ACADEMIC CURRICULA

Professional Elective Courses

COMPUTER SCIENCE AND ENGINEERING

Regulations - 2018

SRM INSTITUTE OF SCIENCE AND TECHNOLOGY

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

Kattankulathur, Kancheepuram, Tamil Nadu, India

Course Code	18CSE351T	Course Name	COMPUTATIONAL LOGIC	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		Computer Science and Engineering		Data Book / Codes/Standards	Nil

Course Learning Rationale (CLR):	The purpose of learning this course is to:		Learning			Program Learning Outcomes (PLO)															
CLR-1 :	Understand the basics of Propositional logic	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-2 :	Acquire skills on rules to handle Propositional logic																		
CLR-3 :	Understand the First order Logic and Meta theorems																		
CLR-4 :	Learn the art of application of AI Concepts.																		
CLR-5 :	Master various theorems on Logic																		

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 :	Apply the skills acquired on propositional logic to solve examples at hand	2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	Apply the rules learnt towards problem solving	2	75	80	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-3 :	Acquire mastry over FOL and Meta theorems and apply the same with confidence	2	85	80	H	M	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	Apply the acquired knowledge on AI under appropriate problem solving contexts	2	80	75	H	H	H	-	-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	Attempt to apply the acquired knowledge on logics under appropriate problem solving contexts	2	75	85	H	M	H	-	-	-	-	-	M	-	-	H	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Propositional Logic-Introduction	Natural Deduction of Propositional Logic: Rules of Conjunction, Disjunction	First Order Logic-Introduction	Axiomatic System FC: Introduction	Modal Logic K-Introduction
	SLO-2	Syntax of PL	Natural Deduction of Propositional Logic: Implication, Negation	First Order Logic-Illustration	Axiomatic System FC: Example applications, Illustrations	Modal Logic K-Illustration
S-2	SLO-1	Is It a Proposition?	Natural Deduction of Propositional Logic: Proofs	Syntax of FL	Monotonicity Theorem-Detail	Syntax and Semantics of K
	SLO-2	Unique Parsing, PropDet	Natural Deduction of Propositional Logic: Examples	Scope and Binding	Deduction Theorem- Detail	Syntax and Semantics of K: Illustration
S-3	SLO-1	Sub Propositions, Precedence rules	Natural Deduction of Propositional Logic: Problems	Scope and Binding-Illustration	Theorem-RA, Fitness- Detail	Validity and Consequence in K
	SLO-2	Proposition: Theorems and Examples	Natural Deduction of Propositional Logic: Problems	Substitutions	Paradox of material Implication-Detail	Validity and Consequence in K: Illustration
S-4	SLO-1	Interpretations	Derived Rules of Propositional Logic: Introduction	Substitutions- Illustrations	Strong Generalization Theorem:Introduction	Axiomatic System KC
	SLO-2	Boolean conditions, Truth table	Derived Rules of Propositional Logic: Examples	Substitutions- Problems	Strong Generalization Theorem: Illustration	Axiomatic System KC: Illustration
S-5	SLO-1	Interpretations: Theorems, Conventions and Lemma	Derived Rules of Propositional Logic:Problems	Semantics of FL	Adequacy of FC to FL	Adequacy of KC to K
	SLO-2	Interpretations: Examples	Derived Rules of Propositional Logic:Problems	Semantics of FL: Illustration	Adequacy of FC to FL: Illustration	Adequacy of KC to K: Illustration
S-6	SLO-1	Models: Introduction to terminologies	Parse Tree	Translating into FL	Compactness of FL	Natural Deduction in K
	SLO-2	Equivalences and Consequences : Introduction to terminologies	Sub Formula	Translating into FL: Illustrations	Compactness of FL: Proof	Natural Deduction in K: Illustration
S-7	SLO-1	Equivalences and Consequences :	Soundness of Propositional Logic	Satisfiability and Validity	Laws in FL	Analytic Tableau for K

		Examples				
	SLO-2	Deduction Theorem (DT)-Introduction	Soundness of Propositional Logic: Illustration	Satisfiability and Validity:Illustrations	Laws in FL: Illustration	Analytic Tableau for K: Illustration
S-8	SLO-1	RA Theorem, Monotonicity Theorem (M)-Introduction	Completeness of Propositional Logic	Metatheorems: Introduction	Natural Deduction	Modalities
	SLO-2	Fitness Theorem	Completeness of Propositional Logic: Illustration	Metatheorems: Deduction, Substitution, Chaining	Natural Deduction: Illustration	Modalities: Illustration
S-9	SLO-1	Theorem-Paradox of material Implication	Gentzen sequent calculus	Metatheorems: Examples	Analytic Tableaux	Computation Tree Logic
	SLO-2	Replacement Laws	Gentzen sequent calculus: Illustration	Metatheorems: Problems	Analytic Tableaux: Illustration	Computation Tree Logic: Illustration

Learning Resources	1. Arindama Singh,"Logics for Computer Science", PHI Learning Private Ltd,2nd Edition,2018 2. Wasilewska & Anita,"Logics for computer science: classical and non-classical",Springer ,2018 3. Huth M and Ryan M ," Logic in Computer Science : Modeling and Reasoning about systems",Cambridge University Press, 2005	4. Dana Richards & Henry Hamburger,"Logic And Language Models For Computer Science",Third Edition,World Scientific Publishing Co. Pte. Ltd,2018. 5. https://www.cs.cornell.edu/courses/cs3110/2012sp/lectures/lec15-logic-contd/lec15.html

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. Paventhan Arumugum, Director (R&D), ERNET India		Mr. T.Senthil Kumar, SRMIST
Mr Shiv Kumar Ganesh Full stack developer Altemetric, US		Dr.Kayalvizhi Jayavel, SRMIST
		Ms. Jeyasudha, SRMIST

