysis-Tagging distributions*	*Geographical Estimation*
	SLO-2	*Microblogging Sites*	*Time Sensitivity*	*Homophily*	*Identifying Tag Semantics*	*Inference Methods-Discriminative Vs Generative Models*
S-7	**SLO-1**	*Blogs/Wikis*	*Short Length*	*Existential Test for Social Influence*	*Tags Vs Keywords*	*Graph-based Inference: Ranking*
	SLO-2	*Predictive Vs Descriptive Analytics*	*Unstructured Phrases*	*Influence and Actions*	*Visualization of Tags-Tag Clouds for Browsing, Tag selection for Tag clouds*	*Clustering*
S-8	**SLO-1**	*Dimensions of Analysis: Depth of Analysis*	*Abundant Information*	*Influence and Interaction*	*Tag hierarchy generation, Tag clouds display format, Tag evolution visualization*	*Semi supervised Learning, Online Learning*
	SLO-2	*Machine capacity*	*Applying Text Analytics to social media-Event Detection*	*Influence Maximization in Viral Marketing*	*Tag recommendations- Using tag quality, Tag co-occurrences, Mutual information between words*	*Datasets and Industrial Systems*
S-9	**SLO-1**	*Domain of Analysis*	*Collaborative Question Answering, Social Tagging*	*Influence Maximization*	*Applications of Tags-Indexing, Search*	*Content-based Recommendation and Advertisements*
	SLO-2	*Velocity of Data*	*Bridging the Semantic Gap, Exploiting the Power of Abundant Information*	*Other applications*	*Taxonomy generation, Social Interesting Discovery, Enhanced Browsing*	*Multimedia Information Networks via Cloud Computing*

Learning Resources	1. *Charu. C. Agarwall, Social Network Data Analytics, Springer,2011.* 2. *Matthew Ganis, Avinash Kohirkar, Social Media AnalyticsTechniques and Insights for Extracting Business Value Out of Social Media, IBM Press, 2015.* 3. *Charu C. Aggarwal, ChengXiang Zhai. Mining Text Data,Kluwer Academic Publishers,2014.* 4. *Alex Gonçalves, Social Media Analytics Strategy Using Data to Optimize Business Performance, Apress, 2017.* 5. *Marshall Sponder, Social Media Analytics: Effective Tools for Building, Interpreting, and Using Metrics, Mc Graw Hill, 2014.* 6. *Siddhartha Chatterjee, Michal Krystyanczuk, Python Social Media Analytisc, Packt, 2017.* 7. *Gabor szabo, Gungor polatkan, Oscar boykin, Antonios Chalkiopoulos, Social Media Data Mining and Analytics,Wiley, 2018.* 8. *Arun Reddy Nelakurthi, Jingrui He, Social Media Analytics for User Behavior Modeling: A Task Heterogeneity Perspective, CRC Press, 2020.*

Learning Assessment						
	Bloom's Level of	Continuous Learning Assessment (50% weightage)				Final Examination (50% weightage)
		CLA – 1 (10%)	CLA – 2 (15%)	CLA – 3 (15%)	CLA – 4 (10%)#	

	Thinking	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
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 Industry	Experts from Higher Technical Institutions	Internal Experts
E Sampath Kumar, Senior Leader, TCS, Chennai	Dr. Priyanka Kokil, IIITDM, Kancheepuram	Dr.S.K.Lavanya, SRMIST.

Course Code	18AIE332T	Course Name	Image and Video Processing	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

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

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

		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering 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
CLR-1 :	Introduce the fundamentals of image processing and transforms																		
CLR-2 :	Discuss the concepts of image enhancement and restoration																		
CLR-3 :	Acquire knowledge on image compression and segmentation methods																		
CLR-4 :	Apply motion estimation methods in video processing																		
CLR-5 :	Utilize the concepts of image and video processing for practical applications																		
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																		
CLO-1 :	Demonstrate the basics of digital image processing fundamentals and transforms	1,2	80	70	L	-	-	M	-	-	-	-	-	-	-	H	M	-	-
CLO-2 :	Design 2D filters and apply it for image enhancement and restoration	3	85	70	H	H	-	H	H	-	-	-	-	-	-	H	M	-	H
CLO-3 :	Apply image compression and segmentation methods on digital images	3	80	70	M	H	-	H	H	-	-	-	-	-	-	H	-	-	H
CLO-4 :	Compile various motion techniques used in video coding	2	80	65	H	M	-	H	H	-	-	-	-	-	-	H	-	-	H
CLO-5 :	Implement the concepts of digital image, video processing and their applications	2,3	85	70	M	-	-	-	-	-	-	-	-	-	-	-	M	-	M

Duration (hour)		9	9	9	**9**	9
S-1	SLO-1	**Digital Image Fundamentals and Image Transforms :** *Fundamental steps in digital image processing*	**Image Enhancement and Restoratio:** *Spatial Domain methods: Histogram Processing*	**Image Segmentation and Compression :** *Image segmentation – detection of isolated points, line detection*	**Basic Steps of Video Processin:** *Analog video signals, standard*	**2D Motion Estimation:** *2D motion estimation – Optical flow – 2D motion vs. apparent motion*
	SLO-2	*Components of an image processing system*	*Histogram equalization, Matching*	*Edge models, Basic edge detection*	*Digital video signal, standard, Digital video processing*	*Correspondence and optical flow,*
S-2	SLO-1	*Structure of human eye, Image formation*	*Local Histogram Processing,*	*Thresholding*	*Time varying image formation models – 3D motion models*	*Occlusion problem*
	SLO-2	*Brightness adaptation and discrimination*	*Using histogram statistics for image enhancement*	*Local & Regional processing*	*Rigid motion in Cartesian*	*Aperture problem, 2D motion field models*

S-3	**SLO-1**	*Basic concepts in sampling and Quantization , Representing digital images*	*Fundamentals of Spatial Filtering, Smoothing Spatial filters*	*Region based segmentation – region growing*	*Homogenous coordinates*	*Block motion models- translational block motion*
	SLO-2	*Neighbors of a pixel, Adjacency, Connectivity, Regions and Boundaries*	*Smoothing linear filters*	*Region splitting and merging*	*Homogenous coordinates*	*Generalized/ Deformable block motion, Block matching criteria, Matching procedures*
S 4	**SLO-1**	*Distance Measures, A simple image formation model*	*Order statistics nonlinear filters*	*Spatial, frequency domain techniques*	*Deformable motion*	*Hierarchical motion estimation, Mesh based Motion Estimation*
	SLO-2	Color fundamentals and models.	*Sharpening spatial filters*	*Texture based segmentation*	*Geometric image formation*	*Gradient based optimization*
S-5	**SLO-1**	*Fourier transform of sampled functions*	*Combined spatial enhancement methods*	*Image Compression- Fundamentals of image compression*	*Perspective projection*	*Steepest Descent method*
	SLO-2	*Sampling theorem, Aliasing, Obtaining the DFT from the Continuous Transform of a Sampled Function*	*Frequency Domain methods: Basics of filtering in frequency domain*	*coding redundancy, spatial and temporal redundancy*	*Photometric image formation*	*Newton Raphson method, Transform coding*
S-6	**SLO-1**	*Properties of 2D DFT*	*image smoothing, image sharpening*	*Irrelevant information, measuring image information*	*Photometric effects of 3D motion*	*Local vs. Global minima*
	SLO-2	*Relationship between spatial and frequency interval, Translation and Rotation, Periodicity, symmetric properties*	*selective filtering, Homomorphic filtering,*	*Image compression model, Lossy and Lossless compression techniques*	*Observation noise*	*Mesh based Motion Estimation*
S-7	**SLO-1**	Fast Fourier Transform FFT	*A model of image degradation/ restoration process*	*Lossless compression, Huffman coding*	*Sampling structures of analog video*	*Region based Motion Estimation*
	SLO-2	Discrete Cosine Transform DCT	*Noise models*	*Arithmetic Coding, Run length coding*	*Sampling structures of digital video*	*Multi resolution motion estimation*
S-8	**SLO-1**	Discrete Wavelet Transform *DWT*	*Adaptive filters*	*LZW coding, Bit Plane coding*	*2D fourier transform relations*	*Waveform based coding*
	SLO-2	*Some basic intensity transformation functions – image negatives*	*Band reject Filters, Band pass Filters*	*transform coding, predictive coding*	*Intra frame filtering- LMMSE filtering*	*Block based transform coding*
S-9	**SLO-1**	*log transformations*	*Inverse Filtering – Wiener*	*wavelet coding*	*Median and weighted median filtering*	*Predictive coding*
	SLO-2	*Piecewise linear transformation functions*	*Singular value decomposition*	*JPEG standards*	*Motion detection based filtering*	*Application of motion estimation in Video coding*

Learning Resources	*1. Rafael C Gonzalez, Richard E Woods, "Digital Image Processing"- 3rd Edition, Pearson Education 2008.* *2. Yao wang, JoemOstarmann and Ya – quin Zhang, "Video processing and communication ",1st edition , PH Int.* *3. M. Tekalp ,"Digital video Processing", Prentice Hall International* *4. A.K. Jain, "Fundamentals of Digital Image Processing". Pearson education* *5. William K Pratt, "Digital Image Processing", John Willey (2001).*

Learning Assessment			
	Bloom's	Continuous Learning Assessment (50% weightage)	Final Examination (50% weightage)

	Level of Thinking	CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
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 Industry	Experts from Higher Technical Institutions	Internal Experts
E Sampath Kumar, Senior Leader, TCS, Chennai	Dr. Priyanka Kokil, IIITDM, Kancheepuram	Dr.R.Rani Krihtiga, SRMIST

Course Code	18AIE333T	Course Name	BIOMETRICS	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Artificial Intelligence	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 :	Illustrate the concept of authentication using biometrics		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)		Engineering 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 :	Understand basic image processing techniques required to design a biometric system																				
CLR-3 :	Gain knowledge on the basics of biometric traits, sensors and data acquisition																				
CLR-4 :	Acquire knowledge on design of biometric systems																				
CLR-5 :	Implement multi-biometrics and the real time application of biometrics																				
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																				
CLO-1 :	Understand the knowledge on various biometric traits		1	85	80		M	-	-	-	-	-	-	-	M	-	-	M	M	L	H
CLO-2 :	Acquire the basic image processing concepts		2	80	70		L	M	-		-	-	-	-	M	-	-	M	L	L	L
CLO-3 :	Gain knowledge on pattern recognition system and its features		2	85	75		M	H	--	-	-	-	-	-	L	-	-	H	M	M	M
CLO-4 :	Apply the basic ideas about physical and hehaviourial biometric traits		3	85	75		M	L	H	-	H	-	-	-	H	-	-	M	M	M	M
CLO-5 :	Implement authentication systems for real time security applications and use it in designing a biometric system		2	80	70		H	-	H	-	M	-	-	-	H	-	-	M	H	H	H

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Introduction of biometric systems	Image processing basics	Biometrics Sensors and Data Acquisition	Selection of suitable biometric	Introduction to multibiometrics
	SLO-2	Biometric fundamentals	what is image, acquisition, type, point operations, Geometric transformations.	Creating and Maintaining Databases	Biometric attributes, Zephyr charts,	Sources of multiple evidence
S-2	SLO-1	Biometric technologies	Linear interpolation	Biometrics Pre-processing	APIs, Standards, and Databases	Acquisition sequence
	SLO-2	Biometrics vs traditional techniques	Brightness correction, histogram	Image restoration	Biometric system vulnerabilities, circumvention, covert acquisition, quality control, template generation, interoperability, data storage.	Processing sequence
S-3	SLO-1	Characteristics of a good biometric system	Basic image operations:	Image segmentation	Physiological Biometrics: Fingerprint Recognition and acquisition	Fusion level: Sensor level fusion

	SLO-2	*Benefits of biometrics*	*Convolution, linear/non-linear filtering, Guassian, Median, Min, gray level reduction.*		*Fingerprint features, matching and synthesis*	*Feature level fusion*
S 4	SLO-1	*Key biometric processes:*	*Special filters, enhancement filter, Edge detection, derivatives.*	*Pattern/Feature extraction*	*Face recognition and acquisition*	*Score level fusion*
	SLO-2	*verification, identification and biometric matching*	*Laplacian, unsharp masking, high boot filtering, sharpening special filtering, Edge detection.*	*Feature Selection*	*Face detection, feature extraction and matching*	*Rank level fusion and decision level fusion*
S-5	SLO-1	*The design cycle of biometric systems*	*First and second derivative, steps in edge detection, smoothening, enhancement, thresholding, localization.*	*Introduction to decision theory*	*Iris recognition and acquisition*	*Security of biometric systems: Advisory,insider,infrastructure attacks*
	SLO-2	*Building blocks of a generic biometric system*	*Robert's method, Sobel's method, Perwitt's method.*	*Pattern Classification / Template Matching*	*Iris Segmentation, normalization and matching*	*Attacks at the user interface, impersonation, obfuscation, spoofing*
S-6	SLO-1	*Introduction to unimodal system*	*Laplacian of Gaussian, Zero crossing.*	*Identification/verification*	*Other physiological biometrics: Hand-scan, Retina scan, Ear Biometrics*	*Counter measure: Biometric template security and spoof detection*
	SLO-2	*Introduction to multimodal system*	*Canny edge detection.*	*Threshold, Score distribution,*	*Retina scan - components, working principles, strengths and weaknesses.*	*Challenges in biometric systems like fool proofing, false positives*
S-7	SLO-1	*Biometric system errors*	*Low level feature extraction, Describing image motion*	*FAR/FRR,System design issues.*	*Hand-scan, and Ear Biometrics*	*Biometric Applications:*
	SLO-2	*Performance measures*	*High level feature extraction*	*Positive/negative identification / authentication*	*working principles, strengths and weaknesses*	*Access control like a lock or an airport check-in area, immigration and naturalization*
S-8	SLO-1	*Biometric system, authentication*	*Hough transform for lines*	*Matching, null and alternative hypothesis h0, h1,Error type I/II, Matching score distribution, FM/FNM, ROC curve, DET curve, FAR/FRR curve*	*Behavioural Biometrics: Leading technologies: Signature-scan – Keystroke scan*	*Welfare distribution, military applications*
	SLO-2	*physiological and behavioral properties*	*Hough transform for circles and ellipses*		*Signature-scan – components, working principles, strengths and weaknesses*	*Banking, e.g., check cashing, credit card, ATM, audio-visual tracking and on-line shopping*
S-9	SLO-1	*Selecting Biometrics*	*Dimensionality Reduction*	*Comparing two systems using ROC curve, Expected overall error, available best error rates, cost function, biometric myths and misrepresentations, negative authentication, trade-offs b/w security and convenience.*	*Keystroke scan*	*Mini project:*
	SLO-2	*Application areas.*	*PCA: Eigen vectors and values, 2D-PCA*		*components, working principles, strengths and weaknesses.*	*Fingerprint / Face detection / signature / iris detection*

Learning Resources	*1. Michael Fairhurst -Biometrics: A Very Short Introduction, Oxford University Press, 2018.* *2. James wayman,Anil k.Jain ,Arun A.Ross ,Karthik Nandakumar, —Introduction to. Biometrics‖, Springer, 2011* *3. Mark S.Nixon, Alberto S.Aguado, Feature Extraction and image processing for computer vision, Third Edition, , Elsevier 2012*

	4. Digital Image Processing using MATLAB, By: Rafael C. Gonzalez, Richard Eugene Woods, 2nd Edition, Tata McGraw-Hill Education 2010 *5. Guide to Biometrics, By: Ruud M. Bolle, Sharath Pankanti, Nalini K. Ratha, Andrew W. Senior, Jonathan H. Connell, Springer 2009* *6. Pattern Classification, By: Richard O. Duda, David G.Stork, Peter E. Hart, Wiley 2007* *7. Shimon K.Modi , ―Biometrics in Identity Management :concepts to applications‖, Artech House 2011* *8. Anil K. Jain, Patrick Flynn, and Arun A. Ross, "Handbook of Biometrics", Springer, 2008.*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
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 Industry	Experts from Higher Technical Institutions	Internal Experts
E Sampath Kumar, Senior Leader, TCS, Chennai	Dr. Priyanka Kokil, IIITDM, Kancheepuram	Dr. A. Alice Nithya, SRMIST

Course Code	18AIE334T	Course Name	Pattern Recognition Techniques	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Artificial Intelligence	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 :	Introduce basic concepts in pattern recognition.		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)		Engineering 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 :	Gain knowledge in pattern recognition theories such as bayes classifier, linear discriminant analysis.																				
CLR-3 :	Develop sufficient background knowledge necessary to read more advance journal articles in pattern recognition.																				
CLR-4 :	Acquire knowledge in neural network approach to pattern recognition.																				
CLR-5 :	Implement pattern recognition techniques in practical problems.																				
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																				
CLO-1 :	Understand the fundamentals of Pattern recognition.		1	80	80		M	M	M	M	M	-	-	-	M	L	-	H	H	M	H
CLO-2 :	Select appropriate features that allows to build useful pattern recognition models.		2	80	85		H	H	H	H	H	-	-	-	H	L	-	H	H	H	H
CLO-3 :	Explore various approaches to identify the patterns.		3	80	85		M	H	M	H	M	-	-	-	M	L	-	H	M	H	M
CLO-4 :	Explore various neural network models used for pattern recognition.		3	80	85		M	H	M	H	M	-	-	-	M	L	-	H	M	H	M
CLO-5 :	Apply pattern recognition techniques on the real time application development.		3	85	80		H	H	H	H	H	-	-	-	H	L	-	H	H	H	H

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Basics of pattern recognition	Density estimation-non-parametric approach	Sequential pattern recognition	Neural pattern recognition	Recent advances in pattern recognition
	SLO-2	Design principles of pattern recognition	Parzen-window method	State Machines	Artificial neural network architecture	Fuzzy pattern classifiers
S-2	SLO-1	Pattern recognition approaches	K-Nearest Neighbor method	Hidden Markov Models (HMMs)	Biases and thresholds	Pattern classification using genetic algorithms
	SLO-2	Issues in pattern recognition problem	Feature extraction	Discrete HMMs	Hebb net, perceptron	Applications-Face recognition
S-3	SLO-1	Supervised Vs unsupervised approaches	Principle component analysis	Continuous HMMs	Adaline and Madaline	Speech Recognition
	SLO-2	Statistical pattern recognition	Independent component analysis	Syntactic pattern recognition	Generalized delta rule	Handwriting Recognition
S 4	SLO-1	Bayesian Decision Theory	Linear discriminant analysis	Grammar based approaches	Neural network-based pattern Associators, CAM	Image pattern recognition
	SLO-2	Minimum-error-rate classification	Feature selection through functional approximation	Formal grammars	Linear Associative mapping	Human detection

