Course Code	21ECO103T	Course Name	MODERN WIRELESS COMMUNICATION SYSTEM	Course Category	O	OPEN ELECTIVE	L	T	P	C
							3	0	0	3

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

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1:	*Learn to analyze the transmission of various wireless communication systems*
CLR-2:	*Understand the fundamentals of various networks in wireless communication*
CLR-3:	*Understand the techniques involved in personal communication services.*
CLR-4:	*Introduce various wireless systems for 3G and future communication*
CLR-5:	*Learn to analyze wireless networks for short range communication and understanding the fundamentals*

Course Outcomes (CO):	*At the end of this course, learners will be able to:*	Program Outcomes (PO)												Program Specific outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12			
		Engineering Knowledge	Problem Analysis	Design/development of solutions	Conduct investigations of complex problems	Modern Tool Usage	The engineer and society	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO-1	PSO-2	PSO-3
CO-1:	*Discuss the fundamentals of transmission in wireless systems*	-	-	-	*3*	-	-	-	-	-	-	-	-	*3*	-	-
CO-2:	*Provide an overview of various approaches to communication networks*	-	-	-	*3*	-	-	-	-	-	-	-	-	-	-	*3*
CO-3:	*Study the numerous different-generation technologies with their individual pros and cons*	-	-	-	*3*	-	-	-	-	-	-	-	-	*2*	-	*3*
CO-4:	*Discuss about the principles of operation of the different access technologies like FDMA, TDMA, SDMA and CDMA and their pros and cons*	-	-	-	*3*	-	-	-	-	-	-	-	-	*2*	-	*3*
CO-5:	*Learn about the various mobile data services and short-range networks and gain knowledge on Fundamentals*	-	-	-	*3*	-	-	-	-	-	-	-	-	*3*	-	*3*

Unit-1 - Transmission Fundamentals	***9 Hour***
Cellphone Generations- 1G and 2G- 2.5G- 3G- 4G Transmission Introduction- 4G Transmission Fundamentals- Time domain concepts- Frequency domain concepts- Radio Media- Analog Vs Digital- Channel capacity- Transmission media- Signaling Schemes	
Unit-2 - Network Concepts	***9 Hour***
Communication Networks, LANs, MANs, WANs, Circuit switching, Packet switching, ATM Cellular Networks Introduction, Cells, Duplexing, Multiplexing, Voice coding, Multiple Access Techniques: FDMA, TDMA, SDMA, CDMA, Spectral efficiency	
Unit-3 - Personal Communication Services	***9 Hour***
Personal communication Introduction, HSCSD, GPRS, D-AMPS, CDMA One, CDMA Two, Packet Data Systems- GSM-HSCSD- GPRS- D-AMPS- CDMA Introduction-CDMA One- CDMA Two- Packet Data Systems	
Unit-4 - 3G and Beyond	***9 Hour***
3G Introduction- MT-2000 Introduction- IMT-2000- W-CDMA Introduction- W-CDMA- CDMA 2000 Introduction- EDGE- Wi-Fi Introduction- WiMAX Introduction- WiMAX-OFDM- MIMO	
Unit-5 - Mobile Data Services and Short Range Network	***9 Hour***
Mobile Data Services Introduction Messaging, wireless web, WAP, site design Short-Range Wireless Networks: Unlicensed spectrum, WLANs, cordless telephony, IrDA, Bluetooth Smart Phones: Future phones , mobile OSs, smart phone applications- Data Services- Messaging- Wireless web-WAP- Site design- Short-Range Wireless Networks- Unlicensed spectrum- WLANs- Cordless telephony- IrDA- Bluetooth Smart Phones- Future phones- Mobile Oss- Smart phone applications	

Learning Resources	1. *Simon Haykin, David Koilpillai, Michael Moher," Modern Wireless Communication", 1/e, Pearson Education, 2011.* 2. *Rappaport T.S, "Wireless Communications: Principles and Practice", 2nd edition, Pearson education.* 3. *Andrea Goldsmith, "Wireless Communications", Cambridge University Press, Aug. 2005.* 4. *Andy Dornan, "The essential guide to wireless communications applications: from cellular systems to Wi-Fi", 2nd Edition, Prentice Hall, 2002*	5. *Ian F.Akyildiz, David M. Gutierrez Estevez, and Elias Chavarria Reyes, " The evolution of 4G cellular systems: LTE advanced", Physical communication, Volume 3, No. 4, pp. 217-298, Dec. 2010* 6. *William Stallings, "Wireless Communication & Networking", Pearson Education Asia, 2004.* 7. *Andrea.F. Molisch, "Wireless communications", 2nd edition, Wiley Publications.*

Learning Assessment

	Bloom's Level of Thinking	*Continuous Learning Assessment (CLA)*				*Summative Final Examination (40% weightage)*	
		Formative CLA-1 Average of unit test (50%)		*Life-Long Learning CLA-2 (10%)*			
		Theory	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*
Level 1	*Remember*	*15%*	-	*15%*	-	*15%*	-
Level 2	*Understand*	*25%*	-	*20%*	-	*25%*	-
Level 3	*Apply*	*30%*	-	*25%*	-	*30%*	-
Level 4	*Analyze*	*30%*	-	*25%*	-	*30%*	-
Level 5	*Evaluate*	-	-	*10%*	-	-	-
Level 6	*Create*	-	-	*5%*	-	-	-
	Total	*100 %*		*100 %*		*100 %*	

Course Designers

Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
1. *Mr. Anuj Kumar, Bombardier Transportation, Ahmedabad, kumaranuj.anii@gmail.com*	1. *Dr. Meenakshi, Professor of ECE, CEG, Anna University, meena68@annauniv.edu*	1. *Dr. Sandeep Kumar P, SRMIST*
2. *Mr. Hariharasudhan - Johnson Controls, Pune, hariharasudhan.v@jci.com*	2. *Dr. Venkatesan, Sr. Scientist, NIOT, Chennai, venkat@niot.res.in*	