Course Code	18CSE352T	Course Name	NEURO FUZZY AND GENETIC PROGRAMMING	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		Computer Science and Engineering		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 Artificial Neural Networks																			
CLR-2 :	Learn the various topologies and learning algorithms of ANN																			
CLR-3 :	Understand the principles and fundamentals of Fuzzy Logic																			
CLR-4 :	Understand the Fuzzy Rule based systems																			
CLR-5 :	Understand the basic concepts and techniques of Genetic Algorithms																			
CLR-6 :	Utilize the Neural, Fuzzy and Genetic Algorithms for real-time application development																			

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 knowledge on constructing a neural network	3	80	75	L	H	-	H	L	-	-	-	L	L	-	H	-	-	-
CLO-2 :	Identify the basic Neural net and learning algorithm to apply for a real time problem	3	85	75	M	H	M	M	H	-	-	-	M	L	-	H	-	-	-
CLO-3 :	Acquire the ability to use Fuzzy operators, membership functions, Fuzzification and Defuzzification Techniques	3	75	70	M	H	M	H	M	-	-	-	M	L	-	H	-	-	-
CLO-4 :	Gain Knowledge on applying the Fuzzy rules to different applications	3	85	80	M	H	M	H	H	-	-	-	M	L	-	H	-	-	-
CLO-5 :	Acquire the knowledge of fitness functions and Genetic operators	3	85	75	H	H	M	H	M	-	-	-	M	L	-	H	-	-	-
CLO-6 :	Apply the Genetic Algorithm to real-time applications	3	80	70	M	H	M	H	H	-	-	-	L	L	-	H	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Biological and Artificial Neuron	Delta Rule, Derivation of GDR	Crisp sets	Fuzzification of Input Variables, Application of Fuzzy operations	History of Evolutionary Computing, Genetic Algorithms, basic concepts
	SLO-2	History of ANN	Backpropagation Algorithm, Local Minima Problem	Fuzzy sets		GA Cycle , Fitness Function,
S-2	SLO-1	ANN architectures	Radial Basis Function Neural Network	Fuzzy membership functions	Evaluation of Fuzzy rules, Aggregation of output Fuzzy sets	Introduction to GA Operators Selection Operators, Crossover, Mutation Operations
	SLO-2	Learning Algorithms	Pattern Association, Auto Associative nets	Operations of Fuzzy sets		
S-3	SLO-1	Activation Functions, Bias, Threshold and other parameters	Hetero Associative nets	Fuzzy Relations, Operations	Rule based systems, Conventional programs vs Rule based systems	Schema Theorem, Example
	SLO-2	McCulloch Pitts model,	Bidirectional Associative Memory Network	Fuzzy Extension Principle	Fuzzy Propositions	
S-4	SLO-1	Simulation of Logic Functions	Hopfield network Competitive networks: Maxnet	Crisp Relations, Fuzzy relations, Properties, operations,	Fuzzification	Classification of Genetic Algorithm
	SLO-2					
S-5	SLO-1	Perceptron Network	Self Organizing Map Network	Propositional Logic	Defuzzification	Holland Classifier Systems
	SLO-2	Hebbian network	Learning Vector Quantization	Crisp Logic	Fuzzy Controller : Air conditioner control, Cruise Controller	Genetic Programming
S-6	SLO-1	ADALINE networks	Adaptive Resonance Theory Network	Predicate Logic Rules of Inference	Fuzzy Decision making	Data Representation
	SLO-2	MADALINE networks		Fuzzy Truth, Fuzzy Rules		Genetic Operators
S-7,8	SLO-1	Practice of Neural Network tool :	Practice of Neural Network tool : Delta rule	Fuzzy Reasoning	Introduction to neuro fuzzy system-	Application of Genetic Algorithm

		Simple Logic functions			Adaptive Neuro-Fuzzy Inference Systems Coactive Neuro-Fuzzy Modeling	
	SLO-2		Practice of Neural Network tool : Pattern Classification	Practice of Fuzzy Logic tool: Fuzzy functions	Recent Applications	Practice of Optimization and Genetic algorithm tool
S-9	SLO-1	Practice of Neural Network tool : XOR problem	Practice of Neural Network tool : Pattern Clustering	Practice of Fuzzy Logic tool: Fuzzy operations	Practice of Fuzzy Logic tool : Fuzzy controller design and applications	
	SLO-2					

Learning Resources	1. Samir Roy, Udit Chakraborty, "Introduction to Soft Computing: Neuro-Fuzzy and Genetic Algorithms", Pearson Education, 2013. 2. Michael Negnevitsky. Artificial Intelligence: A Guide to Intelligent Systems, 3rd Edition, Pearson Education, 2011. 3. Laurene Fausett, "Fundamentals of Neural Networks, Architectures, Algorithms and Applications", Pearson Education, 2008.	4. Timothy J. Ross , "Fuzzy Logic with Engineering Applications", John Wiley & Sons Ltd, 2010. 5. David E. Goldberg, "Genetic Algorithms-In Search, optimization and Machine Learning", Pearson Education, 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

1. Mr. K. selvaraj, TCS, Bangalore	1. Dr. A.P. Shanthi, Professor,
	    Dept. of Computer Science & Engineering,
	    Anna University, chennai-600025
		1. Dr. V. Ganapathy, SRM IST

2. Mr. Saju G Nair, IBM, Bangalore.	2. Dr. A, Kannan, Professor
	    Dept. of Computer Science & Engineering,
	    VIT, Vellore
		2. Dr. D. Malathi, SRM IST

		3. Dr. Ferni Ukrit, SRM IST

Course Code	18CSE353T	Course Name	DIGITAL IMAGE 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		Computer Science and Engineering		Data Book / Codes/Standards	Nil

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1 :	provide deep understanding of basic concepts of digital image acquisition
CLR-2 :	provide deep Understanding of various digital image enhancement techniques
CLR-3 :	Understand image restoration and segmentation methods
CLR-4 :	provide understanding and implementation of image compression techniques
CLR-5 :	Provide understanding and knowledge of image recognition methods

Learning		
1	2	3
Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)

Program Learning Outcomes (PLO)