S-5	**SLO-1**	*Classifiers*	*Formulation of unsupervised problems*	*Types of grammars*	*Approaches and examples*	*Signature verification*
	SLO-2	*Discriminant functions*	*Clustering for unsupervised learning and classification*	*Syntactic description - String generation*	*Hetero associative memory design*	*Visual pattern recognition*
S-6	**SLO-1**	*Decision surfaces*	*Clustering concept- C means clustering*	*Recognition by string matching and parsing*	*Hebbian learning*	*Forensic Analysis*
	SLO-2	*Normal density and discriminant functions*	*Learning vector Quantization*	*Cocke-Younger-Kasami(CYK) parsing algorithm*	*Feedforward network architecture*	*Occlusion sequence mining*
S-7	**SLO-1**	*Discrete features*	*Formal Characterization of General Clustering procedures*	*Augmented Transition Networks*	*Training in feedforward network*	*Biometrics*
	SLO-2	*Density estimation-parametric approach*	*Clustering Strategies*	*High dimensional grammars*	*Derivation of Delta rule*	*Multimedia object retrieval*
S-8	**SLO-1**	*Gaussian distribution*	*Cluster Swapping approaches*	*Stochastic grammar*	*Backpropagation network*	*Shape recognition*
	SLO-2	*Maximum Likelihood estimation*	*Hierarchical clustering*	*Structural representations*	*Associator for Character Classification*	*Document analysis*
S-9	**SLO-1**	*Maximum a posteriori estimation*	*Graph theoretic approach to pattern clustering*	*Attributed Graphs, Match Graphs*	*Bi directional associative memory*	*Signal analysis*
	SLO-2	*Bayesian estimation*	*Validity of clusters*	*Structural Unification using attributed graphs*	*Hopfield network*	*Texture Analysis*

Learning Resources	1. *C.M.Bishop. Pattern Recognition and Machine Learning, Springer, 2016.* 2. *Robert J, Schalkoff, Pattern Recognition: Statistical, Structural and Neural Approaches, John Wiley & Sons Inc., New York, Reprint 2014.* 3. *Fukunaga, Introduction to Statistical Pattern Recognition, second edition, Academic press, 2013.* 4. *R.O.Duad, P.E.Hart and D.G.Stork, Pattern Classification, John Wiley,2001.* 5. *C.M.Bishop, Neural Networks for Pattern Recognition, Oxford University Press, 1995.*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	*20%*	*20%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*
Level 2	Apply Analyze	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*
Level 3	Evaluate Create	*10%*	*10%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*
	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	Experts from Higher Technical Institutions	Internal Experts
E Sampath Kumar, Senior Leader, TCS, Chennai	Dr. Priyanka Kokil, IIITDM, Kancheepuram	Dr.S.K.Lavanya, SRMIST

Course Code	18AIE335T	Course Name	Surveillance Video Analytics	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

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

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

			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)		Engineering	Problem Analysis	Design &	Analysis, Design,	Modern Tool Usage	Society & Culture	Environment &	Ethics	Individual & Team	Communication	Project Mgt. &	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLR-1 :	Acquire the basics of computer vision and video surveillance cameras		1	2	3		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-2 :	Familiarize the Video representation formats and compression standards																				
CLR-3 :	Familiarize different Object tracking and recognition techniques																				
CLR-4 :	Familiarize the Detection methods and Applications																				
CLR-5 :	Understand the evaluation methods of video surveillance																				
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																				
CLO-1 :	Understand the basics of computer vision and video surveillance cameras		1	80	75		H	M	-		L	-	-	-	-	-	-	L	M	M	M
CLO-2 :	Explain the Video representation formats and compression standards		2	85	75		H	M	-		L	-	-	-	-	-	-	L	M	M	M
CLO-3 :	Summarize the different Object tracking and recognition techniques		2	75	75		H	H	-		L	-	-	-	-	-	-	L	M	M	M
CLO-4 :	Illustrate the Detection methods and Applications		2	85	75		H	H	M	M	L	-	-	-	-	-	-	L	-	-	-
CLO-5 :	Understand the evaluation methods of video surveillance		2	80	70		H	H	M	M	L	-	-	-	-	-	-	L	M	M	M

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Image Processing	Video Compression	Object tracking algorithms	Activity recognition	Detection of visual Cortex
	SLO-2	Overview and Perspectives	Video formats	Updating of the appearance models	State of art	State of art
S-2	SLO-1	Use of images	Compression principles	Multitarget tracking	Ontology	Fast shared boosting
	SLO-2	Strength and weakness of Image Processing	Compression standards	Tracking by PTZ camera	SecRek system, Illustrations	Experiments
S-3	SLO-1	Future of Image Processing	Compressed domain analysis for fast activity detection	Tracking objects of interest through camera network	Unsupervised methods for activity analysis	Operational evaluation platform
	SLO-2			View of overlapping and non-overlapping fields	Detection of abnormal events	PPSL
S 4	SLO-1	Surveillance of railway Infrastructure	Processing methods	Biometric techniques applied to video Surveillance	PLSA	Video Surveillance approach
	SLO-2	Onboard Surveillance	Use of analysis of compressed domain	Databases used for evaluation	PLSM and temporal models	Findings, Context use
S-5	SLO-1	Posteriori Analysis for investigation	Detection of objects of interest	Facial Recognition	Counting and Anomaly detection Applications	Smart video processing

	SLO-2	Requirements in Tools for assisted investigation	Moving objects detection			
S-6	**SLO-1**	Collection and storage of data	Detection by modelling of the objects of interest	Iris Recognition	Data mining in video database	Qualification and evaluation performances
	SLO-2	Exploitation of data			State of art, pre-processing	
S-7	**SLO-1**	Video Surveillance cameras	Tracking of objects of interesting in a sequence of images	Vehicle Recognition in video Surveillance	Activity analysis	Evaluation: ETISEO
	SLO-2	Constraints and nature of information captured		Specificity of context	Automatic classification, results and evaluation	
S-8	**SLO-1**	Video formats	Representation of objects of interest	Vehicle modelling	Analysis of crowded scenes and review	Genetic Evaluation
	SLO-2	Technologies	Associated visual features	Exploitation of object models		
S-9	**SLO-1**	Interfaces from analog to IP	Geometric workspaces	Increasing observability	Data driven crowd analysis	Quasper Project
	SLO-2	Smart Cameras		Performances	Dense aware person detection	

Learning Resources	
	Text book 1. Jean Y Ves Dufour, "Intelligence Video Surveillance Systems", ISTE Ltd and John Wiley 2013. **Reference books**: 1. Yao Wang, JornOstermann and Ya-Qin Zhang, "Video Processing and Communications", Prentice Hall, 2001. 2. A.MuratTekalp, "Digital Video Processing", Pearson, 1995 3. Thierry Bouwmans, FatihPorikli, Benjamin Höferlin and Antoine Vacavant, "Background Modeling and Foreground Detection for Video Surveillance: Traditional and Recent Approaches, Implementations, Benchmarking and Evaluation", CRC Press, Taylor and Francis Group, 2014. 4. Md. Atiqur Rahman Ahad, "Computer Vision and Action Recognition-A Guide for Image Processing and Computer Vision Community for Action Understanding", Atlantis Press, 2011.

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
Level 2	Apply Analyze	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
Level 3	Evaluate Create	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	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	Experts from Higher Technical Institutions	Internal Experts
E Sampath Kumar, Senior Leader, TCS, Chennai	Dr. Priyanka Kokil, IIITDM, Kancheepuram	Dr.C.Amuthadevi, SRMIST

Course Code	18AIE336T	Course Name	Medical Signal Processing	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Artificial Intelligence	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 :	Understand the fundamentals of signal processing for various bio-signal analysis		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)		Engineering 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 :	Design the Infinite impulse response (IIR) filter and study its applications																				
CLR-3 :	Utilize knowledge in the basic concepts of wavelet and speech analysis																				
CLR-4 :	Understand the various bio-signals such as Electro cardiogram (ECG), Electromyogram (EMG) and Phonocardiogram (PCG)																				
CLR-5 :	Gain knowledge on the various case studies approach in processing the bio-signals																				
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																				
CLO-1 :	Acquire the knowledge of signal processing for various bio-signal analysis		1	80	75		M	-	H	-	L	-	-	-	-	-	-	L	M	M	M
CLO-2 :	Analyze the Infinite impulse response (IIR) filter and study its applications		3	80	70		M	-	H	-	L	-	-	-	-	-	-	L	M	M	M
CLO-3 :	Acquire the knowledge of wavelet and speech analysis		1	75	75		M	-	H	-	L	-	-	-	-	-	-	L	M	M	M
CLO-4 :	Analyze the various bio-signals such as Electro cardiogram (ECG), Electromyogram (EMG) and Phonocardiogram (PCG)		3	75	70		M	-	H	M	M	-	-	-	-	L	M	L	M	M	M
CLO-5 :	Analyze the various case studies approach in processing the bio-signals		3	80	75		M	-	H	-	M	-	-	-	-	-	-	L	M	M	M

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Fundamentals of Signal Processing.	Digital filter design: Basics of filter	Time domain filters: synchronized averaging, moving average filters	ANALYSIS OF BIOSIGNALS: Automatic analysis and classification of ECG	Case Studies in Medical signal Processing: ECG rhythm analysis
	SLO-2	Sampling and Aliasing	Design of IIR filter			
S-2	SLO-1	Signal reconstruction	Impulse invariant method	Introduction to adaptive filters	P-wave detection	Normal and ectopic ECG beat
	SLO-2	Simple signal conversion system	Bilinear transformation method	Wavelet And Speech Processing: Introduction to wavelets	QRS complex detection	
S-3	SLO-1	Spectral analysis,Circular convolution Correlation,	Design of bilinear transformation method using Butterworth technique	Time frequency representation	Derivative based method	Analysis of exercise ECG
	SLO-2		Design of impulse invariant method using Butterworth technique		Pan Tompkins algorithm	
S 4	SLO-1	Autocorrelation	Design of bilinear transformation Method- using Chebyshev technique	Discrete wavelet transform	Template matching method	Analysis of respiration

	SLO-2		*Design of impulse invariant method using Chebyshev technique*		*Correlation analysis of ECG signals*	
S-5	SLO-1	*Cross correlation*	*Warping and pre-warping effect*	*Pyramid algorithm*	*Signal averaged ECG*	*Spectral analysis of EEG signals*
	SLO-2		*Frequency transformation, Frequency domain filters*		*Analysis of Heart Rate variability*	
S-6	SLO-1	*FFT*	*Removal of high frequency noise, Butterworth low pass filters*	*Comparison of Fourier transform and wavelet transform*	*Time domain method and frequency domain methods*	*Case studies- in ECG and PCG*
	SLO-2		*Removal of low frequency noise, Butterworth high pass filters*			
S-7	SLO-1	*Decimation in time algorithm*	*Characteristics of FIR filter*	*Speech analysis*	*Synchronized averaging of PCG envelopes*	*PCG and carotid pulse*
	SLO-2		*FIR filter design using windowing techniques*			
S-8	SLO-1	*Decimation in Frequency algorithm*	*Rectangular window*	*Cepstrum*	*Envelogram*	*ECG and atrial electrogram*
	SLO-2		*Hamming window,*		*Analysis of PCG signal*	
S-9	SLO-1	*Different types of bioelectric signals and its basic characteristics*	*Hanning window*	*Homomorphic filtering of speech signals*	*EMG signal analysis*	*Cardiorespiratory interaction*
	SLO-2		*Blackmann window*			*EMG and Vibromyogram (VMG)*

Learning Resources	1. *Rangaraj.M.Rangayyan, "Biomedical signal processing", IEEE press, second edition, 2015* 2. *S.Salivahnan, C.Gnanapriya, "Digital signal processing", Tata McGraw-Hill, New Delhi, 2nd edition 2011.* 3. *John G. Proakis and Dimitris G.Manolakis, "Digital Signal Processing, Algorithms and Applications", PHI of India Ltd., New Delhi, fourth Edition, 2007.* 4. *Sanjit K.Mitra "Digital Signal Processing", A Computer Based Approach", Tata McGraw-Hill, New Delhi, fourth edition 2011.* 5. *Nagoor kani A, 'Digital signal processing', Tata McGraw-Hill, New Delhi, second edition 2012.*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		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 Industry	Experts from Higher Technical Institutions	Internal Experts
E Sampath Kumar, Senior Leader, TCS, Chennai	Dr. Lathaparthiban, Pondicherry University	Dr.R.Rani Krithiga,SRMIST

Course Code	18AIE337T	Course Name	Speech Recognition and Understanding	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

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

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

		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)		Engineering	Problem Analysis	Design &	Analysis, Design,	Modern Tool Usage	Society & Culture	Environment &	Ethics	Individual & Team	Communication	Project Mgt. &	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLR-1 :	To introduce students to the basic concepts and techniques of speech and language processing.	1	2	3		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-2 :	Understanding of the Speech Modelling																			
CLR-3 :	Understanding of the Speech Pronunciation and signal processing																			
CLR-4 :	To study the various Speech identification techniques																			
CLR-5 :	To study the various Speech recognition techniques																			
Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*																			
CLO-1 :	Distinguish models, algorithms, language, thought, understanding.	*2*	*80*	*70*		*H*	*H*	*-*	*H*	*L*	*-*	*-*	*-*	*L*	*L*	*-*	*H*	*-*	*-*	*-*
CLO-2 :	Suggest speech modelling algorithms for any given problem	*1*	*85*	*75*		*M*	*H*	*L*	*M*	*L*	*-*	*-*	*-*	*M*	*L*	*-*	*H*	*-*	*-*	*-*
CLO-3 :	Identify and apply speech sounds and phonetic transcription	*1*	*75*	*70*		*M*	*H*	*M*	*H*	*L*	*-*	*-*	*-*	*M*	*L*	*-*	*H*	*-*	*-*	*-*
CLO-4 :	Apply the appropriate speech identification strategy for any given problem	*3*	*85*	*80*		*M*	*H*	*M*	*H*	*L*	*-*	*-*	*-*	*M*	*L*	*-*	*H*	*-*	*-*	*-*
CLO-5 :	Design systems that use the appropriate speech recognition models	*3*	*85*	*75*		*H*	*H*	*H*	*H*	*L*	*-*	*-*	*-*	*M*	*L*	*-*	*H*	*-*	*-*	*-*

Duration (hour)		*9*	*9*	*9*	*9*	*9*
S-1	**SLO-1**	*Introduction*	*SPEECH MODELLING : Word classes and part of speech tagging*	*SPEECH PRONUNCIATION AND SIGNAL PROCESSING : Phonetics*	*SPEECH IDENTIFICATION : Speech synthesis*	*SPEECH RECOGNITION : Automatic speech recognition*
	SLO-2					*architecture*
S-2	**SLO-1**	*knowledge in speech and language processing*	*hidden markov model*	*speech sounds and phonetic transcription*	*text normalization*	*applying hidden markov model*
	SLO-2					*feature extraction*
S-3	**SLO-1**	*ambiguity*	*computing likelihood*	*articulatory phonetics*	*phonetic analysis*	*mfcc vectors*
	SLO-2					*computing acoustic likelihoods*
S 4	**SLO-1**	*models and algorithms*	*the forward algorithm*	*phonological categories*	*prosodic analysis*	*search and decoding*
	SLO-2					*embedded training*
S-5	**SLO-1**	*language*	*training hidden markov model*	*pronunciation variation*	*diphone waveform synthesis*	*multipass decoding: n-best lists and lattices*
	SLO-2	*thought*	*maximum entropy model*			*a* (_stack') decoding*
S-6	**SLO-1**	*understanding*	*transformation-based tagging*	*acoustic phonetics and signals*	*unit selection waveform synthesis*	*context-dependent acoustic models*
	SLO-2					

S-7	**SLO-1**	*regular expression and automata*	*evaluation and error analysis*	*phonetic resources*	*evaluation*	*triphones*
	SLO-2					
S-8	**SLO-1**	*words & transducers*	*issues in part of speech tagging*	*Articulatory phonology*	*CTC (Connectionist Temporal Classification)*	*discriminative training*
	SLO-2				*ASR Evaluation: Word Error Rate*	
S-9	**SLO-1**	*N grams*	*noisy channel model for spelling*	*gestural phonology*	*text-to-speech (TTS) systems*	*speech recognition by humans*
	SLO-2					

Learning Resources	1. *Daniel Jurafsky and James H. Martin, 3rd edition — Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition, Person education,2020.* 2. *Ikrami Eldirawy , Wesam Ashour, —Visual Speech Recognition, Wiley publications , 2011.* 3. *Daniel Jurafsky and James H. Martin, — Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition, Person education,2013.*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
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 Industry	Experts from Higher Technical Institutions	Internal Experts
E Sampath Kumar, Senior Leader, TCS, Chennai	Dr. Lathaparthiban, Pondicherry University	Dr. Jahnavi Y, SRMIST

Course Code	18AIE338T	Course Name	Logic and Knowledge Representation	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

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

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

			Level of Thinking (Bloom)	Expected Proficiency	Expected Attainment		1 Engineering	2 Problem	3 Design &	4 Analysis,	5 Modern Tool	6 Society &	7 Environment	8 Ethics	9 Individual &	10 Communicati	11 Project Mgt.	12 Life Long	13 PSO - 1	14 PSO - 2	15 PSO – 3
CLR-1 :	*Gain knowledge on propositional logic and First order logic*																				
CLR-2 :	*Understand the concept of description logic and reasoning methods*																				
CLR-3 :	*Know about uncertainty, probability notations and Non-monotonic reasoning*																				
CLR-4 :	*Gain knowledge on Qualitative modeling representations*																				
CLR-5 :	*Understand and construct Bayesian Networks and Apply inference techniques.*																				
Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*																				
CLO-1 :	*Understand and illustrate propositional and First order logic representations*		*2*	*85*	*80*		*H*	*M*	*M*	*M*	*L*	-	-	-	-	-	-	*H*	*H*	*H*	*H*
CLO-2 :	*Understand inference in FOL and Description logic representations*		*2*	*85*	*75*		*H*	*M*	*M*	*M*	*L*	-	-	-	-	-	-	*H*	*H*	*H*	*H*
CLO-3 :	*Apply Bayes rule in uncertainty and understand Non-monotonic reasoning methods*		*2*	*80*	*75*		*H*	*M*	*M*	*M*	*L*	-	-	-	-	-	-	*M*	*H*	*H*	*H*
CLO-4 :	*Illustrate qualitative modeling representation techniques*		*2*	*80*	*75*		*H*	*M*	*M*	*M*	*L*	-	-	-	-	-	-	*M*	*H*	*H*	*H*
CLO-5 :	*Construct Bayesian network and apply its inference methods*		*2*	*85*	*80*		*H*	*M*	*M*	*M*	*L*	-	-	-	-	-	-	*H*	*H*	*H*	*H*

Duration (hour)		*9*	*9*	*9*	*9*	*9*
S-1	**SLO-1**	Knowledge Representation terminologies: syntax – semantics	Inference in FOL : inference rules involving quantifiers	Uncertainity: Handling uncertain knowledge	Qualitative Modeling, introduction	Bayesian Networks, Introduction
	SLO-2	Representation languages		basic probability notation		
S-2	**SLO-1**	inference	forward and backward chaining	Conditional probability	Qualitative Mathematics	Syntax and Semantics of Bayesian Networks
	SLO-2	validity and satisfiability		The axioms of probability		
S-3	**SLO-1**	Inference in Computers, Logics	Resolution	The joint probability distribution	Ontology, Component Ontologies	Exact Inference, Inference with Local (Parametric) Structure
	SLO-2	Fuzzy logic			Process Ontologies, Field Ontologie	Solving MAP and MPE by Search
S 4	**SLO-1**	Propositional Logic: syntax, semantics	**Description Logics** Introduction	bayes' rule and its use	Causality	Compiling Bayesian Networks
	SLO-2			Applying Bayes' rule	Compositional Modeling	Inference by Reduction to Logic