Course Code	21MAB302T	Course Name	DISCRETE MATHEMATICS	Course Category	B	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		Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1 :	Enhance the mathematical skills by applying the principles of sets and functions in storage, communication and processing the data
CLR-2 :	Culminate in extensive use and application of counting strategies in enumeration of data
CLR-3 :	Apply the rules of inference theory to design electronic circuits and to verify computer programs
CLR-4 :	Apply the knowledge of algebraic structures and coding theory to solve problems on detection and correction of errors occurring in binary communication channels
CLR-5 :	Acquire knowledge to solve problems in communication networks using graph models

Course Outcomes (CO):	At the end of this course, learners will be able to:	Program Outcomes (PO)												Program Specific outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12			
		Engineering Knowledge	Problem Analysis	Design/development of solutions	Conduct investigations of complex problems	Modern Tool Usage	The engineer and society	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO-1	PSO-2	PSO-3
CO-1:	Apply the concepts of set theory and its operations in data structures and mathematical modelling languages	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO-2:	Solve problems using counting techniques and understanding the basics of number theory	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO-3:	Comprehend and validate the logical arguments using concepts of inference theory	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO-4:	Inculcate the curiosity for applying the concepts of algebraic structures to coding theory	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO-5:	Apply graph theory techniques to solve wide variety of real world problems	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-

Unit-1 Set Theory	**12 Hour**
Sets - Operations on sets - Laws of set theory - Partition of a set - Cartesian product of sets - Relations - Properties - Equivalence relation and partial order relation - Poset - Graphs of relations - Digraphs - Hasse diagram - Closures of relations - Transitive closure and Warshall's algorithm - Functions - Types of functions - Composition of functions - Properties - Inverse of functions - Necessary and sufficient condition for existence of inverse function - Uniqueness of identity - Inverse of composition.	
Unit-2 -Combinatorics and Number Theory	**12 Hour**
Permutation and combination - Addition and product rules - Principle of inclusion and exclusion - Pigeon-hole principle and generalized pigeon-hole principle - Divisibility and prime numbers - Fundamental theorem of arithmetic - Prime factorization - Division algorithm- Greatest common divisor - Properties - Euclid's algorithm - Least common multiple.	
Unit-3: Mathematical Logic	**12 Hour**
Propositions and logical operators - Truth tables - Converse, inverse and contrapositive - Tautology and contradiction - Equivalences - Implications - Laws of logic - Inference theory - Rules of inference - Direct method - CP rule – Inconsistency - Indirect method - Principle of mathematical induction.	
Unit-4 : Algebraic Structures and Coding Theory	**12 Hour**
Groups - Permutation group - Cyclic group - Properties - Subgroup- Group homomorphism - Properties - Ring - Zero divisor - Integral domain- Field -Coding theory - Group code - Hamming codes - Error correction using matrices - Error correction - Decoding group codes.	
Unit-5: Graph Theory	**12 Hour**
Definitions - Handshaking theorem - Some special graphs - Isomorphism of graphs - Paths, cycles and circuits - Connectivity in undirected graphs - Eulerian and Hamiltonian graphs - Matrix representation of graphs- Isomorphism using adjacency - Digraphs - Trees - Properties - Spanning tree - Kruskal's algorithm - Graph coloring - Chromatic number- Four color theorem (statement only).	

Learning Resources	1. *H. Kenneth Rosen, Discrete Mathematics and its Application, Seventh edition, Tata McGraw-Hill Publishing company PVT. Ltd., New Delhi, 2012.* 2. *J.P. Tremblay and R. Manohar, Discrete Mathematical Structures with applications to Computer Science, 35th edition, Tata McGraw Hill Publishing Co., 2008.* 3. *Narsing Deo, Graph Theory with applications to Engineering and Computer science, Prentice-Hall of India pvt. Ltd., New Delhi, 2004*	4. *C.L. Liu, Elements of Discrete Mathematics, 4th Edition, McGraw Higher ED, 2012.* 5. *R.P. Grimaldi, Discrete and Combinatorial Mathematics: An Applied Introduction, 4th Edition, Pearson Education Asia, Delhi, 2007.* 6. *T. Veerarajan, Discrete Mathematics with Graph Theory and Combinatorics, Tata McGraw Hill, 2015.*

Learning Assessment

	Bloom's Level of Thinking	*Continuous Learning Assessment (CLA)*				*Summative Final Examination (40% weightage)*	
		Formative CLA-1 Average of unit test (50%)		*Life Long Learning CLA-2 – (10%)*			
		Theory	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*
Level 1	*Remember*	*20%*	-	*20%*	-	*20%*	-
Level 2	*Understand*	*20%*	-	*20%*	-	*20%*	-
Level 3	*Apply*	*30%*	-	*30%*	-	*30%*	-
Level 4	*Analyze*	*30%*	-	*30%*	-	*30%*	-
Level 5	*Evaluate*	-	-	-	-	-	-
Level 6	*Create*	-	-	-	-	-	-
	Total	*100 %*		*100 %*		*100 %*	

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. *Mr. Madhan Shanmugasundaram, Infosys Technologies, madshan@gmail.com*	*1 Prof. Y.V.S.S. Sanyasiraju, IIT Madras, sryedida@iitm.ac.in*	*1. Dr. V. Subburayan, SRMIST*
	2. Prof. K.C. Sivakumar, IIT Madras, kcskumar@iitm.ac.in	*2. Dr. J. Sasikumar, SRMIST*
		3. Dr. L. Shobana, SRMIST

Course Code	21PDM301L	Course Name	ANALYTICAL AND LOGICAL THINKING SKILLS	Course Category	M	NON CREDIT	L	T	P	C
							0	0	2	0

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

Course Learning Rationale (CLR):	***The purpose of learning this course is to:***
CLR-1:	*Recapitulate fundamental mathematical concepts and skills.*
CLR-2:	*Arrive at solutions to mathematical problems with requisite speed & accuracy.*
CLR-3:	*Sharpen logical reasoning through skillful conceptualization, hone analytical thinking skills.*
CLR-4:	*understand and master the mathematical concepts to solve types of problem tested in competitive examinations.*
CLR-5:	