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	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	4	5	6	7	8	9	10	11	12	13	14	15
CLO-1 :	Understand basics of digital images and tools for image processing	2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	Learn and implement image Enhancement techniques	2	75	80	H	H	H	-	H	-	-	-	-	-	-	-	-	-	-
CLO-3 :	Understand and Learn image Restoration and Segmentation Methods	2	85	80	H	H	M	-	H	-	-	-	-	-	-	-	-	-	-
CLO-4 :	Understand and implement Image Compression techniques	2	80	75	H	H	M	-	H	-	-	-	-	-	-	-	-	-	-
CLO-5 :	Learn and Implement Image Recognition methods	2	75	85	H	H	M	-	H	-	-	-	-	-	-	-	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Introduction	Introduction to Spatial Domain	Noise models – Mean Filters – Order Statistics	Wavelets – Subband coding – Multiresolution expansions	Boundary representation – Chain Code
S-2	SLO-1	Origin- Steps in Digital Image Processing	Gray level transformations	Adaptive filters – Band reject Filters – Band pass Filters	Fundamentals of Compression – Image Compression methods - Error Free Compression	Polygonal approximation, signature, boundary segments
S-3	SLO-1	Components	Histogram processing	Inverse Filtering – Wiener filtering Segmentation	Variable Length Coding – Bit-Plane Coding – Lossless Predictive Coding	Boundary description – Shape number
S-4	SLO-1	Elements of Visual Perception	Basics of Spatial Filtering	Point, Line, and Edge Detection	Lossy Compression – Lossy Predictive Coding	Fourier Descriptor
S-5	SLO-1	Image Sensing and Acquisition	Smoothing and Sharpening Spatial Filtering	Marr-Hildreth & Canny edge detector	Compression Standards-Huffman, Arithmetic coding, LZW coding, Run Length Encoding	Regional Descriptors
S-6	SLO-1	Image Sampling and Quantization	Frequency Domain: Basics of filtering	Edge Linking and Boundary detection	Compression StandardsHuffman, Arithmetic coding, LZW coding, Run Length Encoding	Topological - Texture – Patterns and Pattern classes
S-7	SLO-1	Relationships between pixels	Smoothing and Sharpening frequency domain filters	Local & Regional processing-Region based segmentation	Block Transform coding, Wavelet coding, JPEG standard	Recognition based on matching
S-8	SLO-1	Introduction to Image processing toolbox in MATLAB	Smoothing and Sharpening frequency domain filters	Morphological processing- Watershed segmentation algorithm	MATLAB code for image compression: Huffam coding, Arithmetic coding, wavelet	MATLAB code for image representation

				coding	
S-9	SLO-1	Tool box practice	MATLAB code for histogram equalization	MATLAB code for restoring an image after degradation using adaptive and wiener filter	MATLAB code for image compression: Huffam coding,	MATLAB code for image recognition
	SLO-2	Exploring functions	MATLAB code for spatial and frequency domain filter.	Edge detection operators	Arithmetic coding, wavelet coding	MATLAB Practice exercises

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
Madhan Thandayithapani kutiyappan, Assistant consultantant, TCS - siruseri	Dr. S. Sridhar, Anna University	Dr. G.Niranjana. Associate Professor/CSE
	Dr. Senthil kumar, Annauniversity	Mr. Rajasekar Assistant Professor/IT Mr. James Joseph Assistant Professor/SWE

Course Code	18CSE354T	Course Name	NETWORK SECURITY	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		CSE		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 networking devices																		
CLR-2 :	Understand the concept of IP security																		
CLR-3 :	Understand the various methods and protocols to maintain E-mail security																		
CLR-4 :	Understand the various methods and protocols to maintain web security																		
CLR-5 :	Understand security measures for wireless and cell phone Communications																		

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 knowledge of network devices used in data Communication	2	80	85	H									H					
CLO-2 :	Acquire the knowledge of IP security and ability to identify the IP security attack	2	75	80	H														
CLO-3 :	Acquire the knowledge of Email security and ability to detect the attacks in e-mail	2	85	80	H														
CLO-4 :	Acquire the knowledge of web security attack and prevention mechanism	2	80	75	H								H						
CLO-5 :	Acquire the knowledge of wireless network security and prevention mechanism	2	75	85	H								H						

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Networking Devices(Layer1,2)	Overview of IPSEC- Security Associations, Security Association Database	Security Services for E-mail	SSL/TLS Basic Protocol	Wireless Security:IEEE 802.11 Wireless LAN
	SLO-2	Networking Devices(Layer 3)	Security Policy databases , AH and ESP	Security Services for E-mail	SSL/TLS Basic Protocol	Wireless Security:IEEE 802.11 Wireless LAN
S-2	SLO-1	Different types of network layer attacks	Tunnel and Transport mode	Establishing keys	computing the keys	Authentication
	SLO-2	Different types of network layer attacks	IP header Protection	Establishing Public and secret keys	computing the keys	Authentication and confidentiality
S-3	SLO-1	Firewall- ACL	IP and IPv6	Privacy	client authentication	Cellphone Security
	SLO-2	Packet Filtering	IPV4 and IPV6 header	End-to end Privacy, Privacy with distribution List Exploders	client authentication	GSM (2G) Security
S-4	SLO-1	DMZ, Alerts	Authentication Header	Authentication of the source	PKI as deployed by SSL	Security in UMTS (3G)
	SLO-2	Audit Trials	Mutable, Immutable and Mutable but predictable	Based on public key technology and secret keys and with distribution list	PKI as deployed by SSL	Security in UMTS (3G)
S-5	SLO-1	IDS	Encapsulation Security Payload(ESP)	Message Integrity	SSLAttacks fixed in v3	Wireless LAN Vulnerabilities
	SLO-2	Advantages and Disadvantages of IDS(Need of IPS)	Internet Key Exchange	Non-repudiation	SSLAttacks fixed in v3	Phishing
S-6	SLO-1	Advantages of IPS ove IDS	Phases of IKE	Introduction and Overviw of PGP	Exportability	Buffer Overflow
	SLO-2	IPS	Phase I IKE- Modes and key types	Efficient Encoding	Exportability	Buffer Overflow
S-7	SLO-1	IPS Types- Signature based	Phase I IKE Protocols	Certificate and key revocation	Encoding	Format String Attacks
	SLO-2	Anomaly based, Policy based	Phase I IKE Protocols	Singature types, Private key, Fing types	Encrypted Record	Cross-site Scripting (XSS)
S-8	SLO-1	IPS Types - Honeypot based	Phase II IKE	Anomalies	Handshake messages	SQL Injection