S-5	**SLO-1**	validity and inference	A basic DL and its Extensions	Nonmonotonic Reasoning Introduction	Qualitative Spatial Reasoning	Approximate Inference: Inference by Stochastic Sampling
	SLO-2				Topological Representations	Inference as Optimization
S-6	**SLO-1**	Rules of inference for propositional logic	Relationships with other Formalisms	Default Logic	Shape, Location, and Orientation Representations	Constructing Bayesian Networks: Knowledge Engineering
	SLO-2			Autoepistemic Logic		
S-7	**SLO-1**	An agent for the wumpus world	Tableau Based Reasoning Techniques	Circumscription	Diagrammatic Reasoning	High-Level Specifications
	SLO-2					
S-8	**SLO-1**	First order Logic: syntax and semantics	The Automata Based Approach	Nonmonotonic Inference Relations	Qualitative Modeling Applications	Learning Bayesian Networks
	SLO-2			Semantic Specification of Inference Relations, Default Conditionals	Automating or Assisting Professional Reasoning	
S-9	**SLO-1**	Extensions and Notational variations	Structural Approaches	Relating Default and Autoepistemic Logics	Education	Knowledge Representation and Question Answering
	SLO-2	Logical agent for Wumpus world		Relating Default Logic and Circumscription	Cognitive Modeling	

Learning Resources	1. S. Russell and P. Norvig. Artificial Intelligence 2nd ed. Prentice Hall, 2002. 2. Handbook of Knowledge Representation. Frank van Harmelen, Vladimir Lifschitz and Bruce Porter (Eds). Foundations of Artificial Intelligence, 2008. 3. Boolos, G. S., Burgess, J. P., Jeffrey, R. C. Computability and logic. – Cambridge university press, 2002. 4. An Introduction to Description Logic. Franz Baader, Ian Horrocks, Carsten Lutz, Uli Sattler

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
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 Industry	Experts from Higher Technical Institutions	Internal Experts
Dr. Marriappan Vaithilingam, Senior Director of Engineering, Fresh works	*Dr. Udendran, Dept. of CSE., Bharathidasan University, Tiruchirappalli*	Mr.S.Joseph James, SRMIST

Course Code	18AIE339T	Course Name	Matrix Theory for Artificial Intelligence	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

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

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

			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)		1 Engineering	2 Problem Analysis	3 Design &	4 Analysis, Design,	5 Modern Tool Usage	6 Society & Culture	7 Environment &	8 Ethics	9 Individual & Team	10 Communication	11 Project Mgt. &	12 Life Long Learning	13 PSO - 1	14 PSO - 2	15 PSO – 3
CLR-1 :	Understand the basic concepts of linear algebra through computer science and Engineering applications		1	2	3		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-2 :	Learn the basic concepts of matrix calculus																				
CLR-3 :	Perform matrix analysis for various optimization algorithms																				
CLR-4 :	Apply the concepts of vector spaces, linear transformations, matrices and inner product spaces in engineering																				
CLR-5 :	Solve problems in computer vision using optimization algorithms with single and multi-variables for large datasets																				
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																				
CLO-1 :	Solve the basic concepts of linear algebra through computer science and Engineering applications		3	85	80		H	H	M	-	L	-	-	-	M	-	-	M	-	-	-
CLO-2 :	Interpret the basic concepts of matrix calculus		2	85	80		H	H	M	-	L	-	-	-	M	-	-	M	-	-	-
CLO-3 :	Use various matrix analysis methods for solving optimization problems		3	85	80		H	H	M	-	L	-	-	-	M	-	-	M	-	-	-
CLO-4 :	Relate the basic concepts of inner product space, norm, angle, Orthogonality and projection and implementing the Gram-Schmidt process, to obtain least square solution and SV in engineering		3	85	80		H	H	M	-	L	-	-	-	M	-	-	M	-	-	-
CLO-5 :	Interpret the concept of multi-variable optimization techniques		2	85	80		H	H	M	-	L	-	-	-	M	-	-	M	-	-	-

Duration (hour)		*Linear Systems*	*Matrix Calculus*	*Matrix Analysis*	*Matrix Solutions*	*Optimization*
S-1	SLO-1	*Linear Systems - Introduction to Linear Algebra*	*Matrix Calculus*	*Jacobian Matrix*	*Gauss Elimination*	*Basics of Optimization*
	SLO-2		*Matrix Decomposition*			
S-2	SLO-1	*Linear Algebra and AI*	*Operation and Properties of Matrix (Identity -Diagonal-Transpose-Symmetric-Trace-Norms)*	*Gradient Matrix*	*Conjugate Gradient Methods*	*Univariate - Bivariate - Multivariate*
	SLO-2	*Examples of Linear Algebra in AI*				
S-3	SLO-1	*From Fundamental System of Solutions to Linear Space*	*Operation and Properties of Matrix (Rank-Inverse- Orthogonal - Range - Determinant))*	*Real Matrix Differential*	*Singular Value Decomposition*	*Convex Objective Functions*
	SLO-2					
S 4	SLO-1	*System of Linear Equations*	*Cramers Rule*	*Complex Gradient Matrices*	*Least Square Method*	*Minutiae of Gradient Descent*
	SLO-2					

S-5	SLO-1	*Matrices*	*Eigenvalues and Eigen Vectors*	*Gradient of Complex variable function*	*Gradient Computation*	*Optimization in AI*
	SLO-2	*Solving Systems of Linear Equations*	*Cholesky Decomposition*			
S-6	SLO-1	*Vector Spaces*	*QR decomposition*	*Gradient Method for smooth convex optimization*	*Gradient Descending*	*Optimization in AI*
	SLO-2					
S-7	SLO-1	*Linear Independence - Basis and Rank*	*LU decomposition*	*Gradient Method for smooth convex optimization*	*Tikhonov Regularization*	*Applications of Matrix in AI*
	SLO-2					
S-8	SLO-1	*Linear Mapping*	*Eigen decomposition and Diagonalization*	*Non-smooth convex optimization*	*Gauss-Seidel method*	*Applications of Matrix in AI*
	SLO-2					
S-9	SLO-1		*Singular value Decomposition*	*Constrained Convex Optimization*	*Application: Gradient Explosion and Gradient Vanishing*	*Case Study*
	SLO-2		*PCA*			
S-10	SLO-1		*Matrix Approximation*			
	SLO-2		*Matrix calculus*			

Learning Resources	1. *Xian-Da Zhang, A Matrix Algebra Approach to Artificial Intelligence, Springer, 2021* 2. *Xian-Da Zhang, Matrix Analysis and Applications - Cambridge University Press, 2017* 3. *Charu C. Aggarwal, Linear Algebra and Optimization for Machine Learning, Springer, 2020.* 4. *Stephen Boyd, Lieven Vandenberghe, Introduction to Applied Linear Algebra- Vectors, Matrices, and Least Squares, Cambridge University Press, 2018* 5. *Linear Algebra- Kenneth Hoffman and Ray Kunze, Prentice Hall India, 2013.* 6. *Linear Algebra- Cheney and Kincaid, Jones and Bartlett learning, 2014*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
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 Industry	Experts from Higher Technical Institutions	Internal Experts
Dr. Marriappan Vaithilingam, Senior Director of Engineering, Fresh works	*Dr. Udendran, Dept. of CSE., Bharathidasan University, Tiruchirappalli*	Mr.C.Arun, Asst Prof, SRM Institute of Science and Technology

Course Code	18AIE42IT	Course Name	SOFT COMPUTING AND ITS APPLICATIONS	Course Category	*E*	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	Nil
Course Offering Department	*Artificial Intelligence*	**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 ideas of fuzzy sets, fuzzy logic and use of heuristics based on human experience		1	2	3		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-2:	Gain knowledge on neural networks with examples		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)		Engineering 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-3:	Gain knowledge on the mathematical background for carrying out the optimization associated with neural network learning																				
CLR-4:	Gain knowledge on genetic algorithms and other random search procedures useful while seeking global optimum in self-learning situations																				
CLR-5:	Introduce case studies utilizing the above and illustrate the intelligent behavior of programs based on soft computing																				
Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*																				
CLO-1:	**Analyse a given computational task to recognize the appropriateness through fuzzy sets**		*3*	*85*	*80*		*M*	-	-	-	-	-	*M*	-	-	-	-	*L*	*L*	-	*L*
CLO-2:	**Design a fuzzy based soft computing system to address the computational task**		*3*	*85*	*80*		*M*	-	*H*	-	-	-	*M*	-	-	-	-	*M*	*L*	*L*	*L*
CLO-3:	**Analyse a given computational task to solve it through neural network**		*3*	*85*	*80*		*M*	*H*	*L*	-	-	-	*M*	*L*	-	-	-	*M*	*L*	*M*	*L*
CLO-4:	**Apply Genetic Algorithm operations for solving a computational task**		*3*	*85*	*80*		*M*	*L*	*L*	-	-	-	*M*	*L*	-	-	-	*M*	*L*	*M*	*L*
CLO-5:	**Design and implement a soft computing system to achieve a computational solution**		*3*	*85*	*80*		*M*	*L*	*L*	-	-	-	*M*	*L*	-	-	-	*M*	*M*	*L*	*L*

Duration (hour)		*9*	*9*	*9*	*9*	*9*
S-1	**SLO-1**	*Introduction to Soft Computing*	*Fuzzy Inference Systems*	*Neural Networks in Computer Science*	*Advanced Search Strategies*	*Hybrid Systems*
	SLO-2	*Evolution from Conventional AI to Computational intelligence*		*Biological model*	*Natural Evolution*	
S-2	**SLO-1**	*Evolutionary Search Strategies Fuzzy Sets*	*Fuzzification, Application of Fuzzy Operators on Antecedent part of Rules*	*McCulloch-Pitts Model*	*Chromosomes*	*Neuro-Fuzzy Modelling*
	SLO-2				*Systematic approach of Elitism (Selection- Crossover- Mutation)*	
S-3	**SLO-1**	*Fuzzy Membership Functions*	*Evaluation of Fuzzy Rules*	*The Perceptron Model*	*Development of Genetic Algorithm, Fitness Function, Population*	*Control*
	SLO-2				*GA operators*	
S 4	**SLO-1**	*Operations*	*Defuzzification*	*Widrow-Hoff's Delta Rule*	*Param#Eters*	*Feedback control*

	SLO-2				*Convergence*	
S-5	**SLO-1**	*Relations*	*Problems associated to Fuzzy controller*	*XOR Problem*	*Pattern Classifiers*	*Neuro fuzzy control*
	SLO-2					
S-6	**SLO-1**	*Fuzzy Extension Principle Basics of Fuzzy Logic*	*Cruise Controller and Air Conditioner Controller*	*Curse of Dimensionality*	*Layered Feed Forward Neural Networks*	*Neuro-fuzzy Reinforcement Learning*
	SLO-2					
S-7	**SLO-1**	*Problem solving using Fuzzy Rules*	*Convergence of efficiency parameter*	*Dimensionality Reduction*	*Solution for XOR Problem*	*Gradient Free Optimization (GA operators)*
	SLO-2				*Hebb's Rule*	
S-8	**SLO-1**	*Fuzzy Reasoning*	*Boltzmann's Machine Learning Algorithm*	*Activation Functions*	*Competitive Learning Methods (Kohonen's Self Organizing Maps and Learning Vector Quantization)*	*Gain Scheduling*
	SLO-2				*Pattern Associators (Hopfield nets)*	
S-9	**SLO-1**	*Mamdani s Representation*	*Back Propagation Algorithm*	*Learning by Neural Nets*	*Back Propagation Networks*	*Case study: Color Recipe Prediction.*
	SLO-2				*Generalized Delta Rule*	

Learning Resources	**1. Sandhya Bansal & Rajiv Goel "Fundamentals of Soft Computing", 1st Edition, Notion Press Publication, 2020** **2. Saroj koushik & Sunita Tiwari "Soft Computing, Fundamentals, Techniques and Applications" 1st Edition, McGraw Hill Publication, 2018** **3. Samir Roy and Udit Chakraborthy , "Introduction to Soft Computing: Neuro-Fuzzy and Genetic Algorithms" Pearson Education,2013.** **4. J.S.R. Jang, C.T.sun and E. Mizutani ,"Neuro-fuzzy and Soft Computing: A computational Approach to Learning and Machine Intelligence, Pearson Education, 2004.** **5.** D.E.GoldBerg, "Genetic Algorithms in Search, Optimization, and Machine Learning", Pearson Education, 2013. 6. S.N.Sivanandam, S.N.Deepa, "Priciples of Soft Computing", 2nd Edition, John-Wiley India,2011. 7. G.J.Klir and B.Yuan, "Fuzzy Sets and Fuzzy Logic: Theory and Applications", Second Reprint, PHI,2000. 8. **J.A.Freeman and D.M.Skapura, "Neural Networks: Algorithms, Applications and Programming Techniques", Pearson Education, 2011.** .

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
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 Industry	Experts from Higher Technical Institutions	Internal Experts
Dr. Marriappan Vaithilingam, Senior Director of Engineering, Fresh works	*Dr. Udendran, Dept. of CSE., Bharathidasan University, Tiruchirappalli*	*Dr. A. Suresh, SRMIST*

Course Code	18AIE422T	Course Name	Artificial Intelligence and High-Performance Computing	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Artificial Intelligence	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 :	Understand the various characteristics of Intelligent agents		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)		Engineering	Problem	Design &	Analysis,	Modern Tool	Society &	Environment &	Ethics	Individual &	Communication	Project Mgt. &	Life Long	PSO - 1	PSO - 2	PSO – 3
CLR-2 :	Learn the different search strategies in AI																				
CLR-3 :	Learn to represent knowledge in solving AI problems																				
CLR-4 :	Know about various Machine Learning Algorithms																				
CLR-5 :	Identify the computational methods in AI																				
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																				
CLO-1 :	Identify appropriate search algorithms for any AI problem		1	80	70		H	M	-	-	H	-	-	-	H	L	-	H	-	-	-
CLO-2 :	Gain Knowledge on various search strategies in AI		2	85	75		H	M	-	-	H	-	-	-	H	L	-	H	-	-	-
CLO-3 :	Understand the impact of apt agent strategy to solve a given problem		2	75	70		H	M	-	-	H	-	-	-	H	L	-	H	-	-	-
CLO-4 :	Acquire knowledge on various Machine learning algorithm with examples		2	80	80		H	M	-	-	H	-	-	-	H	L	-	H	-	-	-
CLO-5 :	Identify the computational methods in AL		2	75	75		H	M	-	-	H	-	-	-	H	L	-	H	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	AI Introduction	Search in Complex Environments	Knowledge, reasoning, and planning	Learning from Examples	Computational Science and Engineering
	SLO-2	The Foundations of Artificial Intelligence	Local Search and Optimization Problems	Logical Agents	Forms of Learning	Introduction
S-2	SLO-1	The History of Artificial Intelligence	Local Search in Continuous Spaces	Knowledge-Based Agents	Supervised Learning	Applications
	SLO-2	The State of the Art	Search with Nondeterministic Actions	The Wumpus World	Learning Decision Trees	Characteristics and requirements
S-3	SLO-1	Risks and Benefits of AI	Search in Partially Observable Environments	Logic	Model Selection and Optimization	Review of Computational Complexity
	SLO-2	Intelligent Agents	Online Search Agents and Unknown Environments	Propositional Logic: A Very Simple Logic	The Theory of Learning	Performance: metrics and measurements
S 4	SLO-1	Agents and Environments	Adversarial Search and Games	Propositional Theorem Proving	Linear Regression and Classification	Granularity and Partitioning

	SLO-2	Good Behavior: The Concept of Rationality	Game Theory	Effective Propositional Model Checking	Nonparametric Models	Locality: temporal/spatial/stream/kernel
S-5	**SLO-1**	The Nature of Environments	Optimal Decisions in Games	Agents Based on Propositional Logic	Ensemble Learning	Basic methods for parallel programming
	SLO-2	The Structure of Agents	Heuristic Alpha–Beta Tree Search	First-Order Logic	Developing Machine Learning Systems	Real-world case studies
S-6	**SLO-1**	Solving Problems by Searching	Monte Carlo Tree Search	Representation Revisited	Learning Probabilistic Models	Multiscale applications
	SLO-2	Problem-Solving Agents	Stochastic Games	Syntax and Semantics of First-Order Logic	Statistical Learning	Multi-discipline applications
S-7	**SLO-1**	Example Problems	Partially Observable Games	Using First-Order Logic	Learning with Complete Data	Measuring performance
	SLO-2		Limitations of Game Search Algorithms	Knowledge Engineering in First-Order Logic		Identifying performance bottlenecks
S-8	**SLO-1**	Search Algorithms	Constraint Satisfaction Problems	Inference in First-Order Logic	Learning with Hidden Variables:	
	SLO-2	Uninformed Search Strategies	Defining Constraint Satisfaction Problems	Propositional vs. First-Order Inference		
S-9	**SLO-1**	Informed (Heuristic) Search Strategies	Constraint Propagation: Inference in CSPs	Unification and First-Order Inference	Learning with Hidden Variables: The EM Algorithm	Partitioning applications for heterogeneous resources
	SLO-2	Heuristic Functions	Backtracking Search for CSPs	Forward and Backward Chaining		

Learning Resources	1. S. Russell and P. Norvig, "Artificial Intelligence: A Modern Approachl, Prentice Hall, Third Edition, 2009 2. I. Bratko, —Prolog: Programming for Artificial Intelligencel, Fourth edition, Addison-Wesley Educational Publishers Inc., 2011. 3. Introduction to High Performance Computing for Scientists and Engineers, Georg Hager Gerhard Wellein, CRC Press, 2010. 4. Petascale Computing: Algorithms and Applications, David A. Bader (Ed.), Chapman & Hall/CRC Computational Science Series, 2007 5. Ertel W. Introduction to artificial intelligence. Springer; 2018 Jan 18.