Course Outcomes (CO):	***At the end of this course, learners will be able to:***	**Program Outcomes (PO)**												**Program Specific outcomes**		
		1	2	3	4	5	6	7	8	9	10	11	12			
		Engineering Knowledge	Problem Analysis	Design/development of solutions	Conduct investigations of complex problems	Modern Tool Usage	The engineer and society	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO-1	PSO-2	PSO-3
CO-1:	*Build a strong base in the fundamental mathematical concepts.*	-	-	-	-	-	-	-	-	*3*	*3*	-	*3*	-	-	-
CO-2:	*Identify the approaches and strategies to solve problems with speed and accuracy.*	-	-	-	-	-	-	-	-	*3*	*3*	-	*3*	-	-	-
CO-3:	*Understand, comprehend and provide logical conclusions to solve problems in teams, groups and individually.*	-	-	-	-	-	-	-	-	*3*	*3*	-	*3*	-	-	-
CO-4:	*Gain appropriate skills to succeed in preliminary selection process for recruitment.*	-	-	-	-	-	-	-	-	*3*	*3*	-	*3*	-	-	-

Unit-1 - Numbers	***10 Hour***
Numbers – Logarithm	
Unit-2 – Modern Mathematics	***10 Hour***
Permutation and Combination – Probability - Clock and Calendars **–** *Crypt Arithmetic*	
Unit-3 – Analytical Ability	***10 Hour***
Number, Word Series – Coding Decoding – Cubes – Geometry, Mensuration – Trigonometry - Data Interpretation – Data Sufficiency	

Learning Resources	
1. *Nishit K. Sinha, The Pearson Guide to Quantitative Aptitude and Data Interpretation for the CAT*	3. *Arun Sharma, How to Prepare for Quantitative Aptitude for CAT, Tata McGraw Hill*
2. *Dinesh Khattar-The Pearson Guide to Quantitative Aptitude for competitive examinations*	

Learning Assessment									
	Bloom's Level of Thinking	Continuous Learning Assessment (CLA)						Final Examination (0% weightage)	
		Formative CLA-1 (30%)		Formative CLA-2 (30%)		Summative (40%)			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	-	30%	-	30%	-	30%	-	-
Level 2	Understand	-	20%	-	20%	-	20%	-	-
Level 3	Apply	-	30%	-	30%	-	30%	-	-
Level 4	Analyze	-	20%	-	20%	-	20%	-	-
Level 5	Evaluate	-	-	-	-	-	-	-	-
Level 6	Create	-	-	-	-	-	-	-	-
	Total	100%		100%		100%		-	

Course Designers		
Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
1. Mr.Pratap Iyer, Study Abroad Mentors,pratap.iyer30@gmail.com	1. Mr Nishith Sinha, dueNorth India Academics LLP, nsinha.alexander@gmail.com	1. Dr. P. Madhusoodhanan, SRMIST
2. Mr Ajay Zenner, Career Launcher, ajay.z@careerlauncher.com	2. Dr.Dinesh Khattar, Delhi University, dinesh.khattar31@gmail.com	2. Dr. M. Sneha Latha, SRMIST
		3. Dr Jayapragash J, SRMIST
		4. Ms. I. Jerlina John, SRMIST

Course Code	21LEM301T	Course Name	INDIAN ART FORM	Course Category	M	NON CREDIT	L	T	P	C
							1	0	0	0

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

Course Learning Rationale (CLR):	***The purpose of learning this course is to:***
CLR-1:	*introduce the learners to the changing art forms in different periods of time: richness, variety and significance of various Indian art forms*
CLR-2:	*enable the students to recognize and appreciate paintings of different schools prevalent in the different geographical locations*
CLR-3:	*draw the learner's attention towards the various types of sculpture based on the materials used and the themes behind them*
CLR-4:	*cultivate a sense of appreciation about the aesthetics of drawing as an integral part of our daily life*
CLR-5:	*orient the learners about the changing Indian social scenario and the ways they are reflected in the changing facets of Modern Indian Art Forms*

Course Outcomes (CO):	***At the end of this course, learners will be able to:***	**Program Outcomes (PO)**												**Program Specific outcomes**		
		1	2	3	4	5	6	7	8	9	10	11	12			
		Engineering Knowledge	Problem Analysis	Design/development of solutions	Conduct investigations of complex problems	Modern Tool Usage	The engineer and society	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO-1	PSO-2	PSO-3
CO-1:	*Classify with an awareness of the rich cultural heritage of India*	-	-	-	-	-	*3*	-	-	-	-	-	*3*	-	-	-
CO-2:	*Understand the contexts and significance of various Indian art forms*	-	-	-	-	-	*3*	-	-	-	-	-	*3*	-	-	-
CO-3:	*Understand how the confluence of the diverse art forms of India create the mosaic of the Indian nation*	-	-	-	-	-	*3*	-	-	-	-	-	3	-	-	-
CO-4:	*Differentiate each artwork from different periods be it an architecture, sculpture, painting or decorative and functional object*	-	-	-	-	-	*3*	-	-	-	-	-	*3*	-	-	-
CO-5:	*Relate with history and development of Art and its historical, social, cultural, religious and political context.*	-	-	-	-	-	*3*	-	-	-	-	-	*3*	-	-	-