	SLO-2	Applications	Phase II IKE	Object Format	Changecipherspec and Alerts	SQL Injection
S-9	SLO-1	Malicious Software	ISAKMP/IKE Encoding	S/MIME	SET	Case Studies: Secure Inter-branch Payment Transactions
	SLO-2	Malicious Software	ISAKMP/IKE Encoding	S/MIME	SET	Virtual Elections

Learning Resources	1. Charlie Kaufman, Radia Perlman, Mike Speciner, Network Security, Prentice Hall of India, 2002. 2. Bernard Menezes - Network Security and Cryptography- Cengage Learning. 2010.	3. William Stallings, Cryptography and Network Security - Principles and Practice, 7th edition, Pearson Publication, 2017 4. Cryptography and network security , AtulkahateTata McGraw-Hill 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	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. M. Sudhakar, M.Tech, (Ph.D)-IIT, IT Infrastructure Service, Tata Consultancy Services.	Dr. P. Yogesh, Associate Professor, Dept of Information Science and Technology, College of Engineering, Guindy,	Dr. A. Jeyasekar, Associate Professor Dr. J. Femilda, Associate Professor Mrs. G. Sujatha, Assistant Professor

Course Code	18CSE356T	Course Name	DISTRIBUTED OPERATING 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		Computer Science and Engineering		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 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, File systems, Shared memory																			
CLR-5 :	To acquire apparent scheme regarding distributed object-oriented based systems																			

Column headers (Learning): Level of Thinking (Bloom), Expected Proficiency (%), Expected Attainment (%)

Column headers (PLO): 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

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLO-1 :	Characterize the fundamental hardware and software concepts of distributed systems.	3	80	70	H	M	M	H	H	M	-	-	H	M	-	H	-	-	-
CLO-2 :	Categorize layered protocols and comprehend the communications in distributed systems	3	85	75	H	M	H	M	H	M	-	-	H	M	-	H	-	-	-
CLO-3 :	Implement synchronization of distributed systems using various algorithms.	3	75	70	H	H	H	H	H	M	-	-	H	M	-	H	-	-	-
CLO-4 :	Demonstrate process scheduling and fault tolerance of distributed systems.	3	85	80	H	H	H	H	H	M	-	-	H	M	-	H	-	-	-
CLO-5 :	Evaluate various Distributed Object-Oriented based systems.	3	85	75	H	H	H	M	H	M	-	-	H	M	-	H	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Introduction- Distributed Systems	Fundamentals of Communication systems	Synchronization in Distributed Systems-Fundamentals of Clock Synchronization	Processes and Processors in Distributed Operating Systems - Threads	Distributed Shared memory - Introduction
	SLO-2	Goals of Distributed Systems		Logical clock, Physical clock	Design issues of Threads package	Bus-Based Multiprocessors
	SLO-2				Work Station Model	Switched Multiprocessors
S-2	SLO-1	Hardware Concepts- Bus-based Multiprocessors	Layered Protocols	Algorithms for Clock synchronization	System Model - Introduction	Ring-based Multiprocessors
S-3	SLO-1	Switched Multiprocessors	ATM networks	Mutual Exclusion-Centralized Algorithm	Using Idle Work Stations	Numa Multiprocessors
	SLO-2					Comparison of Shared Memory Systems
S-4	SLO-1	Bus-based Multicomputers	Client Server model - Blocking Primitives	Distributed Algorithm	Processor Pool Model, Hybrid Model	Consistency Models – Strict Consistency, Casual Consistency, PRAM Consistency
	SLO-2		Non-Blocking Primitives	Token Ring Algorithm	Processor Allocation – Allocation Model	Weak Consistency, Release Consistency, Entry Consistency
S-5	SLO-1	Switched Multicomputers	Buffered Primitives	Comparison of all three algorithms	Design issues for processor Allocation Algorithms	Page Based Distributed Shared Memory – Replication, granularity
	SLO-2		Unbuffered Primitives	Importance of Election Algorithm	Example of processor Allocation Algorithms	Finding the Owner, Finding the Copies
S-6	SLO-1	Software Concepts-Network Operating System	Reliable primitives	Bully Algorithm	Scheduling in Distributed Systems	Page Replacement
	SLO-2		Unreliable primitives	Ring Algorithm	Load Balancing and Sharing Approach	Synchronization
S-7	SLO-1	True Distributed Systems	Message passing and its related issues	Atomic Transaction- Introduction	Fault Tolerance-Component Faults	Shared – Variable Distributed Shared

				Transaction Model, Concurrency Control	System Failures	*memory* *Object Based Distributed Shared memory – DOO Architecture*
	SLO-2			*Transaction Model, Concurrency Control*	*System Failures*	*Object Based Distributed Shared memory – DOO Architecture*
S-8	SLO-1	*Multiprocessors Timesharing Systems*	*Remote Procedure Call and its related issues*	*Deadlock in Distributed Systems*	*Synchronous versus Asynchronous Systems*	*Distributed Object-Oriented Process*
	SLO-2			*Distributed Deadlock Detection*	*Fault tolerance Using Active Replication, Primary-backup*	*Distributed Object-oriented Communication*
S-9	SLO-1	*Design Issues-Distributed Systems*	*Case Studies: SUN RPC, DEC RPC*	*Distributed Deadlock Prevention*	*Real Time Distributed Systems-Communication*	*Case Study - Amoeba*
	SLO-2				*Real Time Scheduling*	*Mach-OS, Chorus*