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
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		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
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 Industry	Experts from Higher Technical Institutions	Internal Experts
Mr.S.Karpagam, Tata Consultancy Services,Chennai.	Mr.Prabha Selvaraj, School of Computer Science and Engineering VIT-AP University, Amaravati, India	Dr.P.Kanmani.CSE/SRMIST

Course Code	18AIE423T	Course Name	Business Intelligence and Analytics	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Artificial Intelligence	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 :	Exposure to the fundamentals of business intelligence and analytics		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)		Engineering 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 :	understand the modeling aspects behind Business Intelligence																				
CLR-3 :	understand of the business intelligence life cycle and the techniques used in it																				
CLR-4 :	Get exposed with different data analysis tools and techniques																				
CLR-5 :	Analyse data to generate information and knowledge that lead to informed decisions for businesses																				
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																				
CLO-1 :	Describe the fundamentals of business intelligence		2	80	85		H	H	M	-	M	M	-	M	M	H	-	H	H	H	H
CLO-2 :	Apply various modelling techniques		2	75	80		H	H	M	-	M	M	-	M	M	H	-	H	H	H	H
CLO-3 :	Describe the data analysis and knowledge delivery stages		2	85	80		H	H	M	-	M	M	-	M	M	H	-	H	H	H	H
CLO-4 :	Apply business intelligence methods to various situations		2	80	75		M	M	M	-	M	M	-	M	M	H	-	H	M	M	M
CLO-5 :	Illustrate the new models for market strategic interaction		2	75	85		M	M	M	-	M	M	-	M	M	H	-	H	M	M	M

Duration (hour)		9	9	9	9	9
S-1	SLO-1	**BUSINESS INTELLIGENCE**: Effective and timely decision	**KNOWLEDGE DELIVERY:** The business intelligence user types	**EFFICIENCY**: Efficiency measures	**BUSINESS INTELLIGENCE APPLICATIONS:** Marketing models	**FUTURE OF BUSINESS INTELLIGENCE:** Future of business intelligence – Emerging Technologies
	SLO-2					
S-2	SLO-1		Standard reports	The CCR model: Definition of target objectives	Logistic and Production models	Machine Learning
	SLO-2	Data, information and knowledge				
S-3	SLO-1		Interactive Analysis and Ad Hoc Querying	Peer groups	Logistic and Production models	Predicting the Future
	SLO-2	Role of mathematical models		Identification of good operating practices		
S 4	SLO-1	Business intelligence architectures	Parameterized Reports and Self-Service Reporting	cross efficiency analysis	Analytics applied to different domains	BI Search
	SLO-2					Text Analytics
S-5	SLO-1	Cycle of a business intelligence	dimensional analysis	virtual inputs and outputs	Case study 1: Descriptive Analytics	BI Search

	SLO-2	analysis	Alerts/Notifications			Text Analytics
S-6	**SLO-1**	Enabling factors in business intelligence projects	Visualization: Charts,	Other models	Case study 2: Predictive Analytics	Advanced Visualization
	SLO-2		Graphs			
S-7	**SLO-1**		Visualization: Widgets, Scorecards	Pattern matching	Case study 3: Prescriptive Analytics	Rich Report
	SLO-2	Development of a business intelligence system	Dashboards			
S-8	**SLO-1**	Ethics and business intelligence	Geographic Visualization	cluster analysis	Case study 4: Decision Making	Future beyond Technology
	SLO-2					
S-9	**SLO-1**		Integrated Analytics	outlier analysis	Case study 5: Data and information visualization	
	SLO-2					
S-10			Considerations: Optimizing the Presentation for the Right Message		Case study 6: Visual Analytics	

Learning Resources	1. Efraim Turban, Ramesh Sharda, Dursun Delen, "Decision Support and Business Intelligence Systems", 9th Edition, Pearson 2013 2. Larissa T. Moss, S. Atre, "Business Intelligence Roadmap: The Complete Project Lifecycle of Decision Making", Addison Wesley, 2003. 3. Carlo Vercellis, "Business Intelligence: Data Mining and Optimization for Decision Making", Wiley Publications, 2009. 4. David Loshin Morgan, Kaufman, "Business Intelligence: The Savvy Manager"s Guide", Second Edition, 2012. 5. Cindi Howson, "Successful Business Intelligence: Secrets to Making BI a Killer App", McGraw-Hill, 2007. 6. Ralph Kimball , Margy Ross , Warren Thornthwaite, Joy Mundy, Bob Becker, "The Data Warehouse Lifecycle Toolkit", Wiley Publication Inc.,2007.

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
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 Industry	Experts from Higher Technical Institutions	Internal Experts
Soundararajan Dhakshinamoorthy, Principle software Engineer, Technology Leadership, OptumInsights India Pvt Ltd., Chennai	Dr. G. Aghila, Anna University	Mrs. C.Anupama,SRMIST

Course Code	18AIE424T	Course Name	Artificial Intelligence and Internet of Things	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

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

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

			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)		Engineering	Problem Analysis	Design &	Analysis, Design,	Modern Tool Usage	Society & Culture	Environment &	Ethics	Individual &Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLR-1 :	Understand the need for AI in IoT		1	2	3		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-2 :	Learn the Machine Learning Models and Classification algorithms																				
CLR-3 :	Understand the Deep Learning Models and its types																				
CLR-4 :	Know about the Genetic Algorithms with IoT																				
CLR-5 :	Identify the application of IoT																				
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																				
CLO-1 :	Comprehend the importance of IoT and AI		2	80	70		H	-	-	H	H	-	-	-	M	*L*	-	*H*	-	-	-
CLO-2 :	Understand the Machine Leanring with IoT		2	85	75		H	-	-	H	H	-	-	-	M	*L*	-	*H*	-	-	-
CLO-3 :	Analyze various layered architecture in deep Learning		3	75	70		H	-	-	H	H	-	-	-	M	*L*	-	*H*	-	-	-
CLO-4 :	Apply Real Time example with IoT		3	75	75		H	-	-	H	H	-	-	-	M	*L*	-	*H*	-	-	-
CLO-5 :	Design IoT with Smart Home Technologies		2	75	75		H	-	-	H	H	-	-	-	M	*L*	-	*H*	-	-	-

Duration (hour)		*9*	*9*	*9*	*9*	*9*
S-1	**SLO-1**	*Principles of IoT and AI*	*Machine learning and IoT*	*Deep Learning for IoT*	*Genetic Algorithms for IoT*	*Distributed AI and IoT*
	SLO-2	*Fundamentals of IoT and AT*		*Introduction*	*Optimisation*	*Inroduction*
S-2	**SLO-1**	*Definition is IoT*	*Learning Paradigms*	*Artificial Neuron*	*Deterministic and Analytic methods*	*Introducing H2O.ai*
	SLO-2	*IoT reference Model*	*Linear Regression*	*Modelling single neuron in Tensor flow*	*Natural Optimistaion Methods*	*Apche MLlib*
S-3	**SLO-1**	*IoT platforms*	*Prediction of Linear Regression*	*Neural Networks*	*Introduction to GA*	*Personal and Home IoT*
	SLO-2	*IoT verticals*	*Entropy and Cross Entropy*	*Conventional Neural Network*	*Coding Genetic Algorithms*	*Personal IoT*
S4	**SLO-1**	*Big Data and IoT*	*Logistic Regression*	*Different Layers of CNN*	*Reinforcement Learning for IoT*	*Heart Monitor*
	SLO-2	*Infusion of AI and IoT*	*Logisticc Regression for classification*	*Convolution layer*	*Introduction*	*Digital Assistants*
S-5	**SLO-1**	*The standard process in data mining*	*Different Classification algorithms*	*Pooling Layer*	*RL Terminology*	*IoT and Smart Homes*

	SLO-2	*IoT Platforms and AI platforms*	*Supervise and Unsupervised Learning*	*Recurrent Neural Networks*	*Simulated Environments*	*Home Activity recognition*
S-6	SLO-1	*Introduction to Datasets*	*Classification using Support Vector Machine*	*Long short term Memory*	*Policy Gradients*	*AI for Industrial IoT*
	SLO-2	*Tensorflow*	*Naïve Bayes*	*Gated recurrent unit*	*Generative model for IoT*	*Intorduction to AI-powered Industrial IoT*
S-7	SLO-1	*Keras*	*Decision trees*	*Encoders*	*Introduction*	*Predictive Maintenance using IoT*
	SLO-2	*Dataset Examples*	*Ensemble Learning*	*Auoto Encoders*	*VAE*	*AI for smart cities IoT*
S-8	SLO-1	*Data Access and distributed processing for IoT*	*Overfitting*	*Denoising Auto Encoders*	*Generating images using VAEs*	*Componenets of Smart city*
	SLO-2	*Text files in python*	*Underfitting*	*Variational Auto Encoders*	*VAEs in TensorFlow*	*Processing Different types of data*
S-9	SLO-1	*SQL data*	*Regularisation*	*Popular CNN model*	*GANs*	*Computing in Cloud*
	SLO-2	*HDF5*	*Cross validation*			

Learning Resources	1. Kapoor, A., 2019. *Hands-On Artificial Intelligence for IoT: Expert machine learning and deep learning techniques for developing smarter IoT systems*. Packt Publishing Ltd. 2. Gorunescu, F., 2011. *Data Mining: Concepts, models and techniques* (Vol. 12). Springer Science & Business Media. 3. Murphy, K.P., 2012. *Machine learning: a probabilistic perspective*. MIT press.

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
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 Industry	Experts from Higher Technical Institutions	Internal Experts
S.Karpagam, Tata Consultancy Services,Chennai	Prabha Selvaraj, School of Computer Science and Engineering, VIT-AP University, Amaravati, India	Dr.P.Kanmani, SRMIST

Course Code	18AIE425T	Course Name	Compiler Design	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

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

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

			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)		Engineering 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-1 :	Utilize the mathematics and engineering principles for the Design of Compilers		1	2	3		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-2 :	Acquire knowledge of Lexical Analyzer from a specification of a language's lexical rules																				
CLR-3 :	Acquire knowledge of Syntax Analyzer for parsing the sentences in a compiler grammar																				
CLR-4 :	Gain knowledge to translate a system into various intermediate codes																				
CLR-5 :	Analyze the methods of implementing a Code Generator for compilers																				
CLR-6	Analyze the methods of developing a Code Optimizer																				
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																				
CLO-1 :	Utilize the mathematics and engineering principles for the Design of Compiler		3	80	70		H	H	H	-	M	-	-	-	M	-	-	H	L	L	L
CLO-2 :	Acquire knowledge of Lexical Analyzer from a specification of a language's lexical rules		3	85	75		H	H	H	-	M	-	-	-	M	-	-	H	L	L	L
CLO-3 :	Gain knowledge to translate a system into various intermediate codes		3	75	70		H	H	H	-	M	-	-	-	M	-	-	H	L	L	L
CLO-4 :	Analyze the methods of implementing a Code Generator for compilers		3	85	80		H	H	H	-	M	-	-	-	M	-	-	H	L	L	L
CLO-5 :	Design a Code Optimizer		3	85	75		H	H	H	-	M	-	-	-	M	-	-	H	L	L	L

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Compilers – Analysis of the source program	Syntax Analysis Definition - Role of parser	Bottom Up Parsing	Intermediate Code Generation	Code optimization
	SLO-2	Phases of a compiler – Cousins of the Compiler	Lexical versus Syntactic Analysis	Reductions	Intermediate Languages - prefix - postfix	Introduction– Principal Sources of Optimization
S-2	SLO-1	Grouping of Phases – Compiler construction tools	Representative Grammars	Handle Pruning	Quadruple - triple - indirect triples Representation	Function Preserving Transformation
	SLO-2	Lexical Analysis – Role of Lexical Analyzer	Syntax Error Handling	Shift Reduce Parsing	Syntax tree- Evaluation of expression - three-address code	Loop Optimization
S-3	SLO-1	Input Buffering	Elimination of Ambiguity, Left Recursion	Problems related to Shift Reduce Parsing	Synthesized attributes – Inherited attributes	Optimization of basic Blocks
	SLO-2	Specification of Tokens	Left Factoring	Conflicts During Shift Reduce Parsing	Intermediate languages – Declarations	Building Expression of DAG
S 4	SLO-1	Finite automation - deterministic	Top down parsing	LR Parsers- Why LR Parsers	Assignment Statements	Peephole Optimization
	SLO-2	Finite automation - non deterministic	Recursive Descent Parsing, back tracking	Items and LR(0) Automaton, Closure of Item Sets,	Boolean Expressions, Case Statements	Basic Blocks, Flow Graphs

S-5	**SLO-1**	*Transition Tables*	*Computation of FIRST*	*LR Parsing Algorithm*	*Back patching – Procedure calls*	*Next -Use Information*
	SLO-2	*Acceptance of Input Strings by Automata*	*Problems related to FIRST*	*Operator Precedence Parser Computation of LEADING*	*Code Generation*	*Introduction to Global Data Flow Analysis*
S-6	**SLO-1**	*State Diagrams and Regular Expressions*	*Computation of FOLLOW*	*Computation of TRAILING*	*Issues in the design of code generator*	*Computation of gen and kill*
	SLO-2	*Conversion of regular expression to NFA – Thompson's*	*Recursive Descent Parsing, back tracking*	*Problems related to LEADING AND TRAILING*	*The target machine – Runtime Storage management*	*Computation of in and out*
S-7	**SLO-1**	*Conversion of NFA to DFA*	*Construction of a predictive parsing table*	*SLR Grammars*	*A simple Code generator*	*Parameter Passing.*
	SLO-2		*Predictive Parsers LL(1) Grammars*	*SLR Parsing Tables*	*Code Generation Algorithm*	*Runtime Environments*
S-8	**SLO-1**	*Converting Regular expression directly to DFA*	*Transition Diagrams for Predictive Parsers*	*Problems related to SLR*	*Register and Address Descriptors*	*Source Language issues*
	SLO-2	*Minimization of DFA*	*Error Recovery in Predictive Parsing*	*Construction of Canonical LR(1) and LALR*	*Generating Code of Assignment Statements*	*Storage Organization*
S-9	**SLO-1**	*Minimization of NFA*	*Predictive Parsing Algorithm*	*Construction of LALR*	*Cross Compiler – T diagrams*	*Activation Records*
	SLO-2	*Design of lexical analysis (LEX)*	*Non Recursive Predictive Parser*	*Problems related to Canonical LR(1) and LALR Parsing Table*	*Issues in Cross compilers*	*Storage Allocation strategies*

Learning Resources

1. *Alfred V Aho,Jeffery D Ullman,RaviSethi,"Compilers,Principlestechniquesandtools",Pearson Education2011*
2. *S.Godfrey Winster,S.Aruna Devi,R.Sujatha,"CompilerDesign",YesdeePublishingPvt.Ltd,2019*
3. *WilliamM.Waiteand Gerhard Goos.CompilerConstruction.Springer-Verlag,New York,2013.*
4. *K.Muneeswaran,,"CompilerDesign",OxfordHigherEducation,Fourthedition2015*
5. *DavidGalles,"ModernCompilerDesign",PearsonEducation,Reprint2012.*
6. *RaghavanV.,"PrinciplesofCompilerDesign",TataMcGrawHillEducationPvt.Ltd.,2010*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember / Understand	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
Level 2	Apply / Analyze	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
Level 3	Evaluate / Create	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	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	Experts from Higher Technical Institutions	Internal Experts
Soundararajan Dhakshinamoorthy, Principle software Engineer, Technology Leadership, OptumIns Pvt Ltd., Chennai	Dr. G. Aghila, Anna University	Dr.Godfrey Winster S, SRMIST

ourse Code	18AIE426T	Course Name	Virtual Reality and Augmented Reality	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Artificial Intelligence	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 challenges of Virtual Reality*		1	2	3		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-2 :	*Design and work with models*		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)		Engineering	Problem Analysis	Design &	Analysis, Design,	Modern Tool Usage	Society & Culture	Environment &	Ethics	Individual & Team	Communication	Project Mgt. &	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLR-3 :	*Identify VR Systems*																				
CLR-4 :	*Analyze the features and architecture of 3D Scanner*																				
CLR-5 :	*Implement right database models for real time applications*																				
Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*																				
CLO-1 :	*Understand the challenges of Virtual Reality and propose solutions*		*1*	*85*	*75*		*H*	*H*	*M*	*H*	*H*	*M*	*H*	*M*	*H*	*H*	*H*	*H*	*H*	*H*	*H*
CLO-2 :	Analyze the models		*1*	*85*	*75*		*H*	*H*	*H*	*H*	*H*	*M*	*H*	*M*	*H*	*H*	*H*	*H*	*H*	*L*	*L*
CLO-3 :	Design *the process of VR Systems*		*2*	*80*	*70*		*H*	*M*	*H*	*M*	*H*	-	-	-	-	-	*H*	*H*	*H*	*L*	*M*
CLO-4 :	*Identify the features and architecture of 3D Scanner*		*2*	*85*	*75*		*H*	*M*	*H*	*M*	*H*	*M*	*H*	*M*	*H*	*H*	*H*	*H*	*H*	*L*	*M*
CLO-5 :	Implement right database models for real time applications		*2*	*80*	*70*		*H*	*H*	*H*	-	-	-	-	-	-	-	*H*	*H*	*H*	*L*	*M*

Duration (hour)		9	9	9	9	9
S-1	**SLO-1**	Introduction, Fundamental Concept and Components of Virtual Reality	3D clipping, Colour theory, Simple 3D modelling,	VR technology, Model of interaction, VR Systems.	Sensor, Digital Glove, Movement Capture	user considerations, and basic AR interaction options.
	SLO-2					
S-2	**SLO-1**	VR, AR, MR, xR: similarities and differences	Illumination models, Reflection models, Shading algorithms	Animating the Virtual Environment: Introduction, The dynamics of numbers, Linear and Nonlinear interpolation	Video-based Input, 3D Menus & 3DScanner	technical limitations - low-light conditions, surfaces challenge, User flow
	SLO-2				Output -- Visual /Auditory / Haptic Devices.	
S-3	**SLO-1**	Benefits of virtual reality, Historical development of VR	Radiosity, Hidden Surface Remova	the animation of objects, linear and non-linear translation	Geometry of virtual worlds. Translations, rotations, orientation through matrix transformations	Surface detection and creating planes, User interaction: hit-testing and pose
	SLO-2					
S 4	**SLO-1**	HARDWARE TECHNOLOGIES FOR 3D USER INTERFACES: Visual Displays	Realism- Stereographic image	shape & object inbetweening, free from deformation, particle system	Human factors: Introduction, the eye, the ear, the somatic senses	Placing with anchor points, Occlusion between virtual assets

	SLO-2	Auditory Displays, Haptic Displays, Choosing Output Devices for 3D User Interfaces.			VR Hardware: Introduction, sensor hardware, Head-coupled displays, Acoustic hardware, Integrated VR systems	
S-5	SLO-1	Computer graphics, Real time computer graphics	Introduction, From 2D to 3D, 3D space curves	Physical Simulation: Introduction, Objects falling in a gravitational field,	VR Software: Introduction, Modeling virtual world, Physical simulation, VR toolkits	Light estimation: matching virtual light to real light
	SLO-2					
S-6	SLO-1	Flight Simulation, Virtual environment requirement	3D boundary representation Geometrical Transformations: Introduction	Rotating wheels, Elastic collisions, projectiles	Augmented and Mixed Reality - history, AR today, technology and features of augmented reality, AR functionality-Placing and positioning assets,Scale and the size of assets,Occlusion	Multi-plane detection and spatial mapping
	SLO-2					
S-7	SLO-1	Scientific Landmark 3D Computer Graphics: Introduction	Frames of reference, Modeling transformations	simple pendulum, springs	Tracking in AR, Environmental understanding: feature points and plane-finding, Light estimation, AnchorsInterface issues and lack of UI metaphors	Processing needs in mobile AR, Breaking immersion,
	SLO-2					
S-8	SLO-1	The Virtual world space, positioning the virtual observer, the perspective projection	Instances, Picking, Flying, Scaling the VE, Collision detection Generic VR system: Introduction,	Flight dynamics of an aircraft	AR's technical constraints: size, power, heat,3D barrier, Computer vision limitations, Constraints of occlusion and shading	Framing as a creative device, marker-less tracking for augmented reality,
	SLO-2					
S-9	SLO-1	human vision, stereo perspective projection	Virtual environment, Computer environment	Multiple Models of Input and Output Interface in Virtual Reality: Input -- Tracker	strengths and current constraints of the ARCore platform	enhancing interactivity in AR environments, evaluating AR system
	SLO-2					