Unit-1 - Indian Art over Ages - An Overview	***3 Hour***
Ancient India: An Overview, Raj-Ravi Verma: religious stories like mythologies of Hindu gods, Mysore and Tanjore Art: included themes revolving around Hindu epics like, Ramayana and Mahabharata, Indian artists from different fields, Folk Art, Folk art and popular culture: Classical and folk art. Influential factors giving rise to modern art. Concepts and Motifs behind modern art Mughal paintings. Astonishing contemporary paintings by Indian artists. Fairs, festivals and local deities in the development of art forms. Myth, legends, snippets from epic, multitudinous gods born out of dream and fantasy in art forms	
Unit-2 - Indian Painting	***3 Hour***
Indus Valley civilization paintings on pottery. Cave paintings from different parts of India. The paintings of the Ajanta and Ellora caves. Paintings of North India, South India, East India, West India, Central and Deccan India, Thanjavur, Madhubani paintings, Analyzing the recurrent themes style through selected illustrations. Kalamkari paintings – Features of organic art; obtaining colours from natural sources, Attempting Simple Kalamkari/Madhubani paintings using natural colours, Pattachitra paintings, Students, presenting and sharing their paintings, Moghal paintings, Moghal paintings from the various Moghal dynasties and identification of the common features	
Unit-3 - Indian sculpture	***3 Hour***
Sculpture during the Harappan period, Terra Cota – What? Where? When? – A discussion, Rock cut sculpture – Differences between rock cut sculpture and stone sculpture ,Sculptures in religious buildings, Buddhism, Hinduism, and Jainism in sculpures,Visit to Mahabalipuram and submitting a report by the students, Bronze sculptures in India, Cultural stonework in India - in the form of primitive cupule art, the Buddhist Pillars of Ashoka of the Mauryan period, The figurative Greco-Buddhist sculpture of the Gandhara and Mathura schools, and the Hindu art of the Gupta period: Brief Introduction, Khajuraho Temples in Madhya Pradesh, Debate on "Religion and Art Today"	

Unit-4 - The Indian Art of Floor Decoration	***3 Hour***
Kolam - the traditional floor drawing of South India, Daily life and Kolam - Line drawings, geometric designs and natural world - Some examples, Beliefs behind Kolam, Rangoli – Occasions and motifs, Kalamezhuthu in Kerala - Religious significance ,Mandana paintings of Rajasthan and Madhya Pradesh by oldest tribal communities, Bengal's floor art-Alpona, Festival specific Floor Art across India, Festival specific Floor Art across India,Pookalam: The Onam Floral Rangoli,Body Art: Traditional Mehendi, Mehendi designs, religious and cultural significances	
Unit-5 - Modern Art	***3 Hour***
Matching the picture with the artist, Tracing the major ideas through paintings – Going back to Hindu themes, Student presentations on individual artists, Tracing the major ideas through paintings – Indian Village Life and nationalist themes, Student presentations on individual artists, European influences (British) – Trends in, painting – portrait, landscape and realistic, Collection and display of paintings by various artists, British Gothic and Indo Saracenic architecture through examples, Field trip to places in Chennai which have Indo Saracenic, architecture and report submission, Indian Art post-Independence Progressive Artists' Group and their Influence ,Fusion of western style and Indian themes	

Learning Resources	1. *Ketkar, Anil Rao Sandhya. The History of Indian Art (Paperback). Jyotsna Prakashan, 2017.* 2. *Haturvedi, P. N. Encyclopedia of Indian Art and Architecture. M. D. Publications Pvt. Ltd., 2009.*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (CLA)						Final Examination (0% weightage)	
		Formative CLA-1 (30%)		Formative CLA-2 (30%)		Summative (40%)			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	*Remember*	*30%*	-	*30%*	-	*30%*		-	-
Level 2	*Understand*	*20%*	-	*20%*	-	*20%*		-	-
Level 3	*Apply*	*30%*	-	*30%*	-	*30%*		-	-
Level 4	*Analyze*	*20%*	-	*20%*	-	*20%*		-	-
Level 5	*Evaluate*	-	-	-	-	-		-	-
Level 6	*Create*	-	-	-	-	-		-	-
	Total	*100 %*		*100 %*		*100%*		-	

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. *Dr. Usha Kodandaraman, ABK AOTS , Chennai drushsk@gmail.com*	1. *Dr. S. P.Dhanavel, Professor of English, IIT, Chennai dhanavelsp@iitmac.in*	1. *Dr .K.Anbazhagan, SRMIST*
2. *Mr. Durga Prasad Bokka, TCS Chennai durgaprasad@tcs.com*	2. *Ms. Subashree, Asst. Prof., VIT, Chennai subashree@vit.ac.in*	2. *Dr.Sukanya Saha, SRMIST*

Course Code	21GNP301L	Course Name	COMMUNITY CONNECT	Course Category	P	PROJECT WORK, SEMINAR, INTERNSHIP IN INDUSTRY / HIGHER TECHNICAL INSTITUTIONS	L	T	P	C
							0	0	2	1

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:***
CLR-1:	*Train oneself in finding the aspects in real-time work environment and prepare them to join the workforce in the future*
CLR-2:	*Gain the exposure to the society including rules, regulations and safety practices*
CLR-3:	*Enhance social service and skills of the students*
CLR-4:	*Develop the students in terms of ability, competence and interpersonal relationship*
CLR-5:	*Enhance students' knowledge in one particular technology*

Course Outcomes (CO):	***At the end of this course, learners will be able to:***	**Program Outcomes (PO)**												**Program Specific outcomes**		
		1 Engineering Knowledge	2 Problem Analysis	3 Design/development of solutions	4 Conduct investigations of complex problems	5 Modern Tool Usage	6 The engineer and society	7 Environment & Sustainability	8 Ethics	9 Individual & Team Work	10 Communication	11 Project Mgt. & Finance	12 Life Long Learning	PSO-1	PSO-2	PSO-3
CO-1:	*Apply social knowledge in the real world of work and get attached to the community*	-	-	-	-	-	*3*	-	-	-	-	-	-	-	-	-
CO-2:	*Demonstrate competency in societal problems and finding solutions*	-	-	-	-	-	*3*	-	-	*3*	-	-	-	-	-	-
CO-3:	*Effectively implement skills in professional communication, technical writing and using multimedia tools*	-	-	-	-	-	*3*	-	-	*3*	*2*	-	-	-	-	-
CO-4:	*Develop ability to work as an individual and in a group as an effective team member*	-	-	-	-	-	*3*	-	-	*3*	-	-	-	-	-	-
CO-5:	*Master the professional and ethical responsibilities of a social worker*	-	-	-	-	-	*3*	-	*3*	-	-	-	-			

Students shall undergo social service in government recognized NGOs/Hospitals/Service organizations for a duration of 4 to 6 weeks during the IV semester vacation. At the end of the community connect, the student shall submit a report to the department and make a presentation during the 5th semester, which will be assessed by a committee constituted by the department or school.