Learning Resources	1. Andrew S. Tanenbaum, "Distributed Operating Systems "PearsonEducation, 2011. 2. Pradeep K. Sinha "DistributedOperatingSystems Concepts and Design "PHI 2012.	3. Mukesh Singhal, Niranjan G Shivratri "Advanced concepts in Operating Systems ", Mc Graw Hill International 2011. 4. http://www.seas.gwu.edu/~jstanton/courses/cs251/ 5. http://cse.yeditepe.edu.tr/~sbaydere/courses new/cse532/

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 %		-	

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
JP Vinjamoori, Director, Pavartha Software Pvt.Ltd, *jp@pavarthasoftware.com*	*Dr. E.Sivasankar,NIT,Trichy*	*Mrs. S. Aruna, Dr.G. Maragatham, Mrs. A. Jackulin Mahriba, SRMIST*

Course Code	18CSE357T	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		Computer science		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 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 :	Gain knowledge on the basics of biometric traits, sensors and data acquisition																			
CLR-3 :	Gain knowledge on design of biometric security systems																			
CLR-4 :	Acquire knowledge on pattern recognition systems																			
CLR-5 :	Introduce the various feature extraction and matching techniques for different biological traits.																			
CLR-6 :	Understand the real time application of biometrics																			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLO-1 :	Acquire the knowledge on various biometric traits	1	80	85	H	M	H	H	-	-	H-	-	-	-	-	-	-	-	-
CLO-2 :	Acquire the ability to identify pattern recognition system and its features	1	75	80	H	H	H	H	-	-	H	-	-	-	-	-	-	-	-
CLO-3 :	Understand the basic ideas about physical and hehaviourial biometric traits	1	85	80	H	M	M	M	-	-	M	-	-	-	-	-	-	-	-
CLO-4 :	Apply the knowledge of biometrics on developing identification system.	2	80	75	H	M	M	M	-	H	-	H	-	-	-	-	-	-	-
CLO-5 :	Apply the knowledge for designing biometric sytems	2	75	85	H	H	L	-	-	-	-	-	-	-	-	-	-	-	-
CLO-6 :	Acquire the knowledge on authentication systems for real time security applications	1	80	85	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Introduction of biometric systems	Biometrics Sensors and Data Acquisition	Introduction to multibiometrics	Biometric system authentication	Biometric Authentication Applications
	SLO-2	Biometric functionalities: verification, identification	Biometric data acquisition and database	Sources of multiple evidence	physiological and behavioral properties of biometric system,	access control like a lock or an airport check-in area
S-2	SLO-1	The design cycle of biometric systems	Biometrics Pre-processing	Acquisition sequence	Software biometrics systems	immigration and naturalization
	SLO-2	Building blocks of a generic biometric system	The related biometrics preprocessing technologies	Processing sequence	Hardware biometrics systems	welfare distribution
S-3	SLO-1	Introduction to unimodal system	Image restoration	Fusion level	Security of biometric systems	military application
	SLO-2	Introduction to Multimodal biometric system	Image segmentation	Sensor level fusion	Advisory,insider,infrastructure attacks	banking, e.g., check cashing, credit card, ATM
S-4	SLO-1	Biometric system errors	Pattern extraction and classification	Feature level fusion	Attacks at the user interface	computer login; intruder detection; smart card
	SLO-2	Performance measures	Pattern classification	Score level fusion	impersonation ,obfuscation, spoofing	multi-media Communication; WWW and an electronic purse
S-5	SLO-1	Image processing basics	Fingerprint Recognition and acquisition	Rank level fusion	Attacks on biometric processing	sensor fusion; decision fusion
	SLO-2	what is image, acquisition, type, point operations, Geometric transformations	Fingerprint features, matching and synthesis	Decision level fusion	Attacks on system module and interconnections	categorization: e.g., age and gender
S-6	SLO-1	First and second derivative	Face recognition and acquisition	Features Matching and Decision Making	Counter measure: Biometric template security	industrial automation

	SLO-2	steps in edge detection, smoothening, enhancement, thresholding, localization,	Face detection, feature extraction and matching	Feature matching: null and alternative hypothesis h0, h1, Error type I/II, Matching score distribution, FM/FNM, ROC curve, DET curve, FAR/FRR curve.	Countermeasure:spoof dectection	gesture interpretation;
S-7	SLO-1	Robert's method, Sobel's method, Perwitts	Iris recognition and acquisition	Introduction to Various matching methods:	Challenges in biometric systems like fool proofing, false positives	efficient enrollment
	SLO-2	Laplacian of Gaussian, Zero crossing	Iris Segmentation, normalization and matching	LDA	Developing Tools for Comparing fingerprints	audio-visual tracking
S-8	SLO-1	Low level feature extraction, Describing image motion	Ear recognition	PCA, Eigen vectors and values, 2D-PCA,	Enhancing pattern when data is minimum	stock market;
	SLO-2	High level feature extraction ,Template matching	Ear detection	generalization to p-dim, covariance and correlation, algebra of PCA, projection of data	Biometric failures in special cases like(too much moisture in hands which system can't read)	on-line shopping
S-9	SLO-1	Hough transform for lines	Hand geometry features	Introduction to decision theory and their examples	Mini project: Fingerprint, Face detection	compact embedded systems
	SLO-2	Hough transform for circles and ellipses	palmprint features	Explanation – examples	Mini project: signature ,iris detection	other commercialized services