Learning Resources

1. *Steven M. LaValle. Virtual Reality, Cambridge University Press, 2020. http://lavalle.pl/vr/*
2. *Kelly S. Hale (Editor), Kay M. Stanney (Editor). 2014. Handbook of Virtual Environments: Design, Implementation, and Applications, Second Edition (Human Factors and Ergonomics) ISBN-13: 978-1466511842. Amazon*
3. *Matjaž Mihelj, Domen Novak, Samo Beguš ,Virtual Reality Technology and Applications, 2013.*
4. *Burdea, G. C. and P. Coffet. Virtual Reality Technology, Second Edition. Wiley-IEEE Press, 2003/2006.*
5. *Alan B. Craig, Understanding Augmented Reality, Concepts and Applications, Morgan Kaufmann, 2013.*
6. *Alan B Craig, William R Sherman and Jeffrey D Will, "Developing Virtual Reality Applications: Foundations of Effective Design", Morgan Kaufmann, 2009.*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
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 Industry	Experts from Higher Technical Institutions	Internal Experts
Soundararajan Dhakshinamoorthy, Principle software Engineer, Technology Leadership, Optum| Pvt Ltd., Chennai	Dr. G. Aghila, Anna University	Ms.Sasi Rekha Shankar, AP/SWE, SRMIST

Course Code	18AIE427T	Course Name	Data Mining and Analytics	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

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

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

			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)		Engineering	Problem Analysis	Design &	Analysis, Design,	Modern Tool Usage	Society & Culture	Environment &	Ethics	Individual & Team	Communication	Project Mgt. &	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
CLR-1 :	To introduce students to the basic concepts of Data Mining.																				
CLR-2 :	Understanding the concept of association rule mining																				
CLR-3 :	Understanding of the various classification algorithms																				
CLR-4 :	To study the concepts of Cluster analysis techniques																				
CLR-5 :	To Implement the Data mining concepts with various domains																				
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																				
CLO-1 :	Distinguish various kinds of data, data mining functionalities.		2	80	70		H	H	-	H	L	-	-	-	L	L	-	H	-	-	-
CLO-2 :	Identify Frequent Patterns using Efficient and Scalable Frequent itemset mining methods		2	85	75		M	H	L	M	L	-	-	-	M	L	-	H	-	-	-
CLO-3 :	Suggest the Classification algorithm for any given problem		1	75	70		M	H	M	H	L	-	-	-	M	L	-	H	-	-	-
CLO-4 :	Apply the appropriate Cluster Analysis for any given problem		3	85	80		M	H	M	H	L	-	-	-	M	L	-	H	-	-	-
CLO-5 :	Design systems that use the appropriate data analytics		3	85	75		H	H	H	H	L	-	-	-	M	L	-	H	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Introduction to Data Mining – Kinds of Data	Association Rules : Basic Concepts	Classification and Prediction : Issues Regarding Classification and Prediction	Cluster Analysis Introduction	Applications and Trend in Data Mining
	SLO-2					
S-2	SLO-1	Data mining Functionalities – Interesting Patterns	Market basket analysis	Classification by Decision Tree Induction	Types of data in Cluster Analysis	Text Analytics
	SLO-2					
S-3	SLO-1	Task Primitives	Frequent item set	Bayesian Classification	A categorization of Major Clustering Methods	Social Network Analytics
	SLO-2					
S 4	SLO-1	Issues in Data Mining	Association Rules	Rule Based Classification	Partitioning Methods	Spatial Data Analytics
	SLO-2					
S-5	SLO-1	Data Preprocessing	Efficient and Scalable Frequent itemset mining methods	Classification by Back Propagation	Hierarchical Methods	Multimedia Data Analytics
	SLO-2		Apriori Algorithm			
S-6	SLO-1	Data Cleaning	FP-Growth	Support Vector Machine	Density based Methods	Machine learning
	SLO-2					

S-7	**SLO-1**	*Data Integration*	*Correlation Analysis*	*Associative Classification*	*Grid-based methods*	*Big Data*
	SLO-2			*Lazy Learners*		
S-8	**SLO-1**	*Data Transformation*	*Various kinds of association rules*	*Prediction, Accuracy and Error Measures*	*Model based clustering methods*	*Crowds of predictive models Boosting and Random Forests*
	SLO-2			*Evaluating the accuracy of a Classifier or a Predictor*	*Clustering High Dimensional data*	
S-9	**SLO-1**	*Data Selection*	*Constraint based association mining*	*Ensemble Methods*	*Constraint based cluster analysis*	*Neural networks and deep learning*
	SLO-2				*Outlier Analysis*	

Learning Resources	1. *Jiawei Han, Micheline Kamber, Jian Pei,"Data Mining – Concepts and Techniques", Third Edition, Morgan Kaufmann Publishers, 2012.* 2. *M. H. Dunham, "Data Mining: Introductory and Advanced Topics", Pearson Education 2001.* 3. *Daniel Jurafsky and James H. Martin, — Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition, Person education,2013.* 4. *I H. Witten and E. Frank, "Data Mining: Practical Machine Learning Tools and Techniques", Morgan Kaufmann. 2000.* 5. *Nathan Marz, James Warren, "Big Data-Principles and best practices of scalable real-time data systems", DreamTech Press, 2015.* 6. *Arshdeep Bahga, Vijay Madisetti, "Cloud Computing: A Hands-On Approach", University Press, 2016.* 7. *Cen Wan, Hierarchical Feature Selection for Knowledge Discovery: Application of Data Mining to the Biology of Ageing, Advanced Information and Knowledge Processing, Springer International Publishing, 2019.* 8. *Valentina Porcu, Python for Data Mining Quick Syntax Reference, Apress, 2019.*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
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 Industry	Experts from Higher Technical Institutions	Internal Experts
Soundararajan Dhakshinamoorthy, Principle software Engineer, Technology Leadershi OptumInsights India Pvt Ltd., Chennai	Dr. S. Muthurajkumar, Anna University	Dr. Jahnavi Y, SRMIST

Course Code	18AIE428T	Course Name	TIME SERIES ANALYSIS	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*ARTIFICIAL INTELIGENCE*	**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 time series analysis, trends and characteristic of stochastic component of time series	1	2	3		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-2 :	Apply appropriate filters and understand Autoregressive-moving average models ARMA	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)		Engineering	Problem Analysis	Design & Development	Analysis, Design,	Modern Tool Usage	Society & Culture	Environment &	Ethics	Individual & Team	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLR-3 :	Analyse the Forecasting, trend and seasonality in Box-Jenkins model																			
CLR-4 :	Analyse Vector autoregression (VAR)model, Co-integration and error correction model and Granger																			
CLR-5 :	Understand the structure and Application of VAR, filtering method and GARCH																			
Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*																			
CLO-1 :	Understand mathematical considerations for analyzing time series, including concepts of white noise, stationarity, autocovariance, autocorrelation	1	*85*	*80*		*H*	*H*	*L*	*L*	*M*	-	*L*	-	*L*	-	-	*H*	*H*	*L*	*L*
CLO-2 :	Apply various techniques of time series models, including the seasonal autoregressive moving average (SARIMA) models, regression with ARMA models	2	*85*	*80*		*H*	*H*	*M*	*M*	*H*	-	*L*	-	*L*	-	-	*H*	*H*	*L*	*H*
CLO-3 :	Apply various techniques for the modeling: including parameter estimation, assumption verification, and residual sequence diagnosis	2	*85*	*80*		*H*	*H*	*M*	*M*	*H*	-	*M*	-	*L*	-	-	*H*	*H*	*L*	*H*
CLO-4 :	Analyse the properties of linear predictor operator, and apply various linear forecasting techniques	2	*85*	*80*		*H*	*H*	*M*	*M*	*H*	-	*M*		*L*	-	-	*H*	*H*	*L*	*H*
CLO-5 :	Analyse and apply techniques of selected additional topics, such as spectral analysis, state space models, ARCH and GARCH, multivariate time series, principle component analysis, process control, and other topics.	2	*85*	*80*		*H*	*H*	*H*	*H*	*H*	-	*M*	-	*H*	-	*H*	*H*	*H*	*H*	*H*

Duration (hour)		9	9	9	9	9
S-1	**SLO-1**	Introduction to Time Series	Linear Filtering	Box-Jenkins methodology to identification of stationary time series models	Regressive dynamic models	Structural VAR
	SLO-2	definitions of trends	Theorem of Filtering		Autoregressive models with distributed lags (ADL).	
S-2	**SLO-1**	seasonality and noise	Convolutions and compositions	Forecasting, trend and seasonality in Box-Jenkins model.	Vector autoregression (VAR)model	Application of VAR
	SLO-2	Stationary processes	causal processes		Time series co-integration	
S-3	**SLO-1**	autocovariance	Autoregressive-moving average models ARMA	Non-stationary time series	Co-integration regression	Fiscal stimulus
	SLO-2	autocorrelation	ARMA Equation	Time series with non-stationary variance and mean	Testing of co-integration.	
S 4	**SLO-1**	Stochastic process and its main characteristics	Moving average models MA(q)	ARIMA (p,d,q) models	Co-integration and error correction model.	Monetary policy
	SLO-2		Condition of invertability		Causality in time series	
S-5	**SLO-1**	Time series as a discrete stochastic process	Autoregressive models AR(p)	The use of Box-Jenkins methodology to determination of order of integration	Granger causality	Forecasting & Structural Break
	SLO-2	Stationarity	Yull-Worker equations			
S-6	**SLO-1**	Main Course Learning Rationale	Stationarity conditions	The unit root problem	Hypothesis testing on rational expectations	Filtering Methods
	SLO-2		Autoregressive-moving average models ARMA (p,q)	Spurious trends and regressions		
S-7	**SLO-1**	Stationary stochastic processes	Solving the ARMA equation	Dickey Fuller Test	Hypothesis testing on market efficiency	Filtering Application
	SLO-2		Applications and Examples			
S-8	**SLO-1**			Spurious Regressions	Periodogram	Filtering Application

	SLO-2	main characteristic of stochastic component of time series	Coefficient estimation in ARMA (p,q) processes. Box-Jenkins' approach	Super Consistency		GARCH-model
S-9	**SLO-1**	Wold decomposition. Lag operator	Coefficients estimation in autoregressive models	Non-stationary time series, TSP or DSP	VECM (Vector Error Correction Model)	
	SLO-2		Coefficient estimation in ARMA (p) processes			Introduction to spectral models

Learning Resources	1. Shumway & Stoffer (2011) Time Series Analysis and its applications, with examples in R , 3rd edition, Springer. 2. Brockwell & Davis (2016) Introduction to Time Series and Forecasting, 3rd edition, Springer 3. Cryer & Chan (2008) Time Series Analysis with Applications in R, Springer 4. Prado & West (2010) Time Series: Modeling, Computation, and Inference Chapman & Hall 5. Petris, Petrone, Campagnoli (2009) Dynamic Linear Models with R, Springer

Learning Assessment

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		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
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 %	

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Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Soundararajan Dhakshinamoorthy, Principle software Engineer, Techn Leadership, OptumInsights India Pvt Ltd., Chennai	Dr. S. Muthurajkumar, Anna University	Mrs.SasiRekhaSankar, SRMIST

Course Code	18AIE429T	Course Name	Cloud Computing	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

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

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

		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)		Engineering	Problem Analysis	Design &	Analysis, Design,	Modern Tool Usage	Society & Culture	Environment &	Ethics	Individual & Team	Communication	Project Mgt. &	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
CLR-1 :	Understand the fundamental ideas behind Cloud Computing, the evolution of the paradigm, its applicability; benefits, as well as current and future challenges																			
CLR-2 :	*Gain knowledge on virtualization structure and its tools*																			
CLR-3 :	Explore the different cloud architectures																			
CLR-4 :	Design the cloud security threats and protective mechanism for cloud computing																			
CLR-5 :	*Implement the applications on cloud development*																			
Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*																			
CLO-1 :	*Acquire the knowledge about fundamentals of cloud computing*	*3*	*85*	*80*		*H*	*H*	*H*	*H*	*L*	-	-	-	-	-	-	*H*	*H*	*M*	*M*
CLO-2 :	*Analyze the structure of virtualization*	*3*	*85*	*80*		*H*	*H*	*H*	*H*	*H*	*L*	*L*	*L*	*M*	-	-	*H*	*H*	*H*	*H*
CLO-3 :	Design the knowledge on different cloud architectures	*3*	*85*	*80*		*H*	*H*	*H*	*H*	*H*	*L*	-	*L*	*M*	-	-	*H*	*H*	*H*	*H*
CLO-4 :	Evaluate the security issues related to cloud computing and handle the security threats and construct different cloud delivery design models	*3*	*85*	*80*		*H*	*H*	*H*	*H*	*H*	*L*	-	-	*M*	-	-	*H*	*H*	*H*	*H*
CLO-5 :	*Implement the knowledge on applications of cloud development*	*3*	*85*	*80*		*H*	*H*	*H*	*H*	*H*	*L*	-	*L*	*M*	-	-	*H*	*H*	*H*	*H*

Duration (hour)		*9*	*9*	*9*	*9*	*9*
S-1	***SLO-1***	*Cloud Computing Fundamentals: Evolution of Cloud Computing*	*Introduction & benefit of Virtualization: Implementation Levels of Virtualization*	***Service Models:** Infrastructure as a Service (IaaS)*	*Fundamental Cloud Security: Basic Terms and Concepts, Threat Agents, Cloud Security Threats*	*Cloud Application Development and Architectural Styles*
	SLO-2	*Cloud Computing definition*				
S-2	***SLO-1***	*Origin of Cloud Computing, Basic Concepts and Terminology*	*VMM Design Requirements and Providers*	*Resource Virtualization: Server, Storage, Network*	*Cloud Security Mechanisms: Encryption, Hashing: Digital Signature, Public Key Infrastructure*	*MapReduce Programming Model*
	SLO-2					
S-3	***SLO-1***	*Goals and Benefits, Risks and Challenges, Roles and Boundaries, Cloud Characteristics*	*Virtualization at OS level*	*Case studies: Platform as a Service (PaaS)*	*Identity and Access Management*	*Case Study: the Grep, The Web Application*
	SLO-2		*middleware support for Virtualization*			
S 4	***SLO-1***	*Types of cloud, Cloud services*	*Virtualization structure/tools and mechanisms: Hypervisor and Xen Architecture, Binary Translation with*	*Cloud platform & Management: Computation, Storage*	*Single Sign-On: Kerberos authentication, One-time password*	*Hadoop: SLO-2 Yarn and Tez*
	SLO-2					

			full Virtualization, Para Virtualization with Compiler Support			
S-5	***SLO-1***	*Cloud Delivery Models, Cloud Deployment Models*	*Virtualization fo CPU, Memory and I/O Devices*	*Case studies. Software as a Service (SaaS)*	*Basic cloud data security mechanisms*	*SQL on Hadoop: Pig, Hive, and Impala*
	SLO-2					
S-6	***SLO-1***	*Cloud Service Providers and the Cloud Ecosystem*	*Hardware support for Virtualization in intel x86 processor*	*Web services, Web 2.0,*	*Advanced Clouds, Mobile Cloud*	*Current Cloud Applications and New Opportunities*
	SLO-2					
S-7	***SLO-1***	*Amazon Web Services(AWS), Google Clouds, Microsoft Azure Cloud*	*CPU Virtualization*	*Web OS*	*Media Cloud, Green Cloud*	*Design approaches with Case Study*
	SLO-2					
S-8	***SLO-1***	*SLA Management in Cloud Computing: A Service Providers Perspective*	*Memory Virtualization and I/O Virtualization*	*Case studies : Anything as a service (XaaS)*	*Virtual Machine Security, Security of Virtualization, A Trusted Hypervisor*	*Design methodology for IaaS Service SLO-2 Model*
	SLO-2					
S-9	***SLO-1***	*Case Study on Open Source & Commercial Clouds: Eucalyptus, OpenStack, Aneka*	*Virtualization in Multicore processors*	*Microservices*	*Mobile Devices and Cloud Security*	*Google API, AWS EC2 Instances*
	SLO-2					

Learning Resources	1. Dan C. Marinescu," Cloud Computing Theory and Practice", Second Edition Copyright © 2018 Elsevier Inc. All.https://www.sciencedirect.com/book/9780128128107/cloud-computing 2. Rajkumar Buyya, James Broberg, AndrzejGoscinski, Cloud Computing Principles and Paradigms, Wiley Publications, 2017. 3. Gautam Shroff, "Enterprise Cloud Computing Technology Architecture Applications",Cambridge University Press; 1 edition,[ISBN: 978-0521137355],2010. 4. Thomas Erl, ZaighamMahmood, and RichardoPuttini, "Cloud Computing: Concepts, Technology & Architecture", Prentice Hall/PearsonPTR, Fourth Printing, 2014, ISBN: 978013338752. 5. K. Chandrasekaran, "Essentials of Cloud Computing", Chapman and Hall/CRC Press, 2014, ISBN 9781482205435 6. Arshdeep Bahga, Vijay Madisetti, "Cloud Computing: A Hands-On Approach", University Press, 2016, ISBN13: 978-0996025508.