Learning Assessment	
Community Connect Certification and Report Submission (80% weightage)	*Final Presentation (20% weightage)*

Note: Final Presentation Evaluation would be done by the expert Committee formed by the Department.

Course Code	21ASP302L	21AIP302L	21AUP302L	21BTP302L	21BMP302L	21CHP302L	21CEP302L	21CSP302L	Course Name	PROJECT	Course Category	P	PROJECT WORK, SEMINAR, INTERNSHIP IN INDUSTRY / HIGHER TECHNICAL INSTITUTIONS	L	T	P	C
	21ECP302L	21EEP302L	21EVP302L	21EIP302L	21FPP302L	21MEP302L	21MHP302L	21NTP302L						0	0	6	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:*
CLR-1:	*Learn responsible and professional way of working*
CLR-2:	*Practice development-oriented approach to work*
CLR-3:	*Enhance students' knowledge in one particular technology*
CLR-4:	*Create awareness of the social, cultural, global and environmental responsibility as an engineer*
CLR-5:	*Grow more empathetic, become systems thinkers, become explorers, problem-solvers.*

Course Outcomes (CO):	*At the end of this course, learners will be able to:*	Program Outcomes (PO)												Program Specific outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12			
		Engineering Knowledge	Problem Analysis	Design/development of solutions	Conduct investigations of complex problems	Modern Tool Usage	The engineer and society	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO-1	PSO-2	PSO-3
CO-1:	*Develop capability to acquire and apply fundamental principles of engineering*	*3*	*3*	*3*	*3*	*3*	-	*3*	*3*	*3*	*3*	*3*	*3*	-	-	-
CO-2:	*Become updated with all the latest changes in technological world*	*3*	*3*	*3*	*3*	*3*	-	*3*	*3*	*3*	*3*	*3*	*3*	-	-	-
CO-3:	*Make deep connections between ideas*	*3*	*3*	*3*	*3*	*3*	-	*3*	*3*	*3*	*3*	*3*	*3*	-	-	-
CO-4:	*Learn to take creative risks*	*3*	*3*	*3*	*3*	*3*	-	*3*	*3*	*3*	*3*	*3*	*3*	-	-	-
CO-5:	*Be ready for the creative economy also engage in iterative thinking and divergent thinking*	*3*	*3*	*3*	*3*	*3*	-	*3*	*3*	*3*	*3*	*3*	*3*	-	-	-

Project Work Selection: Project Work Titles for students would be finalized by the Department Project Work Evaluation Committee.

	Continuous Learning Assessment (100% weightage)				*Final Examination (0%)*
	Review - 1	*Review - 2*	*Project Report*	*Viva-Voce*	
Project	*30 %*	*40%*	*10 %*	*20 %*	-

Note: Final Presentation Evaluation would be done by the expert Committee formed by the Department.

Course Code	21CSC301T	Course Name	FORMAL LANGUAGE AND AUTOMATA	Course Category	C	PROFESSIONAL CORE	L	T	P	C
							3	0	0	3

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

Course Learning Rationale (CLR):	***The purpose of learning this course is to:***
CLR-1:	*Construct automata for any equivalent regular expressions*
CLR-2:	*Acquire brief knowledge about automata languages*
CLR-3:	*Analyze about context free grammars and its implementation in Push down automata*
CLR-4:	*Interpret the power of Turing machine and the decidable nature of a problem*
CLR-5:	*Categorize undecidable problems and NP class problems*

Course Outcomes (CO):	***At the end of this course, learners will be able to:***	**Program Outcomes (PO)**												**Program Specific outcomes**		
		1	2	3	4	5	6	7	8	9	10	11	12			
		Engineering Knowledge	Problem Analysis	Design/development of solutions	Conduct investigations of complex problems	Modern Tool Usage	The engineer and society	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO-1	PSO-2	PSO-3
CO-1:	*Summarize the basic concepts of deterministic and non-deterministic finite automata and its applications.*	-	*1*	*1*	-	-	-	-	-	-	-	-	-	*1*	*3*	-
CO-2:	*Analyze the formal relationships among machines, languages and Context free grammars and its normalization*	-	*3*	*3*	-	-	-	-	-	-	-	-	-	*1*	*3*	-
CO-3:	*Construct the Push down stack machine and its context free language acceptance and its equivalence with CFG*	-	*2*	*2*	-	-	-	-	-	-	-	-	-	*1*	*3*	-
CO-4:	*Analyze the techniques for Turing machine construction and its recursive languages and functions*	-	*2*	*2*	-	-	-	-	-	-	-	-	-	*1*	*3*	-
CO-5:	*Evaluate the computational complexity of various problems*	-	*3*	*3*	-	-	-	-	-	-	-	-	-	*1*	*3*	-

Unit-1 - Finite Automata and Regular Expressions	***9 Hour***
Deterministic and Non-Deterministic Finite Automata, Finite Automata with ε-moves, regular expressions – equivalence of NFA and DFA, two-way finite automata, Moore and Mealy machines, Equivalence of Moore and Mealy machines, applications of finite automata.	
Unit-2 - Regular Sets and Context Free Grammars	***9 Hour***
Properties of regular sets, context-Free Grammars, and Languages – derivation trees, Simplification of CFG: Elimination of Useless Symbols Simplification of CFG: Unit productions, Null productions - Chomsky Normal Forms and Greibach Normal Forms, ambiguous and unambiguous grammars; minimization of finite automata	
Unit-3 - Pushdown Automata and Parsing Algorithms	***9 Hour***
Deterministic Push Down Automata – Non-Deterministic Push Down Automata – Equivalence of Pushdown Automata and context-free languages; Properties of CFL; Applications of pumping lemma — closure properties of CFL and decision algorithms; Overview of Top-down parsing and Bottom-up parsing	
Unit-4 - Turing machines	***9 Hour***
Turing machines (TM) – computable languages and functions – tuning machine constructions – storage in finite control – variations of TMs – Church-Turing thesis – Universal Turing machine– recursive and recursively enumerable languages	
Unit-5 - Introduction to Computational Complexity	***9 Hour***
Time and Space complexity of TMs – complexity classes – introduction to NP-Hardness and NP-Completeness Post Correspondence Problems (PCP) – Modified PCP – Halting Problems – Undecidability Problems	