Learning Resources	1. James wayman,Anil k.Jain ,Arun A.Ross ,Karthik Nandakumar, ―Introduction to. Biometrics‖, Springer, 2011 2. Mark S.Nixon, Alberto S.Aguado, Feature Extraction and image processing for computer vision, Third Edition, , Elsevier 2012 3. Digital Image Processing using MATLAB, By: Rafael C. Gonzalez, Richard Eugene Woods, 2nd Edition, Tata McGraw-Hill Education 2010	4. Guide to Biometrics, By: Ruud M. Bolle, Sharath Pankanti, Nalini K. Ratha, Andrew W. Senior, Jonathan H. Connell, Springer 2009 5. Pattern Classification, By: Richard O. Duda, David G.Stork, Peter E. Hart, Wiley 2007 6. Shimon K.Modi , ―Biometrics in Identity Management :concepts to applications‖, Artech House 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
1. Raghuraghavendra s, Chief Executive Officer at Forensic & Biometric Investigation Services FBIS Chennai, Tamil Nadu, India Chennai Area, India	1. Dr. J.Dhalia Sweetlin Designation:Assistant Professor [Sr Grade] Madras Institute of Technology, MIT Road, Radha Nagar,Chromepet, Chennai,Tamil Nadu 600044, India.Email:jdsweetlin@mitindia.edu Area of Specialization: Image Processing, Soft Computing	1. Dr. C. Malathy, SRMIST
		2. M.Gayathri, SRMIST 3.Ms.Meenakshi/IT Dept,SRMIST

Course Code	18CSE358T	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		CSE		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 Pattern Recognition techniques																		
CLR-2 :	Learn Statistical models of Pattern Recognition																		
CLR-3 :	Understand the principles of Clustering approaches to Pattern Recognition																		
CLR-4 :	Understand the Syntactic Pattern Recognition techniques																		
CLR-5 :	Understand the Neural Network approach to 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

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																		
CLO-1 :	Acquire the knowledge on various biometric traits																		
CLO-2 :	Acquire the ability to identify pattern recognition system and its features	2	80	85	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-3 :	Understand the basic ideas about physical and hehaviourial biometric traits	2	75	80	H	H	-	-	H	-	-	-	-	-	-	-	-	-	-
CLO-4 :	Apply the knowledge of biometrics on developing identification system.	2	85	80	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	Apply the knowledge for designing biometric sytems	2	80	75	-	H	-	-	H	-	-	-	-	-	-	-	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Pattern and features	Introduction to StatPR, Statistical models,	Formulation of unsupervised problems	Syntactic Pattern Recognition, Grammar based approaches,	Neural Networks fundamentals, Learning in Neural networks,
	SLO-2	Classification, Description, Pattern Mappings	Gaussian case and Class Dependence	Illustration	Formal Grammars, Types of Grammars	Physical Neural Networks
S-2	SLO-1	Patterns and Feature Extraction	Discriminant Functions- Uniform Densities	Unsupervised Learning Approaches	String generation as Pattern Description	Artificial Neural Networks model,
	SLO-2	Examples	Classifier Performance, Risk and Errors	Illustration	Example	activation functions, weights
S-3	SLO-1	Classifiers	Supervised learning – Parametric estimation	Clustering for unsupervised learning and classification	Recognition by String Matching and Parsing,	Neural Network based Pattern Associators, CAM
	SLO-2	Example	Maximum Likelihood Estimation	Example	Example	Linear Associative Mappings, Different approaches
S-4	SLO-1	Decision Regions	Bayesian parameter estimation	c-means algorithm	Cocke-Younger-Kasami Parsing Algorithm	Heteroassociative memory design
	SLO-2	Boundaries	Example	Illustration	Illustation	Examples
S-5	SLO-1	Training in pattern recognition systems	Nonparametric approaches-	Learning Vector Quantization,	Augmented Transition Networks, High Dimensional Grammars,	Hebbian learning
	SLO-2	Learning in pattern recognition systems	Density estimation	Example	Example	Example
S-6	SLO-1	Pattern recognition approaches	Parzen Windows	Formal Characterization of General Clustering Procedures	Stochastic Grammars and applications	Feedforward Network Architecture, Training in Feedforward networks,
	SLO-2	Statistical pattern recognition, Example	k-nn Nonparametric estimation	Explanation on procedure	Example	Explanation
S-7	SLO-1	Syntactic pattern recognition	Nearest Neighbor Rule	Clustering Strategies	Graph based structural representations	GDR, Derivation of Delta Rule
	SLO-2	Examples	Example	Different scenarios	Graph Isomorphism	Explanation

S-8	SLO-1	Neural pattern recognition	Linear Discrimant Functions, Fisher's Linear Discriminant	Cluster Swapping Approaches	Attributed Graphs, Match Graphs,	Backpropagation Algorithm,
	SLO-2	Comparison	Discrete and Binary Classification problems	Examples	Examples	Explanation
S-9	SLO-1	Black Box approaches	Techniques to directly obtain Linear Classifiers	Hierarchical clustering procedure	Cliques, Structural Unification using attributed graphs	Pattern Associator for Character Classification
	SLO-2	Reasoning driven pattern recognition	Illustration	Example	Examples	Example

Learning Resources	1. Robert J, Schalkoff, "Pattern Recognition: Statistical, Structural and Neural Approaches", John Wiley & Sons Inc., New York, Reprint 2014.	2. Earl Gose, Richard Johnsonbaugh, Steve Jost, "Pattern Recognition and Image Analysis", Prentice Hall of India Private Ltd., New Delhi – 110 001,1999. 3. DudaR.O.andHartP.E.,"Pattern Classification and Scene Analysis",Wiley,NewYork,1973

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.Deepan Raj, Visteon,Chennai	Dr.T.Nagarajan, Professor and Head, Dept. of IT, SSN college of Engineering.	1. Dr. M. Thenmozhi, SRMIST
		2. Dr.S Prabakaran, SRMIST
		3. Dr. Alice Nithya , SRMIST

Course Code	18CSE359T	Course Name	NATURAL LANGUAGE 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		CSE		Data Book / Codes/Standards	Nil

Course Learning Rationale (CLR):	The purpose of learning this course is to:		Learning			Program Learning Outcomes (PLO)														
CLR-1 :	Teach students the leading trends and systems in natural language processing.	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-2 :	Make them understand the concepts of morphology, syntax, semantics and pragmatics of the language and that they are able to give the appropriate examples that will illustrate the above mentioned concepts.																		
CLR-3 :	Teach them to recognize the significance of pragmatics for natural language understanding.																		
CLR-4 :	Enable students to be capable to describe the application based on natural language processing and to show the points of syntactic, semantic and pragmatic processing.																		
CLR-5 :	To conceive basics of knowledge representation, inference, and relations to the artificial intelligence.																		
CLR-6 :	To understand natural language processing and to learn how to apply basic algorithms in this field																		