Learning Assessment

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Level 1	Remember	*40%*	-	*15%*	-	*15%*	-	*15%*	-	*15%*	-
	Understand										
Level 2	Apply	*40%*	-	*20%*	-	*20%*	-	*20%*	-	*20%*	-
	Analyze										
Level 3	Evaluate	*20%*	-	*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	Experts from Higher Technical Institutions	Internal Experts
Dr. Marriappan Vaithilingam, Senior Director of Engineering, Fresh works	Dr. S. Muthurajkumar, Anna University	Dr.R.Rani Krithiga,SRMIST

Course Code	18AIE430T	Course Name	Distributed Systems	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

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

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

			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)		Engineering 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
CLR-1 :	To recognize the essential concepts of distributed system.																				
CLR-2 :	To comprehend about the communication that takes place in Distributed systems																				
CLR-3 :	To realize the necessity of synchronization, consistency and Fault tolerance in a Distributed System.																				
CLR-4 :	To value the Process management, Resource Management and to handle system failure.																				
CLR-5 :	To acquire apparent scheme regarding distributed file system and applications of distributed systems.																				
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																				
CLO-1 :	Characterize the fundamental hardware and software concepts of distributed systems.		2	80	70		H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	Categorize layered protocols and comprehend the communications in distributed systems.		3	85	75		H	-	H	-	-	-	-	-	-	-	-	-	M	-	-
CLO-3 :	Implement synchronization of distributed systems using various algorithms.		3	75	70		H	H	-	-	-	-	-	-	-	-	-	-	M	-	M
CLO-4 :	Demonstrate process scheduling and fault tolerance of distributed systems.		1	85	80		H	H	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	Evaluate various Distributed file systems and its applications.		1	85	75		H	-	-	H	-	-	-	-	-	-	-	-	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Introduction to distributed systems*	*Fundamentals of Communication systems*	*Clock Synchronization*	*Threads: Models*	*Cloud Computing and service Models*
	SLO-2				*Issues, Implementation*	
S-2	SLO-1	*Goals and Trends in Distributed Systems.*	*Layered Protocols - OSI*	*Logical, Physical clocks, clock synchronization algorithms*	*Processor Allocation*	*Architectural Design of Compute Clouds*
	SLO-2				*Allocation model*	
S-3	SLO-1	*Hardware Concepts-Bus-based*	*ATM network - Client Server model*	*Distributed Mutual Exclusion*	*Design issues for processor allocation algorithm*	*Architectural Design of Storage Clouds*
	SLO-2					
S-4	*SLO-1*	*Switched Multiprocessors*	*Inter process Communication - API for internet protocol*	*Consensus and Agreement Centralized*	*Scheduling in Distributed systems*	*Peer to Peer Computing Systems*
	SLO-2				*Resource Management*	
S-5	SLO-1	*Distributed System Models and Enabling Technologies*	*Remote Invocation – RMI - Multicast communication*	*Checkpointing and Rollback recovery*	*Task Assignment Approach - Load Balancing*	*P2P Overlay Networks and Properties*
	SLO-2			*Election Algorithms*		
S-6	Slo-1	*System Models for Distributed System Models and Cloud Computing*	*Indirect Communication Mechanism*	*The Bully algorithm*	*Fault tolerance- Component faults*	*Clous trends in Supporting ubiquitous Computing*
	SLO-2			*ring algorithm*	*system failures, synchronous versus*	

					asynchronous systems	
S-7	SLO-1	*True Distributed System and Time sharing Multiprocessor*	*Virtualization*	*Deadlock prevention and detection in distributed systems*	*fault tolerance using active replication*	*Performance of Distributed System and the cloud*
	SLO-2				*primary backup*	
S-8	SLO-1	*Parallel Programming Systems and Models*	*Implementation levels of virtualization*	*Termination detection, Message ordering.*	*Distributed File Systems File service architecture*	*Enabling Technologies for IoT*
	SLO-2					
S-9	SLO-1	*Design issues of distributed system*	*Virtualization Structure and mechanism*	*Case Study: Distributed Randomized Algorithms*	*File model -File accessing models*	*Innovative Applications of IoT*
	SLO-2					

Learning Resources	1. *George Coulouris, Jean Dollimore and Tim Kindberg, "Distributed Systems Concepts and Design", Fifth Edition, Pearson Education, 2012.* 2. *Kai Hwang Jack Dongarra Geoffrey Fox, Distributed and Cloud Computing From Parallel Processing to the Internet of Things ,1st Edition, Morgan Kaufmann, 2012.* 3. *Sukumar Ghosh, Distributed Systems: An Algorithmic Approach, Second Edition, Chapman & Hall/CRC, Computer and Information Science Series, 2014, ISBN 978-1466552975* 4. *Pradeep K Sinha, "Distributed Operating Systems: Concepts and Design", Prentice Hall of India, 2007.* 5. *Tanenbaum A.S., Van Steen M., "Distributed Systems: Principles and Paradigms", Pearson Education, 2007.* 6. *Liu M.L., "Distributed Computing, Principles and Applications", Pearson Education, 2004. 5.Nancy A Lynch, "Distributed Algorithms", Morgan Kaufman Publishers, USA, 2003.* 7. *https://nptel.ac.in/courses/106106168/*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
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 Industry	Experts from Higher Technical Institutions	Internal Experts
Dr. Marriappan Vaithilingam, Senior Director of Engineering, Fresh works	Dr. Lathaparthiban, Pondicherry University	Mr.C.Arun, Asst Prof, SRM Institute of Science and Technology

Course Code	18AIE431T	Course Name	Big Data Analytics: Hadoop, Spark and NoSQL	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Artificial Intelligence	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 be able to understand the challenges of big data and different analytical architectures																				
CLR-2 :	To be able to Dsesign and work with hadoop framework																				
CLR-3 :	To be able to process big data with advanced architectures like spark																				
CLR-4 :	To be able to Analyse the features and architecture of NoSQL																				
CLR-5 :	To be able to identify right database models for real time applications																				
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)		Engineering	Problem Analysis	Design &	Analysis, Design,	Modern Tool Usage	Society & Culture	Environment &	Ethics	Individual & Team	Communication	Project Mgt. &	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	Understand the challenges of big data and propose solutions		1	85	75		H	H	M	H	H	M	H	M	H	H	H	H	H	H	H
CLO-2 :	Analyse the Big Data using Map-reduce programming in Both Hadoop and Spark framework		1	85	75		H	H	H	H	H	M	H	M	H	H	H	H	H	H	H
CLO-3 :	Design spark programming with different programming languages.		2	80	70		H	M	H	M	H	M	H	M	H	H	H	H	H	H	H
CLO-4 :	Identify the graph algorithms and live streaming data in Spark		2	85	75		H	M	H	M	H	M	H	M	H	H	H	H	H	H	H
CLO-5 :	Implement right database models for real time applications		2	80	70		H	H	H	M	H	M	H	M	H	H	H	H	H	H	H

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Introduction to Big Data: Types of Digital Data	Requirement of Hadoop Framework	Introduction to GPU Computing	SQL Context – Importing and Saving data	Mongo DB: Introduction
	SLO-2	Characteristics of Data		CUDA Programming Model		Features - Data types
S-2	SLO-1	Evolution of Big Data - Definition of Big Data -	Design principle of Hadoop	CUDA API, Simple Matrix	Data frames – using SQL	Mongo DB Query language
	SLO-2	Challenges with Big Data	Comparison with other system	Multiplication in CUDA		CRUD operations, Arrays
S-3	SLO-1	Data Storage and Analysis	Hadoop Components	CUDA Memory Model	GraphX overview – Creating Graph	Functions: Count – Sort – Limit – Skip
	SLO-2		Hadoop 1 vs Hadoop 2	Shared Memory Matrix Multiplication		Aggregate - Map Reduce
S 4	SLO-1	Typical Analytical Architecture	Hadoop Daemon's	Additional CUDA API Features	Graph Algorithms	Cursors – Indexes
	SLO-2	Requirement for new analytical architecture	HDFS Commands			Mongo Import – Mongo Export

S-5	**SLO-1**	Business Intelligence vs. Big Data	Map Reduce Programming: I/O formats	Data Analysis with Spark Shell	*Spark Streaming Overview*	Cassandra: Introduction
	SLO-2	Big Data Analytics: Classification of analytics	Map side join, Reduce Side Join			Features
S-6	**SLO-1**	Need of big data frameworks	Secondary sorting	Spark Programming in Scala	Errors and Recovery	Data types – CQLSH
	SLO-2		Pipelining MapReduce jobs	Writing Spark Application		Key spaces
S-7	**SLO-1**	Data Science - Terminologies in Big Data	Serialization: AVRO	Spark Programming in Python	Streaming Source	CRUD operations – Collections
	SLO-2			Writing Spark Application		Counter
S-8	**SLO-1**	CAP Theorem - BASE Concept	Co-ordination: Zookeeper	Spark Programming in R	Streaming live data with spark	TTL - Alter commands
	SLO-2			Writing Spark Application		
S-9	**SLO-1**		Databases: HBase, Hive	Spark Programming in Scala JAVA		Import and Export
	SLO-2		Scripting language: Pig, Streaming: Flink, Storm	Application Execution		Querying System tables

Learning Resources	1. Mike Frampton, "Mastering Apache Spark", Packt Publishing, 2015. 2. TomWhite,"Hadoop:TheDefinitiveGuide",O'Reilly,4thEdition,2015. 3. NickPentreath,MachineLearningwithSpark,PacktPublishing,2015. 4. Mohammed Guller, Big Data Analytics with Spark, Apress,2015 5. Seema Acharya, Subhashini Chellappan, "Big Data and Analytics", Wiley Publication, 2015 6. Donald Miner, Adam Shook, "Map Reduce Design Pattern", O'Reilly, 2012

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
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 Industry	Experts from Higher Technical Institutions	Internal Experts
Dr. Marriappan Vaithilingam, Senior Director of Engineering, Fresh works	*Dr. Udendran, Dept. of CSE., Bharathidasan University, Tiruchirappalli*	*Mrs.Anupama C G, SRMIST*

Course Code	18AIE432T	Course Name	Brain Machine Interface	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

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

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

			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)		Engineering	Problem	Design &	Analysis, Design,	Modern Tool	Society &	Environment &	Ethics	Individual &	Communication	Project Mgt. &	Life Long	PSO - 1	PSO - 2	PSO – 3
			1	2	3		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-1 :	Introduce students to the basic concepts and techniques of Brain Machine Interface																				
CLR-2 :	Understand the various features used in BCI																				
CLR-3 :	Design the major components of BCI																				
CLR-4 :	Apply the various Feature Translation Methods																				
CLR-5 :	Implement the various applications of BCI																				
Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*																				
CLO-1 :	Distinguish various BCI systems		*1*	*80*	*70*		*L*	*H*	-	*H*	*L*	-	-	-	*L*	*L*	*L*	*H*	*L*	*L*	*L*
CLO-2 :	Design systems that uses the appropriate EEG features used in BCI		*1*	*85*	*75*		*M*	*M*	*H*	*H*	*L*	-	-	-	*M*	*L*	-	*H*	*L*	*L*	*L*
CLO-3 :	Suggest various filters and models for any given problem		*2*	*80*	*70*		*M*	*H*	*M*	*H*	*L*	-	-	-	*M*	*L*	-	*H*	*M*	*M*	*M*
CLO-4 :	Apply the appropriate feature translation method for any given problem		*2*	*85*	*80*		*M*	*H*	*M*	*H*	*L*	-	-	-	*M*	*L*	-	*H*	*H*	*H*	*H*
CLO-5 :	Identify the BCI algorithms and apply to various Datasets		*2*	*85*	*75*		*H*	*H*	-	*H*	*L*	-	-	-	*M*	*L*	*L*	*H*	*H*	*H*	*H*

Duration (hour)		9	*9*	9	*9*	9
S-1	**SLO-1**	Introduction to Brain Computer or Machine Interface: *Fundamentals of BCI*	*EEG features used in BCI*	*Major components of BCI: Signal Processing*	*Feature Translation Method: Linear Discriminant Analysis*	*Applications of BCI: Study of BCI Competition III – Dataset I, II, III, IV and V,*
	SLO-2					
S-2	**SLO-1**	*Structure of BCI system*	*EEG Process*	*Spatial filters*	*Nearest neighbours*	*Functional restoration using Neuroprosthesis*
	SLO-2			*Temporal filters*		
S-3	**SLO-1**	*Classification of BCI*	*Temporal characteristics*	*Spectral filters*	*Support Vector Machines*	*Functional Electrical Stimulation*
	SLO-2			*Spatio-temporal filters*		
S 4	**SLO-1**	*Invasive*	*Spatial Characteristics*	*Feature extraction*	*Regression*	*Visual Feedback and control - External device controllers*
	SLO-2					
S-5	**SLO-1**	*Non-invasive*	*Oscillatory EEG activity*	*Time/Space Methods*	*Learning Vector Quantization*	*Case study: Brain actuated control of mobile Robot.*
	SLO-2			*Fourier Transform, Wavelets*		
S-6	**SLO-1**	*Partially invasive*	*Event related potentials (ERP)*	*Auto Regressive Model*	*Gaussian Mixture Modeling*	*Ethical issues in BCI research.*

	SLO-2			*Moving Average Model*		*BCI application-P300 speller*
S-7	SLO-1	*BCI Brain signal acquisition*	*Slow cortical potentials (SCP)*	*ARMA models*	*Hidden Markov Modeling*	*Neuro prosthetic devices*
	SLO-2			*Bandpass filtering*		*Toolbox Architecture*
S-8	SLO-1	*Signal Preprocessing*	*Neuronal potentials*	*Template matching*	*Neural Networks*	*Plug-in concepts*
	SLO-2			*Kalman filter*		
S-9	SLO-1	*Artifact's removal*	*Motor Imagery BCI*	*Principle Component Analysis*	*Machine Learning*	*Implementing ERP Based BCI*
	SLO-2					

Learning Resources	1. *Andrew Webb, ―Statistical Pattern Recognition‖, Wiley International, Second Edition, 2002* 2. *Jonathan Wolpaw, Elizabeth Winter Wolpaw,'Brain Computer Interfaces: Principles and practice", Edition 1, Oxford University Press, USA, January 2012*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
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 Industry	Experts from Higher Technical Institutions	Internal Experts
Soundararajan Dhakshinamoorthy, Principle software Engineer, Technology Leaders OptumInsights India Pvt Ltd., Chennai	Dr. Lathaparthiban, Pondicherry University	Dr. Jahnavi. Y, SRMIST

Course Code	18AIE433T	Course Name	Nature Inspired Computing	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Artificial Intelligence	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 :	Understand fundamental concepts related to heuristic and Nature inspired optimization algorithms																				
CLR-2 :	Learn various evolutionary algorithms to optimize the results																				
CLR-3 :	Learn swarm intelligence based optimization algorithms																				
CLR-4 :	Learn Science based optimization algorithms																				
CLR-5 :	Apply Nature inspired optimization algorithms in Image processing																				
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)		Engineering	Problem Analysis	Design &	Analysis, Design,	Modern Tool Usage	Society & Culture	Environment &	Ethics	Individual & Team	Communication	Project Mgt. &	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	Describe natural phenomena that motivate the discussed algorithms		1	85	80		H	H	L	L	M	-	L	-	L	-	-	H	H	L	L
CLO-2 :	Elaborate various evolutionary algorithms for result optimization		2	85	80		H	H	M	M	H	-	L	-	L	-	-	H	H	L	H
CLO-3 :	Explore swarm optimization algorithms for feature selection		2	85	80		H	H	M	M	H	-	M	-	L	-	-	H	H	L	H
CLO-4 :	Describe various science based optimization algorithms		2	85	80		H	H	M	M	H	-	M		L	-	-	H	H	L	H
CLO-5 :	Apply Bio inspired algorithms in Image processing		3	85	80		H	H	H	H	H	-	M	-	H	-	H	H	H	H	H

Duration (hour)		9	9	9	9	9
S-1	SLO-1	***Introduction*** *: Computation Inspired by Nature, Biological Processes*	***Evolutionary Algorithms*** *: Genetic Algorithms - Evolutionary Algorithms Versus Simulated Annealing*	***Swarm intelligence-based Approach*** *: Introduction to Particle Swarm Optimization*	***Science-Based Approach*** *: Introduction to Biomolecular Computing.*	***Applications in Image Processing*** *: Image processing and optimization*
	SLO-2	*Evolution Versus Learning*	*Terminologies of Evolutionary Computation*	*Swarm Behavior.*	*Biochemical Networks*	*Image segmentation via optimization*
S-2	SLO-1	*Swarm Intelligence - Group Behaviors*	*Encoding/Decoding*	*Particle Swarm Optimization. Algorithm*	*DNA Computing.*	*Key issues in optimization*
	SLO-2	*Foraging Theory*	*Selection/Reproduction..*	*Variants of the Algorithm*	*DNA Data Embedding.*	*Efficiency of an algorithm*
S-3	SLO-1	*Heuristics, Metaheuristics*	*Crossover .*	*Ant Colony Optimization*	*Membrane Computing - Cell-Like P System*	*How to choose algorithms?*
	SLO-2	*Hyper-Heuristics*	*Mutation*	*Ant Colony Characteristics*	*Computing by P System*	*Time and resource constraints*
S 4	SLO-1	*Classification of Optimization Problems*	*Two-Dimensional Genetic Algorithms*	*Traveling Salesman Problem*	*Other P Systems*	*Fine-Tuning Deep Belief Networks using Cuckoo Search - Introduction*
	SLO-2	*Classification of Optimization Techniques*	*Genetic Algorithms for Sequence Optimization*	*Algorithm*	*Membrane-Based Optimization*	*Theoretical background - Deep belief networks*
S-5	SLO-1	*Optimization. - Lagrange Multiplier Method*	*Introduction to Genetic Programming*	*Firefly Algorithm*	*Introduction to Quantum Computing*	*Restricted Boltzmann machines*

	SLO-2	*Direction-Based Search and Simplex Search*	*Syntax Trees.*	*Firefly Behavior and Characteristics.*	*Grover's Search Algorithm*	*Deep belief nets*
S-6	SLO-1	*Discrete Optimization Problems*	*Causes of Bloat.*	*Firefly-Inspired Optimization*	*Hybrid Methods - Quantum-Inspired EAs.*	*Methodology*
	SLO-2	*P, NP, NP-Hard, and NP-Complete*	*Bloat Control .*	*Algorithm.*	*Other Quantum-Inspired Hybrid Algorithms*	*Mobile object tracking using the modified cuckoo search*
S-7	SLO-1	*Multi objective Optimization Problem.*	*Designing Genetic Operators*	*Cuckoo Search Algorithm*	*Metaheuristics Based on Sciences - Search Based on Newton's Laws*	*Single mobile object tracking using the modified cuckoo search algorithm*
	SLO-2	*Robust Optimization*	*Gene Expression Programming*	*Cuckoo Bird Behavior*	*Search Based on Electromagnetic Laws*	*Hybrid Kalman cuckoo search tracker*
S-8	SLO-1	*Performance Indicators.*	*Evolutionary Gradient Search and Gradient Evolution*	*Levy Flights.*	*Search Based on Natural Phenomena -Introduction*	*Pseudo code of the Cuckoo search based Mobile Object tracker*
	SLO-2	*No Free Lunch Theorem*	*CMA Evolutionary Strategies .*	*Cuckoo Search Optimization Algorithm*	*Search Based on Water Flows*	*Cuckoo search–based reidentification*
S-9	SLO-1	*Simulated Annealing. Basic Simulated Annealing*	*Memetic Algorithms*	*Discrete Cuckoo Search Algorithm.*	*Search Based on Cosmology*	*parametric representation*
	SLO-2	*Variants of Simulated Annealing*	*Simplex-based Memetic Algorithms.*	*Multi-Objective Cuckoo Search Algorithm (MOCS)..*	*Black Hole-Based Optimization*	*MCS-driven reidentification strategy*

Learning Resources	1. Ke-Lin Du ,M.N.S. Swamy, Search and Optimization by Metaheuristics Techniques and Algorithms Inspired by Nature, Springer International Publishing Switzerland 2016 2. A Vasuki, Nature-Inspired Optimization Algorithms, Taylor & Francis, CRC Press, 2020 3. Xin-She Yang, João Paulo Papa, Bio-Inspired Computation and Applications in Image Processing, Elsevier, 2016

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
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 Industry	Experts from Higher Technical Institutions	Internal Experts
Soundararajan Dhakshinamoorthy, Principle software Engineer, Technology Leaders OptumInsights India Pvt Ltd., Chennai	Dr. Lathaparthiban, Pondicherry University	1. Dr.A.Revathi, SRMIST