Learning Resources	1. *Hopcroft J.E., Motwani R. and Ullman J.D, "Introduction to Automata Theory, Languages and Computations", Second Edition, Pearson Education, 2008.* 2. *Michael Sipser, "Introduction to the Theory of Computation" Cengage Learning, 2012*	3. *John.C. Martin, "Introduction to Languages and the Theory of Computation" McGraw-Hill Education, 01- May-2010.* 4. *Peter Linz, "An introduction to formal languages and automata", Jones & Bartlett Learning, Sixth Edition, 2017*

Learning Assessment

	Bloom's Level of Thinking	*Continuous Learning Assessment (CLA)*				*Summative Final Examination (40% weightage)*	
		Formative CLA-1 Average of unit test (50%)		*Life-Long Learning CLA-2 (10%)*			
		Theory	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*
Level 1	*Remember*	*15%*	-	*15%*	-	*15%*	-
Level 2	*Understand*	*25%*	-	*20%*	-	*25%*	-
Level 3	*Apply*	*30%*	-	*25%*	-	*30%*	-
Level 4	*Analyze*	*30%*	-	*25%*	-	*30%*	-
Level 5	*Evaluate*	-	-	*10%*	-	-	-
Level 6	*Create*	-	-	*5%*	-	-	-
	Total	*100 %*		*100 %*		*100 %*	

Course Designers

Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
1. *Santhosh Muniswami, Cisco Systems, Inc.*	1. *Dr. P. Victer Paul, Indian Institute of Information Technology Kottayam*	1. *Dr. N. Arunachalam*
2. *B. Divya, TCS*	2. *Dr.C. Punitha Devi, Pondicherry University,*	2. *Dr. K. Vijaya*

Course Code	21CSC302J	Course Name	COMPUTER NETWORKS	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	*School of Computing*	**Data Book / Codes / Standards**		*Nil*	

Course Learning Rationale (CLR):	***The purpose of learning this course is to:***
CLR-1:	*Define the layered network architecture*
CLR-2:	*Produce knowledge in IP addressing*
CLR-3:	*Identify suitable routing algorithms based on geographical location of the devices*
CLR-4:	*Apply the concept of Error detection to identify the errors in data.*
CLR-5:	*Exploring reliable and unreliable protocols*

Course Outcomes (CO):	***At the end of this course, learners will be able to:***	**Program Outcomes (PO)**												**Program Specific outcomes**		
		1	2	3	4	5	6	7	8	9	10	11	12			
		Engineering Knowledge	Problem Analysis	Design/development of solutions	Conduct investigations of complex problems	Modern Tool Usage	The engineer and society	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO-1	PSO-2	PSO-3
CO-1:	*Apply the knowledge of communication*	*3*	-	-	-	*3*	-	-	-	-	-	-	-	*1*	-	-
CO-2:	*Construct the network using addressing schemes*	*3*	-	-	*2*	-	-	-	-	-	-	-	-	*1*	-	-
CO-3:	*Design and implement the various Routing Protocols*	*3*	-	-	*2*	*3*	-	-	-	-	-	-	-	*1*	-	-
CO-4:	*Identify and correct the errors in transmission*	*3*	-	-	-	-	-	-	-	-	-	-	-	*1*	-	-
CO-5:	*Analyze the services provided by Transport and Application layers*	*3*	-	-	-	-	-	-	-	-	-	-	-	*1*	-	-

Unit-1 - Introduction to Networks ***15 Hour***

Network Types: LAN, MAN, PAN, WAN - Network Topology : BUS, STAR, RING, MESH, HYBRID - Switching : Circuit Switching, Packet Switching - OSI Layered Architecture - TCP/IP Model - Physical Layer Overview - Latency, Bandwidth, Delay - Guided Media : Twisted pair, Coaxial cable, Fiber optic cable - Unguided Media : Radio waves, Microwaves, Infrared.
Lab 1: Introduction to Packet Tracer, Peer to Peer communication, study of cables and its colour codes
Lab 2: Implementation of Network Topologies
Lab 3: Router Configuration (Creating Passwords, Configuring Interfaces)

Unit-2 - Addressing ***15 Hour***

IPV4 Addressing - Address space - Classful addressing - Subnet mask - FLSM - Classless Addressing - VLSM – NAT – Super netting - Network Devices: Hub, Repeaters, Switch, Bridge, Router
Lab 4: IP addressing and Sub netting (VLSM)
Lab 5: Static and Default Routing
Lab 6: NAT Configuration

Unit-3 - Routing ***15 Hour***

Forwarding of IP Packets — Static and Default Routing — Unicast Routing Algorithms: Distance Vector Routing, Link State Routing, Path Vector Routing — Protocols: RIP V1, RIP V2, OSPF, BGP, EIGRP — Multicasting Basics — IPV6 Addressing Basics
Lab 7: Implementation of RIP version 1
Lab 8: Implementation of RIP version 2
Lab 9: Implementation of Single Area OSPF

Unit-4 – Medium Access Control	***15 Hour***
ALOHA ,CSMA/CD, CSMA/CA, Ethernet, Token Ring - Flow Control :Stop and Wait, Sliding Window - Error Control: Stop and Wait ARQ, Sliding Window ARQ - Error Detection : Parity Check, Checksum, CRC - Error Correction: Hamming codes - Data-Link Layer Protocols : HDLC, PPP. *Lab 10: Implementation of Multi Area OSPF* *Lab 11: PPP Configuration* *Lab 12: HDLC Configuration*	
Unit-5 – Transport and Application Layer Protocols	***15 Hour***
Port Numbers — User Datagram Protocol — Transmission Control Protocol — WWW and HTTP — FTP — Email –Telnet – DNS. *Lab 13: Implementation of BGP* *Lab 14: Implementation of EIGRP* *Lab 15: Telnet Configuration*	