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 :	Understand approaches to syntax and semantics in NLP.																		
CLO-2 :	Understand approaches to discourse, generation, dialogue and summarization within NLP.	2	80	85	H	H	H	H	H	-	-	-	H	M	M	H	H	H	H
CLO-3 :	Understand current methods for statistical approaches to machine translation.	2	75	80	H	H	H	H	H	-	-	-	H	M	M	H	H	H	H
CLO-4 :	Understand machine learning techniques used in NLP, including the probabilistic context-free grammars and unsupervised methods, as applied within NLP	2	85	80	H	L	M	H	H	-	-	-	H	M	M	H	H	H	H
CLO-5 :	Understand the knowledge of various levels of analysis involved in NLP	2	80	75	H	H	H	H	H	-	-	-	H	M	M	H	H	H	H
CLO-6 :	Gain knowledge in automated Natural Language Generation and Machine Translation	2	75	85	H	H	H	H	H	-	-	-	H	M	M	H	H	H	H

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Introduction to Natural Language Processing	Syntax Parsing	Semantic Relations	Information Extraction and its approaches	Introduction to Probabilistic Approaches
	SLO-2	Steps – Morphology – Syntax – Semantics	Dependency Parsing	Semantic Role Labeling		Statistical Approaches to NLP Tasks
S-2	SLO-1	Morphological Analysis (Morphological Parsing)	Semantics	Semantic Frames	Information Retrieval	Sequence Labeling
	SLO-2	Stemming – Lemmatization	Semantic Parsing	Ontology and Semantics		
S-3	SLO-1	Parts of Speech Tagging	Word Sense Disambiguation	Semantic Network and Knowledge Graph	Semantic Search	Problems - Similarity Measures
	SLO-2					
S-4	SLO-1	Approaches on NLP Tasks (Rule-based, Statistical, Machine Learning)	Lexical Disambiguation	Intent Detection and Classification	Summarization	Word Embeddings
	SLO-2				Extractive Vs Abstractive, Summarization	
S-5	SLO-1	N-grams	Structural Disambiguation	Paraphrase Extraction	Information Fusion	CBOW
	SLO-2					
S-6	SLO-1	Multiword Expressions	Word, Context and Sentence-level Semantics	Discourse	Single and Multi-document	Skip-gram
	SLO-2			Coreference Resolution	Summarization – Question Answering	
S-7	SLO-1	Collocations (Association Measures, Coefficients and Context Measures)	Pronoun Resolution	Text Coherence	Introduction to Chatbot Applications	Sentence Embeddings
	SLO-2				Retrieval based- Conversation based	

S-8	SLO-1	*Vector Representation of Words*	*Semantic Representation of text*	*DiscourseStructure*	*NLU and NLG*	*Recurrent Neural Networks (RNN)*
	SLO-2			*Coherence*		
S-9	SLO-1	*Language Modeling*	*Introduction to Semantic Relations*	*Discourse Planning*	*Machine Translation*	*Long Short-Term Memory (LSTM)*

Learning Resources	*1. DanielJurafskyandPrenticeHallJamesHMartin,"SpeechandLanguageProcessing:An introductionton NaturalLanguage Processing, Computational Linguistics and Speech Recognition", Prentice Hall, 2nd Edition,2018.* *2. C.Manning and H.Schutze, "Foundations of Statistical Natural Language Processing", MIT Press. Cambridge,MA:,1999*	*3. JamesAllen,Bejamin/cummings,"NaturalLanguageUnderstanding",2ndedition,1995* *4. YoavGoldberg,Neural Network Methods for Natural Language Processing.* *5. http://mccormickml.com/2106/04/19/word2vec-tutorial-the-skip-gram-model/* *6. https://nlp.stanford.edu/pubs/glove.pdf*

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. Dr. J.Balaji, Associate Manager,Allstate Solutions Pvt Ltd, jagank.balaji@gmail.com	1. Dr.G.Nagappan, Professor, nagappan@saveetha.ac.in	1. Dr. M.Ferni Ukrit, SRMIST
		2. Dr.A.Pandian, SRMIST
		3.Ms.K.Meenakshi, SRMIST

Course Code	18CSE360T	Course Name	INFORMATION STORAGE AND MANAGEMENT	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		Computer Science and Engineering		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 components of storage infrastructure.																				
CLR-2 :	Gain knowledge to evaluate storage architectures including storagesubsystems																				
CLR-3 :	Understand the business continuity, backup and recovery methods.																				
CLR-4 :	Acquire knowledge on information security framework																				
CLR-5 :	Introduce the working principle of storage infrastructure with monitoring principles																				
CLR-6 :	Understand the structure of cloud computing and its techniques																				