Course Code	18AIE434T	Course Name	Bio Informatics	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Artificial Intelligence	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 :	Acquire the basics of Bio informatics and biological sequences		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)		Engineering	Problem Analysis	Design &	Analysis, Design,	Modern Tool Usage	Society & Culture	Environment &	Ethics	Individual & Team	Communication	Project Mgt. &	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLR-2 :	Understand the phylogenetic analysis used in prediction of structure of proteins																				
CLR-3 :	Gain the knowledge of ML techniques in different applications of bio informatics																				
CLR-4 :	understand, execute the programs to solve biological issues by using R																				
CLR-5 :	understand, execute the programs for Predictive modelling using R																				
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																				
CLO-1 :	Identify basics of Bio informatics and biological sequences		1	80	75		M	H	M	L	-	-	-	L	-	-	-		-	M	-
CLO-2 :	Understand and explain the phylogenetic analysis used in prediction of proteins		2	85	75		M	H	M	L	-	-	-	L	--	-	-	-	-	M	-
CLO-3 :	Find the significance of ML techniques in different applications of bio informatics		2	75	75		H	H	M	L	-	-	-	L	-	-	-	-	M	M	-
CLO-4 :	Create the programs to solve biological issues by using R		3	85	75		H	H	H	H	H	-	-	-	-	-	-	-	M	M	-
CLO-5 :	Create the programs for Predictive modelling using R		3	80	70		H	H	H	H	H	-	-	-	-	-	-	-	M	M	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Introduction to Bioinformatics	Introduction to phylogenetics	Introduction to Machine learning techniques	Introduction to R for Genomic data analysis	Fitting the Genomic data to model by ML
	SLO-2	Computational Biology	Distance based trees UPGMA trees	Artificial Neural Networks in protein secondary structure prediction	Steps of for Genomic data analysis	Machine learning Vs Statistics
S-2	SLO-1	Biological sequences	Molecular clock theory	Hidden Markov Models for gene finding	Getting started with R	Steps in Supervised Machine Learning
	SLO-2	Biological databases			Computations in R	Use case: Disease subtype from Genomic data
S-3	SLO-1	Genome specific databases	Ultrametric trees	Decision trees	Data Structures, Data Types	Data pre-processing, Splitting the data
	SLO-2	Data file formats	Parsimonious trees	Support Vector Machines	Reading and writing data- Plotting in R with base graphics and ggplot2	Predicting the subtype
S 4	SLO-1	Data life cycle	Neighbour joining trees	Introduction to Systems Biology and Synthetic Biology	Functional and Control structures	Accessing the performance
	SLO-2	Database management system models	Trees based on morphological traits	Microarray analysis	Statistics for genomics	ROC curves
S-5	SLO-1	Basics of Structured Query Language (SQL)	Bootstrapping	DNA computing	Statistical Distributions	Model Tuning and avoid overfitting

	SLO-2	Sequence Analysis		Bioinformatics approaches for drug discovery	Testing Differences between samples	Complexity and bias trade-off
S-6	SLO-1	Pairwise alignment	Protein Secondary structure	Applications of informatics techniques in genomics and proteomics	Linear models and Correlation	Dealing Imbalance classes
	SLO-2	Dynamic programming algorithms for computing edit distance	tertiary structure prediction methods	Assembling the genome		Tree of forests
S-7	SLO-1	String similarity	Homology modelling	STS content mapping for clone contigs	Exploratory data analytics	Supervised algorithms
	SLO-2	Shotgun DNA sequencing	Abinitio approaches		Clustering: Distance metrics	Operations on Genomic intervals with Genomic Range Package
S-8	SLO-1	End space free alignment	Threading	Functional annotation	Hierarchical clustering, K means	Grange object, Regions
	SLO-2	Multiple sequence alignment	Critical Assessment of Structure Prediction		Dimensionality Reduction techniques	Mapping high throughput sequence reads
S-9	SLO-1	Algorithms for Multiple sequence alignment	Structural genomics	Peptide mass fingerprinting	Visualising complex data sets	continuous score over genome
	SLO-2	Generating motifs and profiles, Local and Global alignment				Visualization and summarization of genomic intervals

Learning Resources	**Text Books:** 1.Lesk, A. K., "Introduction to Bioinformatics" 4th Edition, Oxford University Press, 2013. 2.Altuna Akalin "Computational Genomics with R", CRC Press 2021. **Reference books:** 1.Mount, D.W., "Bioinformatics Sequence and Genome Analysis" 2nd Edition, Cold Spring Harbor Laboratory Press, 2004 2.Tindall, J., "Beginning Perl for Bioinformatics: An introduction to Perl for Biologists" 1st Edition, O'Reilly Media, 2001 3.Baldi, P. and Brunak, S., "Bioinformatics: The Machine Learning Approach" 2nd Edition, MIT Press, 2001. 4. Dan Gusfield, "Algorithms on Strings, Trees and Sequences: Computer Science and Computational Biology" Cambridge University Press, 1997

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
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 Industry	Experts from Higher Technical Institutions	Internal Experts
Soundararajan Dhakshinamoorthy, Principle software Engineer, Technology Leadership OptumInsights India Pvt Ltd., Chennai	Dr. Lathaparthiban, Pondicherry University	Dr.C.Amuthadevi,SRMIST

Course Code	18AIE435T	Course Name	Theoretical and Computational Neuroscience	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Artificial Intelligence	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 :	Understand the basics of Computational Neuro Science		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)		Engineering	Problem	Design &	Analysis,	Modern Tool	Society &	Environment &	Ethics	Individual &	Communication	Project Mgt. &	Life Long	PSO - 1	PSO - 2	PSO – 3
CLR-2 :	Apply the concept of Neuron, Associations and learning																				
CLR-3 :	Acquire with Cortical organization and Feed forward mapping networks																				
CLR-4 :	Design the mapping and Learning concepts																				
CLR-5 :	Implement the Cognition concepts																				
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																				
CLO-1 :	Gain the knowledge in basics of Computational Neuro Science		1	80	75		M	M	M	-	M	M	-	-	-	M	M	-	M	M	M
CLO-2 :	Demonstrate Simple Neuron, Associations and learning		2	80	70		M	H	M	M	M	H	-	-	-	M	H	-	M	M	M
CLO-3 :	Categorize Cortical organization and Feed forward mapping networks		2	85	70		H	H	M	M	H	H	-	-	-	H	H	-	M	M	M
CLO-4 :	Apply the different learning methods		2	80	75		H	H	M	M	H	H	--	-	--	H	H	M	L	L	L
CLO-5 :	Implement Cognition concepts and theories		2	80	75		M	M	M	-	M	M	-	-	-	M	M	M	L	L	L

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Tools and Specialization	Basic Spiking Neurons	Large scale brain anatomy	Modular Mapping: Mixture of expert	Hierarchical maps and attentive vision
	SLO-2	Levels of Organization in the brain	Leaky, Integrate and Fire Neuron, Response of IF	Hierarchical architecture of brain	What, Where -Task, Product experts	Invariant object recognition
S-2	SLO-1	Model: Phenomelogical and explanatory	Activation function, Spike response	Rapid Transmission	Coupled attractor Networks	Attentive vision
	SLO-2	models in Computational Neuroscience	Izhikevich , McCullon-Pitts Neuron	Layered Structure of neocortex		Bias in visual search and object recognition
S-3	SLO-1	Brain Theory: Emergence and adaption	Spike Time variability, Basic Irregularities	Columnar organization	Sequential Learning	Interconnecting global workspace
	SLO-2	Level of Analysis	Noise models	Cortical parameters		
S 4	SLO-1	Computational Theory of brain	Simulation of Real Neurons	Simple Perceptron: OCR	Memory: Distributed Model	Brain anticipatory system
	SLO-2	Anticipating brain	Activation function depend on input	Mapping functions	Limited capacity model	Boltzman machine
S-5	SLO-1	Structural Properties of basic neuron	Associative memory, Hebbian learning	Population mode as perceptron, Boolean functions	Spurious synchronization hypothesis	Restricted Boltzman machine
	SLO-2	Information Processing Mechanisms	Associations	Learning the delta rule	Interacting reverberating hypothesis	Contrastive Hebbian learning
S-6	SLO-1	Membrane Potential	Hebbian learning in conditional framework	Multilayer Perceptron: update rule	Motor learning and control	Helmholtz machine

	SLO-2	Ion Channel	Feature associators	Generalization of delta rules, plausibility	Feedback control	
S-7	**SLO-1**	Chemical Synapses and neuro transmitters	Philosophy and biophysics	Advanced MLP: Kernel and RBF	Forward and inverse motor controller	Probabilistic reasoning
	SLO-2	Excitatory and inhibitory Synapses	Typical Plastic experiments	Advanced learning	Cerebellum and motor control	Causal models and Bayesian network
S-8	**SLO-1**	Modelling synaptic responses	Spike time dependent plasticity	Batch Vs online algorithm, self-organizing network architectures and Genetic algorithm	Reinforcement learning	Expectation maximization
	SLO-2	Non-Linear superposition of PSP	Calcium hypothesis and modelling		Classical conditioning	
S-9	**SLO-1**	Minimal mechanism, Ion Lumps	Mathematical model for Hebbian learning plasticity	Mapping with Context units, Probability mapping of network	Temporal delta rule, difference learning	Adaptable resonance theory
	SLO-2	Hodgkin -Huxley Equations, Numerical Integration		SVM	Actor, critic scheme	

Learning Resources	Text Book: 1. Paul Miller ,An Introductory Course in Computational Neuroscience, MIT Press ISBN: 9780262038256 ,October 2018. 2. Hans Peter A.Mallot, " Computational Neuro Science : A First Course" Springer 2013. Reference book: 3.Thomas P. Trappenberg, "Fundamentals of Computational Neuro Science", OXFORD University Press, Second Edition, 2010.

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
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 Industry	Experts from Higher Technical Institutions	Internal Experts
Soundararajan Dhakshinamoorthy, Principle software Engineer, Technology Leadersh OptumInsights India Pvt Ltd., Chennai	Dr. Lathaparthiban, Pondicherry University	Dr.C. Amuthadevi,SRMIST

Course Code	18AIE436T	Course Name	Autonomous Navigation and Vehicles	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
CLR-1:	Impart knowledge on the functional architecture of autonomous vehicles	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-2:	Understand Localization and mapping fundamentals			
CLR-3:	Gain Knowledge about the Sensing Technology and Algorithms applied in Autonomous vehicles			
CLR-4:	Understand the Connectivity Aspects and the issues involved in driverless vehicles			
CLR-5:	Learn the principles of drones			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:			
CLO-1:	Describe the evolution of Automotive Electronics and the operation of ECUs	2	80	75
CLO-2:	Employ localization mapping techniques for autonomous systems	2	80	70
CLO-3:	Discuss about the use of computer vision and learning algorithms in vehicles.	2	85	80
CLO-4:	Summarize the aspects of connectivity fundamentals existing in a driverless car	2	80	75
CLO-5:	Interpret the architecture and mechanisms of drones	2	85	75

Program Learning Outcomes (PLO)														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Engineering 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
L	-	-	-	M	-	-	-	-	-	-	L	M	L	-
H	H	H	-	M	-	-	-	-	-	-	L	M	L	-
M	-	-	-	M	-	-	-	-	-	-	L	M	L	-
M	H	H	-	M	-	-	-	-	-	-	L	M	L	-
M	H	H	-	M	-	-	-	-	-	-	L	M	L	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Evolution of Automotive Electronics	SLAM	Computer Vision and Deep Learning for Autonomous Vehicles	Vehicle-to-Vehicle Technology and Applications	ROS Framework
	SLO-2	Basic Control System Theory applied to Automobiles	Localization and mapping fundamentals	Introduction	Vehicle-to-Vehicle Technology and Applications	ROS Framework
S-2	SLO-1	Overview of the Operation of ECUs	Localization and mapping fundamentals	Computer Vision Fundamentals	Vehicle-to-Roadside and Vehicle-to-Infrastructure Applications	Autonomous Vehicles' Biggest Challenges
	SLO-2	Infotainment, Body, Chassis and and Powertrain Electronics	Basics of Radar Technology and Systems	Computer Vision Fundamentals	Security Issues	Technical Issues
S-3	SLO-1	Advanced Driver Assistance Systems	Ultrasonic Sonar Systems	Advanced Computer Vision	Autonomous Vehicle Technology	Security Issues
	SLO-2	Autonomous Vehicles	LIDAR and visual SLAM	Advanced Computer Vision	Autonomous Vehicle Technology	Moral and Legal Issues
S-4	SLO-1	functional architecture autonomous vehicle system	Camera Technology	Neural Networks for Image Processing	Driverless Car Technology	Drones - overview

	SLO-2	functional architecture autonomous vehicle system	Camera Technology	Neural Networks for Image Processing	Driverless Car Technology	definition
S-5	SLO-1	Major functions in an autonomous vehicle system	Night Vision Technology	TensorFlow	Different Levels of Automation	applications, components platforms
	SLO-2	Motion Modeling	Night Vision Technology	TensorFlow	Different Levels of Automation	propulsion
S-6	SLO-1	Motion Modeling	Use of Sensor Data Fusion	Overview of Deep Neural Networks	Localization	on-board flight control, payloads
	SLO-2	Coordinate frames and transforms	Kalman Filters	Overview of Deep Neural Networks	Localization	communications
S-7	SLO-1	point mass model	Navigation	Convolutional Neural Networks	Path Planning	concepts of flight
	SLO-2	Vehicle modeling	Global path planning	Convolutional Neural Networks	Path Planning	regulatory norms and regulations
S-8	SLO-1	kinematic and dynamic bicycle model - two-track models	Local path planning	Connected Car Technology - Connectivity Fundamentals	Controllers to Actuate a Vehicle	Machine learning and deep learning for autonomous driving
	SLO-2	Sensor Modeling - encoders	Vehicle control - Control structures	Connectivity Fundamentals	Controllers to Actuate a Vehicle	Machine learning and deep learning for autonomous driving
S-9	SLO-1	inertial sensors	PID control	DSRC (Direct Short Range Communication)	PID Controllers	Case study
	SLO-2	GPS	Linear quadratic regulator, Sample controllers	DSRC (Direct Short Range Communication)	Model Predictive Controllers	Case study

Learning Resources

1. *Hong Cheng, "Autonomous Intelligent Vehicles: Theory, Algorithms and Implementation", Springer, 2011. 2.*
2. *Williams. B. Ribbens: "Understanding Automotive Electronics", 7th Edition, Elsevier Inc, 2012.*
3. *Shaoshan Liu, Liyun Li, "Creating Autonomous Vehicle Systems", Morgan and Claypool Publishers, 2017.*
4. *Marcus Maurer, J.ChristianGerdes, "Autonomous Driving: Technical, Legal and Social Aspects" Springer, 2016.*
5. *Ronald.K.Jurgen, "Autonomous Vehicles for Safer Driving", SAE International, 2013.*
6. *James Anderson, KalraNidhi, Karlyn Stanly, "Autonomous Vehicle Technology: A Guide for Policymakers", Rand Co, 2014.*
7. *Daniel Watzenig and Martin Horn (Eds.), Automated Driving: Safer and More Efficient Future Driving, Springer, 2017*
8. *Sumit Ranjan, Dr. S. Senthamilarasu, "Build autonomous vehicles using deep neural networks and behavior-cloning techniques", 2020*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
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 Industry	Experts from Higher Technical Institutions	Internal Experts
1. Ms.Aparna, Associate Consultant, Geetanjali Park, Tata Consultancy Services, Kolkata	*1. Dr. Karthikeyean, Associate Professor, Jain Deemed to be University, Bangalore*	*Dr. V. Anbarasu, Associate Professor, SRMIST*

Course Code	18AIE437 T	Course Name	MOBILE GAME DEVELOPMENT	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Artificial Intelligence	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 concept of Computer science theory to practical programming tasks.		1	2	3		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-2:	Design familiar with basic coding practices		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)		Engineering	Problem Analysis	Design &	Analysis, Design,	Modern Tool Usage	Society & Culture	Environment &	Ethics	Individual & Team	Communication	Project Mgt. &	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLR-3:	Analyze the coding background to do individual and group projects.																				
CLR-4:	Familiarize with coding algorithms in computing platforms																				
CLR-5:	Implement software development for mobile computing platforms such as Smartphones and tablets with an emphasis on games																				
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																				
CLO-1:	Analyse a given computational task to recognize through practical programming tasks.		1	85	75		H	-	H	-	H	-	-	-	-	-	-	L	L	-	L
CLO-2:	Design to develop interactive applications in mobile gaming.		1	85	75		H	-	H	M	H	-	-	-	-	-	-	M	L	L	L
CLO-3:	Identify the component or a product applying all the relevant standards and with realistic constraints.		2	85	75		H	-	H	-	H	-	-	M	-	-	-	M	L	L	L
CLO-4:	Familiarize with the characterization and architecture of mobile applications.		2	85	75		H	-	H	M	H	-	-	M	-	-	-	M	L	L	L
CLO-5:	Implement and developing mobile applications using one application development framework.		2	80	70		H	-	H	M	H	-	-	M	-	-	-	M	L	L	L

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Mobile vs. desktop devices and architecture	Phone GAP	Comparing and Contrasting architectures of all three – Android, iOS and Windows	DB access	User interface
	SLO-2	Power Management			Network access	
S-2	SLO-1	Screen resolution	Native vs. web applications	Underlying OS (Darwin vs. Linux vs. Win 8)	Contacts/photos	Mobile AR-evaluation of AR
	SLO-2					
S-3	SLO-1	Touch interfaces	Mobile-specific enhancements	Kernel structure and native level programming	Native level programming on Android	standardization
	SLO-2					
S 4	SLO-1	Application deployment	Browser- detection	Runtime (Objective-C vs. Dalvik vs WinRT)	Low-level programming on (jailbroken) iOS	GPS-Accelerometer
	SLO-2					
S-5	SLO-1	App Store, Google Play & Windows Store	Touch interfaces	Approaches to power management & Security	Windows low level APIs	Mobile malware
	SLO-2					
S-6	SLO-1	Development environments	Geolocation	Building Application (IOS, Window, Android)	Wake locks and assertions	Device protections
	SLO-2					
S-7	SLO-1	XCode	Screen orientation	App structure & built-in Controls	Low-level OS support	Mobile Security
	SLO-2					
S-8	SLO-1	Eclipse	Mobile browser “interpretations” (Chrome/Safari/Gecko/IE)	File access	Writing power	Overview of the current mobile threat landscape
	SLO-2				Smart applications	

S-9	SLO-1 SLO-2	VS2012	Case studies	Basic graphics Android/iOS/Win8 inbuilt APP	Web and Augmented Reality	Mobile Security Solution

Learning Resources	1. John P Doran "Unity 2017 Mobile Game Development" Packt Publishing Limited , 2017. 2. Mario Zechner and Robert Green "Beginning Android 4 Games Development", 2011 3. Rajiv Ramnath, Roger Crawfis, and Paolo Sivilotti, Android SDK3 for Dummies, Wiley 2011. 4. Valentino Lee, Heather Schneider, and Robbie Schell, Mobile Applications: Architecture, Design, and Development, Prentice Hall, 2004. 5. Brian Fling,Mobile Design and Development O'Reilly Media,2009 6. Maximiliano Firtman Programming the Mobile Web, O'Reilly Media, 2010. 7. Christian Crumlish and Erin Malone Designing Social Interfaces, O'Reilly Media, 2009

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	*40%*		*30%*		*30%*		*30%*		*30%*	
Level 2	Apply Analyze	*40%*		*40%*		*40%*		*40%*		*40%*	
Level 3	Evaluate Create	*20%*		*30%*		*30%*		*30%*		*30%*	
	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	Experts from Higher Technical Institutions	Internal Experts
E Sampath Kumar, SENIOR LEADER, TCS, Chennai	Dr. Priyanka Kokil, IIITDM, Kancheepuram	*Dr. A. Suresh, SRMIST*
		Dr. M. Baskar, SRMIST
		Dr. J. Ramkumar, SRMIST