Learning Resources	1. *Behrouz A. Forouzan, "Data Communication and Networking",5th ed.,2010* 2. *Bhushan Trivedi, " Data Communication and Networks" 2016*	3. *William Stallings, " Data and Computer Communications",9th ed.,2010* 4. *Todd Lammle, "CCNA Study Guide",7th ed.,2011*

Learning Assessment

	Bloom's Level of Thinking	*Continuous Learning Assessment (CLA)*				*Summative Final Examination (40% weightage)*	
		Formative CLA-1 Average of unit test (45%)		*Life-Long Learning CLA-2 (15%)*			
		Theory	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*
Level 1	*Remember*	*20%*	-	-	*20%*	*20%*	-
Level 2	*Understand*	*40%*	-	-	*40%*	*40%*	-
Level 3	*Apply*	*40%*	-	-	*40%*	*40%*	-
Level 4	*Analyze*	-	-	-	-	-	-
Level 5	*Evaluate*	-	-	-	-	-	-
Level 6	*Create*	-	-	-	-	-	-
	Total	*100 %*		*100 %*		*100 %*	

Course Designers

Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
1. *Mr. Srinivasan Varadharajan, Senior Principal Software Engineer, Manhattan Associates, Atlanta, United States*	1. *Dr. I.Joe Louis Paul, Associate Professor, SSN College of Engineering, TamilNadu*	1. *Dr. S. Metilda Florence, SRMIST*

Course Code	21CSC305P	Course Name	MACHINE LEARNING	Course Category	C	PROFESSIONAL CORE	L	T	P	C
							2	1	0	3

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

Course Learning Rationale (CLR):	***The purpose of learning this course is to:***
CLR-1:	*Explore the fundamental mathematical concepts of machine learning algorithms*
CLR-2:	*Apply linear machine learning model to perform regression and classification*
CLR-3:	*Utilize mixture models to group similar data items*
CLR-4:	*Develop machine learning models for time –series data prediction*
CLR-5:	*Design ensemble learning models using various machine learning algorithms*

Course Outcomes (CO):	***At the end of this course, learners will be able to:***	**Program Outcomes (PO)**												**Program Specific outcomes**		
		1	2	3	4	5	6	7	8	9	10	11	12			
		Engineering Knowledge	Problem Analysis	Design/development of solutions	Conduct investigations of complex problems	Modern Tool Usage	The engineer and society	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO-1	PSO-2	PSO-3
CO-1:	*Understand the basics of machine learning using probability theory*	-	*2*	-	-	-	-	-	-	-	-	-	-	*1*	-	-
CO-2:	*Implement machine learning models using supervised learning algorithms*	-	*2*	-	*2*	-	-	-	-	-	-	-	-	-	-	*2*
CO-3:	*Implement machine learning models using unsupervised learning algorithms*	-	*3*	-	*3*	-	-	-	-	-	-	-	-	-	-	*2*
CO-4:	*Implement machine learning models for sequential data analysis and prediction*	-	*3*	-	*3*	-	-	-	-	-	-	-	-	-	-	*3*
CO-5:	*Develop ensemble learning models for supervised and unsupervised learning*	-	*3*		*3*	-	-	-	-	-	-	-	-	-	-	*3*

Unit-1 - Introduction ***9 Hour***

machine learning what and why?, supervised and unsupervised learning, polynomial curve fitting, probability theory- discrete random variables, fundamental rules,Bayes rule, Independence and conditional independence, continuous random variables, Quantiles, Mean and variance, probability densities, Expectation and covariance.

Practice:

1. *Devise a program to import, load and view dataset*
2. *Create a program to display the summary and statistics of the dataset*

Unit-2 - Linear models for regression ***9 Hour***

Maximum likelihood estimation – least squares, robust linear expression, ridge regression, Bayesian linear regression. Linear models for classification: Discriminant function – Probabilistic generative models, Probabilistic discriminative models, Laplacian approximation, Bayesian logistic regression, Kernels functions, using kernels in GLMs, Kernel trick, SVMs.

Practice:

1. *Implement linear regression to perform prediction*
2. *Implement Bayesian logistic regression and SVM for classification*

Unit-3 - Mixture models and EM ***9 Hour***

K-means clustering, mixtures of Gaussians, An alternative view of EM, Factor analysis, PCA, choosing the number of latent dimensions. Clustering – measuring dissimilarity, evaluating the output of clustering methods, Hierarchical clustering.

Practice:

1. *Implement K-means clustering, mixtures of Gaussians and Hierarchical clustering algorithm to categorize data.*
2. *Create a program to perform PCA*

Unit-4 – Hidden Markov Models	***9 Hour***
Sequential data – Markov models, HMM – maximum likelihood for the HMM, The forward and Backward algorithm, the sum-product algorithm, scaling factors, Viterbi algorithm, linear dynamical systems. *Practice:* *1. Implement HMM to predict the sequential data*	
Unit-5 – Combining Models	***9 Hour***
Bayesian model averaging, Boosting, Adaptive basis function models, CART, generalized additive models, Ensemble learning. *Practice:* *1. Implement CART learning algorithms to perform categorization* *2. Implement Ensemble learning models to perform classification*	

Learning Resources	*1. Pattern Recognition and Machine Learning, Christopher M Bishop, Springer, 2006.* *2. Machine Learning- A probabilistic perspective, Kevin P.Murphy, The MIT Press, 2012.*

Learning Assessment

	Bloom's Level of Thinking	*Continuous Learning Assessment (CLA)*						*Final Examination (0% weightage)*	
		Formative CLA-1 Average of unit test (20%)		*Project Based Learning CLA-2 (60%)*		*Report and Viva Voce (20% weightage)*			
		Theory	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*
Level 1	*Remember*	*15%*	-	-	*15%*	-	*15%*	-	-
Level 2	*Understand*	*25%*	-	-	*20%*	-	*20%*	-	-
Level 3	*Apply*	*30%*	-	-	*25%*	-	*25%*	-	-
Level 4	*Analyze*	*30%*	-	-	*25%*	-	*25%*	-	-
Level 5	*Evaluate*	-	-	-	*10%*	-	*10%*	-	-
Level 6	*Create*	-	-	-	*5%*	-	*5%*	-	-
	Total	*100 %*		*100 %*		*100 %*		-	