Course Code	18AIO351T	Course Name	INTRODUCTION TO ARTIFICIAL INTELLIGENCE	Course Category	C	Open Elective	L	T	P	C
							3	0	0	3

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1:	Analyze the various characteristics of Intelligent agents			
CLR-2:	Organizing different search strategies in AI			
CLR-3:	Incorporating Knowledge in solving AI problems			
CLR-4:	Constructing in different ways of designing software agents			
CLR-5:	Planning various applications of AI.			
CLR-6:	Applying different scenarios of reasoning			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering 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:	Use appropriate search algorithms for any AI problem	3	80	70	H		-	-	-	-	-	-	-	-	-	-	H	H	H
CLO-2:	Represent a problem using first order and predicate logic	3	85	75	H	H	H	-	-	-	-	-	-	-	-	-	H	H	H
CLO-3:	Provide the apt agent strategy to solve a given problem	3	75	70	H	H	M	L	L	-	-	-	-	-	-	-	H	H	H
CLO-4:	Design software agents to solve a problem	3	85	75	H	L	M	M	M	L	-	-	-	-	-	-	H	H	H
CLO-5:	Design application that uses Artificial Intelligence.	3	85	75	H	L	H		H		-	-	-	-	M	-	H	H	H
CLO-6:	Experiment with various scenarios in Reasoning	3	80	70	H	L	M	M	M	L	-	-	-	-	-	-	H	H	H

Duration (hour)		12	12	12	12	12
S-1	SLO-1	Introduction, Definition	Alpha beta pruning	Architecture for intelligent agents, Agent communication	Planning, Moving	Resolution method, First order logic
	SLO-2	Future of Artificial Intelligence, Characteristics		Negotiation	Frames	Second order logic
S-2	SLO-1	Typical Intelligent agents	First order predicate logic	Bargaining, Argumentation	Scripts	Genetic algorithms
	SLO-2	Problem solving approach		Agents	Goals	Travelling sales man problem
S-3	SLO-1	Search strategies	Porlog programming, Unification	Trust, Reputation	Plans, Inheritance in Taxonomies	Neural networks
	SLO-2					
S-4	SLO-1	Uniformed and informed	Forward Chaining	Multi agent systems	Description logics	Ant colony optimization
	SLO-2					
S-5	SLO-1	Heuristics, Local search	Backward chiming Resolution	AI applications	Formal concept analysis	Generate and search
	SLO-2					
S-6	SLO-1	Algorithm and optimization problems	Knowledge Representation	Language Models, Information Retrieval	Conceptual graphs, Hierarchies in domain	Depth first search – Breadth First Search
	SLO-2					
S-7	SLO-1	Constraint satisfactory problems	Events, Mental Events	Information extraction,	Knowledge based reasoning, Agents	Quality of Solution
	SLO-2					

7	SLO-1	Constraint propagation	Mental Objects	Natural language processing	Facts of knowledge	Depth bounded DFS
	SLO-2					
8	SLO-1	Back tracking search	Reasoning Systems	Machine translation, Speech recognition	Logic and inference	Hill climbing
	SLO-2					
9	SLO-1	Game playing, Optimal decision	Reasoning with default information, Typical AI Problems	Robot Hardware, Perception	Formal logic	Beam search
	SLO-2				Propositional logic	

Learning Resources	1. S. Russell and P. Norvig, "Artificial Intelligence: A Modern Approach", Prentice Hall, Third Edition, 2009. 2. I. Bratko, "Prolog: Programming for Artificial Intelligence", Fourth edition, Addison- Wesley Educational Publishers Inc., 2011 3. M. Tim Jones, "Artificial Intelligence: A Systems Approach (Computer Science)", Jones and Bartlett Publishers, Inc.; First Edition, 2008 4. Nils J. Nilsson, "The Quest for Artificial Intelligence", Cambridge University Press, 2009.	5. William F. Clocksin and Christopher S. Mellish, Programming in Prolog: Using the ISO Standard", Fifth Edition, Springer, 2003. 6. Gerhard Weiss, "Multi Agent Systems", Second Edition, MIT Press, 2013. 7. David L. Poole and Alan K. Mackworth, "Artificial Intelligence: Foundations of Computational Agents", Cambridge University Press, 2010. 8. "A First Course in Artificial Intelligence", Deepak Khemani, McGraw Hill Education, 2013. 9. "Artificial Intelligence" E. Rich and K. Knight, Mc Graw Hill Publishers INC, 3rd Edition 2017.

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
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 Industry	Experts from Higher Technical Institutions	Internal Experts
Dr. Marriappan Vaithilingam, Senior Director of Engineering, Fresh works	Dr. Udendran, Dept. of CSE., Bharathidasan University, Tiruchirappalli	Dr. A. Suresh, SRMIST Dr. A. Alice Nithya, SRMIST Mr. Joseph James, SRMIST

Course Code	18AIO352T	Course Name	MACHINE LEARNING	Course Category	E	Open Elective	L	T	P	C
							3	0	0	3

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

		Learning		
Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	1	2	3
		Level of Thinking (Bloom) Level of T	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	*To provide basic concepts of machine learning*			
CLR-2 :	*To provide deeper understanding of various tools and techniques for Machine learning Algorithms and outputs*			
CLR-3 :	*Understand and Implement the major classification techniques*			
CLR-4 :	*Understand and Implement the various Clustering Methods*			
CLR-5 :	*Learn and Understand the Tree based machine Learning Algorithms*			
Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*			
CLO-1 :	*Understand the concepts of machine learning*	*2*	*80*	*85*
CLO-2 :	*Learn and understand tools and libraries of machine learning*	*2*	*75*	*80*
CLO-3 :	*Learn and understand the linear learning models and classification in machine learning*	*2*	*85*	*80*
CLO-4 :	*Understand the clustering techniques and their utilization in machine learning*	*2*	*80*	*75*
CLO-5 :	*Study the tree based machine learning techniques and to appreciate their capability*	*2*	*75*	*85*

Program Learning Outcomes (PLO)														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Engineering 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
H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
H	*H*	*H*	-	*H*	-	-	-	-	-	-	-	-	-	-
H	*H*	-	-	*H*	-	-	-	-	-	-	-	-	-	-
H	*H*	-	-	*H*	-	-	-	-	-	-	-	-	-	-
H	*H*	-	*H*	*H*	-	-	-	-	-	-	-	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Machine Learning: What and Why?*	*Platform for machine learning*	*Ridge Regression*	*Measuring (dis)similarity*	*Decision tree representation*
	SLO-2	*Types of Machine Learning*			*Evaluating output of clustering methods*	
S-2	SLO-1	*Supervised Learning*	*Machine learning python libraries*	*Maximum likelihood estimation (least squares)*	*Spectral clustering*	*Basic decision tree learning algorithm*
	SLO-2	*Unsupervised Learning*			*Hierarchical clustering*	
S-3	SLO-1	*Reinforcement learning*	*training data – testing data – validation data*	*principal component analysis*	*Agglomerative clustering*	*Inductive bias in decision tree*
	SLO-2					
S-4	SLO-1	*The Curse of dimensionality*	*k-fold cross validation*	*Bayesian classifier*	*Divisive clustering*	*Decision tree construction*
	SLO-2	*Over fitting and under fitting*	*Features*			
S-5	SLO-1	*Linear Regression*	*Performance metrics*	*Support vector machine*	*Choosing the number of clusters -*	*Issues in decision tree*
	SLO-2				*Clustering datapoints and features*	
S-6	SLO-1	*Bias and Variance tradeoff*	*MSE, accuracy, confusion matrix, precision*	*Support vector machine + kernels*	*Bi-clustering*	*Classification and regression trees (CART)*
	SLO-2	*Testing – cross validation*				
S-7	SLO-1	*Regularization*	*recall, F- score*	*Multi class classification*	*Multi-view clustering*	*Random Forest*
	SLO-2	*Learning Curve*				
S-8	SLO-1	*Classification - Error and noise*	*Linear Regression with multiple variables*	*K nearest neighbour classification*	*K-Means clustering*	*Multivariate adaptive regression trees (MART)*
	SLO-2					
S-9	SLO-1	*Parametric vs. non-parametric models*	*Logistic Regression*	*K nearest neighbour classification*	*K-medoids clustering*	*Introduction to Artificial Neural Networks*
	SLO-2					

Learning Resources	1. *Kevin P. Murphy, -Machine Learning: A Probabilistic Perspective‖, MIT Press, 2012.* 2. *Ethem Alpaydin, -Introduction to Machine Learning‖, Prentice Hall of India, 2005* 3. *Tom Mitchell, "Machine Learning", McGraw-Hill, 1997.*	4. *Sebastian Raschka, Vahid Mirjilili,‖Python Machine Learning and deep learning‖, 2nd edition, kindle book 2018* 5. *Carol Quadros,‖Machine Learning with python, scikit-learn and Tensorflow‖, Packet Publishing, 2018.* 6. *Gavin Hackeling,‖ Machine Learning with scikit-learn‖, Packet publishing, O'Reily, 2018.*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
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 Industry	Experts from Higher Technical Institutions	Internal Experts
Dr. Marriappan Vaithilingam, Senior Director of Engineering, Fresh works	*Dr. Udendran, Dept. of CSE., Bharathidasan University, Tiruchirappalli*	*Dr.G.Vadivu* *Dr. UshaKiruthika* *Mr.S.Joseph James*

Course Code	18AIO353J	Course Name	Python for Data Analytics	Course Category	E	Open Elective	L	T	P	C
							2	0	2	3

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

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

CLR-1 :	Introduce a range of topics and concepts related to data and data analysis process.		1	2	3		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-2 :	Understand the basic data structures involved in python to perform exploratory data analysis		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)		Engineering	Problem Analysis	Design &	Analysis, Design,	Modern Tool Usage	Society & Culture	Environment &	Ethic	Individual & Team	Communication	Project Mgt. &	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLR-3 :	Apply EDA for different file formats.																				
CLR-4 :	Understands data visualization using python																				
CLR-5 :	Provides an exposure to basic machine learning techniques to solve real world problems																				
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																				
CLO-1 :	Understand different types of data and starts working in python environment		2	85	75		H	M	L	-	-	-	-	-	-	-	-	H	H	H	H
CLO-2 :	Understand various data structures involved in python and perform exploratory data analysis		2	75	70		H	M	L	-	-	-	-	-	-	-	-	H	H	H	H
CLO-3 :	Apply the concepts of EDA in various datasets.		2	80	75			M	-	-	-	H	L	-	-	-	-	H	H	H	H
CLO-4 :	Formulate and use appropriate visualization techniques for their data		2	75	70		M	M	L	-	-			-	-	-	-	H	H	H	H
CLO-5 :	Formulate and use appropriate models of data analysis to solve hidden solutions to business-related challenges		2	80	70		-	-	-	M	-	H	H	-	-	-	-	H	H	H	H

Duration (hour)		15	15	15	15	15
S-1	SLO-1	Introduction to Python	Numpy Library: Numpy Installation	Pandas: Reading data from csv, xml, text and html files	Data visualization with matplotlib library	Machine Learning with sci-kit learn
	SLO-2		Ndarray, Create an array and Types of data	Writing data in CSV, Html, Excel, files	Matplotlib – Installation and architecture	sci-kit learn library
S-2	SLO-1	Python Data Structures and Functions	Basic Operations: Arithmetic Operators, Matrix Product, Increment and Decrement Operators	Json data	Pyplot, plotting window	Machine Learning - Supervised learning with sci-kit learn
	SLO-2		Operations on Numpy array	Data preparation - Concatenating	Using Kwargs and adding elements to the chart	
S-3	SLO-1	Basic Python Programs	Application using Numpy and its functions	Applications illustration of loading external data using Panda	Application using different plotting techniques	Application of Supervised learning
	SLO-2					
S-4	SLO-1	Introduction to Data Analysis	Shape and array manipulation	Data transformation- Removing duplicates	Line charts	Linear Regression
	SLO-2	Understanding the nature of Data -- Types of Data	Vectorization, structured arrays	Mapping		

S-5	SLO-1	*Data – Information; Information - Knowledge*	*Pandas library: Installation*	*Discretization and binning: Detecting and filtering outliers*	*Bar charts- Pie charts*	*Logistic Regression*
	SLO-2	*Types of Data*	*Introduction to Pandas data structures*	*Permutation – random sampling - String manipulation*		
S-6	SLO-1	*Application using Python Data structures and libraries*	*Application using Python Panda library*	*Application using Panda library*	*Application using different plotting techniques*	*Application using regression techniques*
	SLO-2					
S-7	SLO-1	*Quantitative Data Analysis*	*Function application and mapping*	*Data Aggregation- Group by*	*Histograms - Polar charts*	*Support Vector Machines*
	SLO-2	*Qualitative Data Analysis*	*Sorting and ranking*	*Hierarchical grouping*	*Mplot 3D toolkit: 3D surfaces*	*Support Vector Classification*
S-8	SLO-1	*Scipy: Numpy*	*Correlation and covariance*	*Advanced data aggregation*	*Scatter plots and bar charts in 3D*	*Support Vector Regression*
	SLO-2	*Pandas, Matplotlib*	*Hierarchical Indexing and leveling*		*Multi-panel plot*	
S9	SLO-1	*Applications using Python libraries*	*Applications using Panda library functions*	*Application illustrating data aggregation function using Panda*	*Application using different plotting techniques*	*Application using Support Vector*
	SLO-2					

Learning Resources	1. Fabio Nelli, Python Data Analytics with Pandas, Numpy and matplotlib (Second edition), Apress 2. Wes McKinney, Python for Data Analysis, 2nd Edition, O'Reilly Media, Inc. (https://learning.oreilly.com/library/view/python-for-data/9781491957653/) 3. Jake vaderplas, Python Data Science Handbook: Essential tools for Working with Data, O'Reily Media, 2016 4. Charles R. Severance , "Python for Everybody Exploring Data Using Python", Charles Severance, 2016.

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		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	Experts from Higher Technical Institutions	Internal Experts
Mr. Senthilnathan, Co-founder, Tenzai, Bangalore	*Dr. E. Sivasankar, Assistant Professor, Department of CSE, NIT, Trichy*	*Mr.C.Arun, School of Computing, SRMIST*

Course Code	18AIO354T	Course Name	Soft Computing	Course Category	E	Open Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	Nil
Course Offering Department	*Artificial Intelligence*	**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:	Understand the ideas of fuzzy sets, fuzzy logic and use of heuristics based on human experience		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)		Engineering 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:	Gain knowledge on neural networks with examples																				
CLR-3:	Gain knowledge on the mathematical background for carrying out the optimization associated with neural network learning																				
CLR-4:	Gain knowledge on genetic algorithms and other random search procedures useful while seeking global optimum in self-learning situations																				
CLR-5:	Introduce case studies utilizing the above and illustrate the intelligent behavior of programs based on soft computing																				
Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*																				
CLO-1:	Analyse a given computational task to recognize the appropriateness through fuzzy sets		*3*	*85*	*80*		*M*	-	-	-	-	-	*M*	-	-	-	-	*L*	*L*	-	*L*
CLO-2:	Design a fuzzy based soft computing system to address the computational task		*3*	*85*	*80*		*M*	-	*H*	-	-	-	*M*	-	-	-	-	*M*	*L*	*L*	*L*
CLO-3:	Analyse a given computational task to solve it through neural network		*3*	*85*	*80*		*M*	*H*	*L*	-	-	-	*M*	*L*	-	-	-	*M*	*L*	*M*	*L*
CLO-4:	Apply Genetic Algorithm operations for solving a computational task		*3*	*85*	*80*		*M*	*L*	*L*	-	-	-	*M*	*L*	-	-	-	*M*	*L*	*M*	*L*
CLO-5:	Design and implement a soft computing system to achieve a computational solution		*3*	*85*	*80*		*M*	*L*	*L*	-	-	-	*M*	*L*	-	-	-	*M*	*M*	*L*	*L*

Duration (hour)		*9*	*9*	*9*	*9*	*9*
S-1	SLO-1	Introduction to Soft Computing	Fuzzy Inference Systems	Neural Networks in Computer Science	Advanced Search Strategies	Hybrid Systems
	SLO-2	Evolution from Conventional AI to Computational intelligence		Biological model	Natural Evolution	
S-2	SLO-1	Evolutionary Search Strategies Fuzzy Sets	Fuzzification, Application of Fuzzy Operators on Antecedent part of Rules	McCulloch-Pitts Model	Chromosomes	Neuro-Fuzzy Modelling
	SLO-2				Systematic approach of Elitism (Selection-Crossover- Mutation)	
S-3	SLO-1	Fuzzy Membership Functions	Evaluation of Fuzzy Rules	The Perceptron Model	Development of Genetic Algorithm, Fitness Function, Population	Control
	SLO-2				GA operators	
S 4	SLO-1	Operations	Defuzzification	Widrow-Hoff's Delta Rule	Parameters	Feedback control
	SLO-2				Convergence	

S-5	SLO-1	Relations	Problems associated to Fuzzy controller	XOR Problem	Pattern Classifiers	Neuro fuzzy control
	SLO-2					
S-6	SLO-1	Fuzzy Extension Principle Basics of Fuzzy Logic	Cruise Controller and Air Conditioner Controller	Curse of Dimensionality	Layered Feed Forward Neural Networks	Neuro-fuzzy Reinforcement Learning
	SLO-2					
S-7	SLO-1	Problem solving using Fuzzy Rules	Convergence of efficiency parameter	Dimensionality Reduction	Solution for XOR Problem	Gradient Free Optimization (GA operators)
	SLO-2				Hebb's Rule	
S-8	SLO-1	Fuzzy Reasoning	Boltzmann's Machine Learning Algorithm	Activation Functions	Competitive Learning Methods (Kohonen's Self Organizing Maps and Learning Vector Quantization)	Gain Scheduling
	SLO-2				Pattern Associators (Hopfield nets)	
S-9	SLO-1	Mamdani s Representation	Back Propagation Algorithm	Learning by Neural Nets	Back Propagation Networks	Case study: Color Recipe Prediction.
	SLO-2				**Generalized Delta Rule**	

Learning Resources	1. Sandhya Bansal & Rajiv Goel "Fundamentals of Soft Computing", 1st Edition, Notion Press Publication, 2020 2. Saroj koushik & Sunita Tiwari "Soft Computing, Fundamentals, Techniques and Applications" 1st Edition, McGraw Hill Publication, 2018 3. Samir Roy and Udit Chakraborthy , "Introduction to Soft Computing: Neuro-Fuzzy and Genetic Algorithms" Pearson Education,2013. 4. J.S.R. Jang, C.T.sun and E. Mizutani ,"Neuro-fuzzy and Soft Computing: A computational Approach to Learning and Machine Intelligence, Pearson Education, 2004. 5. D.E.GoldBerg, "Genetic Algorithms in Search, Optimization, and Machine Learning", Pearson Education, 2013. 6. S.N.Sivanandam, S.N.Deepa, "Priciples of Soft Computing", 2nd Edition, John-Wiley India,2011. 7. G.J.Klir and B.Yuan, "Fuzzy Sets and Fuzzy Logic: Theory and Applications", Second Reprint, PHI,2000. 8. J.A.Freeman and D.M.Skapura, "Neural Networks: Algorithms, Applications and Programming Techniques", Pearson Education, 2011. .

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
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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