Course Designers

Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
1. Mr.Vaisakh. P.S, Assistant executive manager, Samsung Electronics, Bangalore vaishakhps@samsung.com	*1. Dr.C.Oswald, Assistanrt professor, NIT, Trichy,Oswald.mecse@gmail.com*	*1. A.Jackulin Mahariba, SRMIST*

Course Code	21CSE326T	Course Name	ARTIFICIAL NEURAL NETWORKS	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	*School of Computing*	**Data Book / Codes / Standards**		*Nil*	

Course Learning Rationale (CLR):	***The purpose of learning this course is to:***
CLR-1:	*Understand the biological background and basic concepts of neural networks*
CLR-2:	*Gain knowledge about perceptron and back propagation*
CLR-3:	*Know about various training rules and error minimization*
CLR-4:	*Learn the concepts of unsupervised neural networks*
CLR-5:	*Explore the fine-tuning procedures and case studies for designing neural network models*

Course Outcomes (CO):	***At the end of this course, learners will be able to:***	**Program Outcomes (PO)**												**Program Specific outcomes**		
		1	2	3	4	5	6	7	8	9	10	11	12			
		Engineering Knowledge	Problem Analysis	Design/development of solutions	Conduct investigations of complex problems	Modern Tool Usage	The engineer and society	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO-1	PSO-2	PSO-3
CO-1:	*Explain the basic concepts of neural networks*	-	-	-	-	-	-	-	-	-	-	-	-	*1*	-	-
CO-2:	*Describe perceptron and back propagation*	-	-	-	-	-	-	-	-	-	-	-	-	-	*2*	-
CO-3:	*Apply various training rules in neural networks*	-	-	-	-	-	-	-	-	-	-	-	-	*2*	-	-
CO-4:	*Explain unsupervised neural networks*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	*2*
CO-5:	*Fine tune the neural networks*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	*1*

Unit-1 - Introduction to Neural Networks ***9 Hour***

History of neural network research- Biological inspiration: Neural computation, Models of computation, Elements of computing models- Network of neurons: structure, Information processing at neurons and synapses, Information storage, Neurons as self-organizing systems- Artificial Neural Networks: Network of primitive functions, approximation of functions- Neuron Model: Single and multiple input neurons, Transfer functions- Network architectures: Single layered and multi layered neurons, Recurrent Networks

Tutorials:

1. *Implement various neural network architectures*
2. *Implement and study the effect of various activation functions*

Unit-2 - Perceptron ***9 Hour***

Introduction to Perceptron- Perceptron Architecture: Single Neuron Perceptron, Multi Neuron Perceptron- Perceptron learning rule: Constructing Learning rules, Unified Learning rule, Training multi neuron perceptron- Complexity of perceptron learning-Computational Limits of Perception-Linearly separable functions- Learning XOR-Feed forward Networks- Back propagation: Chain of rule Calculus, Back-Propagation Computation in Fully-Connected Multi-layer Perceptron

Tutorials:

1. *Implement Feed forward networks*
2. *Implement back propagation*

Unit-3 - Learning and Training	***9 Hour***
Paradigms of Learning - Using training samples - Gradient Optimization Procedure- Batch Gradient Descent, Stochastic Gradient Descent, Mini-Batch Gradient Descent - Hebbian learning rule – Delta learning rule-Convergence and local minima, representational power of feed forward networks, hypothesis search space and inductive bias, generalization, overfitting and stopping criterion-Error functions, Error minimizing procedures-Hebbian learning *Tutorials:* *5. Implementation of gradient descent* *6. Implementation of delta learning rule*	
Unit-4 - Unsupervised Neural Networks	***9 Hour***
Unsupervised learning in neural networks: Hebbian learning rule, Principle Component Learning, Learning Vector Quantizer-I- Self Organizing Maps: Functionality, Training, Topology Function, Decreasing Learning Rate, Variations of SOMs, Neural gas, Multi-SOM, Multi-neural gas, Growing neural gas- Adaptive Resonance Theory, Orienting subsystems, Learning Laws *7. Implementation of Principle Component analysis* *8. Implementation of Self Organizing Maps*	
Unit-5 - Tuning the Neural Networks	***9 Hour***
Pretraining the model: Data selection, Preprocessing, Selection of network architecture- Training the network: Initializing weights, Choice of training algorithm, stopping criteria, Choice Of performance function, Committees of Networks-Post Training Analysis: Fitting, Pattern Recognition, Clustering- Time delay and Recurrent Neural Networks-Case Studies: Smart Sensor system with function approximation- Myocardial Infarction Recognition using pattern recognition-Forest cover problem using Clustering	

Learning Resources	*1. Martin T. Hagan, Neural Network Design, 2nd edition.* *2. Tom M. Mitchell, Machine Learning, McGraw-Hill Education (India) Private Limited.* *3. Ian Goodfellow, Yoshua Bengio, and Aaron Courville, Deep Learning, MIT Press, 2016*	*4. Andries P., Computational Intelligence: An Introduction, Second Edition, Wiley, 2007* *5. David Kriesel, A Brief Introduction to Neural Networks, 2009*

Learning Assessment

	Bloom's Level of Thinking	*Continuous Learning Assessment (CLA)*				*Summative Final Examination (40% weightage)*	
		Formative CLA-1 Average of unit test (50%)		*Life-Long Learning CLA-2 (10%)*			
		Theory	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*
Level 1	*Remember*	*20%*	-	*20%*	-	*20%*	-
Level 2	*Understand*	*20%*	-	*20%*	-	*20%*	-
Level 3	*Apply*	*30%*	-	*30%*	-	*30%*	-
Level 4	*Analyze*	*30%*	-	*30%*	-	*30%*	-
Level 5	*Evaluate*	-	-	-	-	-	-
Level 6	*Create*	-	-	-	-	-	-
	Total	*100 %*		*100 %*		*100 %*	

Course Designers

Experts from Industry	***Experts from Higher Technical Institutions***	***Internal Experts***
		1. Dr. Sharanya, SRMIST