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 knowledge on the components of storage infrastructure	3	80	70	M	-	-	-	-	-	-	-	L	-	-	M	-	-	-
CLO-2 :	Acquire the ability to evaluate storage architectures including storagesubsystems	3	85	75	M	M	M	M	-	-	-	-	L	-	-	H	-	-	-
CLO-3 :	Understand the business continuity, backup and recovery methods.	3	75	70	M	M	M	M	-	-	-	-	L	-	-	H	-	-	-
CLO-4 :	Appreciate the concepts of storage security and information security applied to virtual machine	3	85	80	M	M	L	L	-	-	-	-	M	-	-	H	-	-	-
CLO-5 :	Apply the knowledge for storage infrastructure	3	85	75	L	M	-	-	-	-	-	-	M	-	-	H	-	-	-
CLO-6 :	Acquire the knowledge on structure of cloud computing and its techniques	3	80	70	M	-	-	-	-	-	-	-	L	-	-	H	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Introduction to Information Storage Management	Virtualization and Cloud Computing : Fiber Channel: Overview	Business Continuity And Back Up Recovery Business Continuity: Information Availability.	Storage Security And Management :	Cloud Computing:Cloud Enabling Technologies
	SLO-2	Evolution of Storage Architecture	SAN and its Evolution	BC Terminology, BC Planning life cycle	Information Security Framework	Characteristics of Cloud Computing
S-2	SLO-1	Data Centre Infrastructure	Components of FC SAN, FCConnectivity, FC Architecture	Failure Analysis, Business Impact Analysis	Risk Triad	Benefits of Cloud Computing
	SLO-2	Virtualization and Cloud Computing	IPSAN-iSCSI components	BC Technology Solutions	Storage Security Domains	Cloud Service Models
S-3	SLO-1	Key challenges in managing information.	iSCSI Protocol StackiSCSI Names	Backup and Archive: Backup Purpose	Security Implementations in Storage Networking	Cloud Deployment models
	SLO-2	Data Center Environment: Application	NAS: General Purpose Servers versus NAS Devices	Backup Considerations	Securing Storage Infrastructure in Virtualized and Cloud Environments	Cloud Infrastructure Mechanism: Logical Network Perimeter
S 4-5	SLO-1 SLO-2	Database Management System (DBMS)	Benefits of NAS- File Systems and Network File Sharing	Backup Granularity , Recovery considerations	RSA and VMware Security Products	Virtual Server , Cloud Storage Device
S-6	SLO-1	Host : Connectivity, Storage	Components of NAS	Backup Methods, Backup Architecture	Monitoring the Storage Infrastructure	Cloud Usage Monitor
	SLO-2	Disk Drive Components,Disk Drive Performance	NAS I/O Operation	Backup and Restore Operations	Monitoring Parameters,	Resource Replication
S-7	SLO-1	Intelligent Storage System	NAS Implementations	Backup Topologies	Components Monitored, Monitoring examples	Ready Made environment
	SLO-2	Components of an Intelligent Storage System	NAS File Sharing Protocols	Backup in NAS Environments	Storage Infrastructure Management Activities	Container

S-8	SLO-1	Storage Provisioning	Object Based Storage Devices	Backup Targets, Data Deduplication for Backup	Storage Infrastructure Management Challenges, Storage Management Examples	Cloud Challenges
	SLO-2	Types of Intelligent Storage Systems	Content Addressed Storage	Backup in Virtualized Environments	Storage Allocation to a New Server/Host,	Cloud Adoption Considerations
S-9	SLO-1	Creation of Virtual storage machine, Navigation of storage system .	Configuration and Tracing of FC scan and iSCSI scan	Sharing Files between host and Virtual Machines, Usage of Backup techniques	Creation of an Linux Instance in Public Cloud, Generate a private key, Access using SSH client	Usage of Cloud services with open source cloud tools (like Eucalyptus, Openstack, Open Nebula and others)
	SLO-2					

Learning Resources	1. EMC Corporation, "Information Storage and Management",2nd edition Wiley India, ISBN13: 978-1118094839 2. Thomas Erl, "Cloud Computing: Concepts, Technology & Architecture", Prentice Hall , 2013,ISBN: 9780133387568	3. UifTroppen Rainer Wolfgang Muller,"Storage Networks Explained", India, Wiley, 2010, ISBN13: 978-0470741436

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.V.Masillamani	1. Dr.B.Amutha SRMIST
		2. Dr.A.Shanthini, SRMIST

Course Code	18CSE451T	Course Name	WIRELESS SENSOR 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		CSE			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 basic sensor network concepts		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-2 :	Know physical layer issues, Medium Access Control Protocols																			
CLR-3 :	Comprehend network and transport layer characteristics and protocols																			
CLR-4 :	Understand the network management and Middleware services																			

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 :	Understand the basic ideas about sensor network concepts with Applications and Apply the knowledge for WSN tools	2	80	85	H	H	H	H	M	M	M	M	M	H	L	H	H	H	H
CLO-2 :	Acquire the knowledge on wireless transmission technology ,hardware and Medium Access Protocols	2	75	80	H	H	H	H	M	M	M	M	M	H	L	H	H	H	H
CLO-3 :	Understand the basic ideas about Wireless Sensor Networks Routing protocols and network - transport layer characteristics	2	85	80	H	H	H	H	M	M	M	M	M	H	L	H	H	H	H
CLO-4 :	Apply the knowledge for network management and Middleware services	2	80	75	H	H	H	H	M	M	M	M	M	H	L	H	H	H	H

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Introduction to computer and wireless sensor networks	Wireless Transmission Technology and systems	Overview-Wireless Mac Protocols	Design Issues in WSN routing- Data Dissemination and Gathering	WSN middleware principles-
	SLO-2				Routing Challenges in WSN	
S-2	SLO-1	Motivation for a network of Wireless Sensor nodes -	Radio Technology Primer	Characteristics of MAC protocols in Sensor networks	Flooding	Middleware architecture
	SLO-2	Sensing and sensors	Available Wireless Technologies			Data related functions, Architecture
S-3	SLO-1	Challenges and constraints	Hardware- Telosb	Contention free MAC Protocols	Flat Based Routing – SAR	Existing middleware
	SLO-2				Directed Diffusion	MiLAN, IrisNet
S-4	SLO-1	Node architecture	Hardware -Micaz motes	MAC Protocols -Characteristics	MCFA Coherent processing	AMF,DSWare
	SLO-2	Sensing sub system		Traffic Adaptive Medium Access	Non-Coherent Processing	CLMF
S-5	SLO-1	Processor sub system	Time Synchronization- Clock	Y-MAC	Hierarchical Routing- LEACH,TEEN, APTEEN,PEGASIS	Operating systems for wireless sensor networks
	SLO-2	Communication interfaces-- prototypes		Low energy Adaptive Clustering		
S-6	SLO-1	Application of Wireless sensors	Synchronization Problems	Contention based MAC Protocols	Query Based Routing	Performance and traffic management
	SLO-2				Negotiation Based Routing	
S-7	SLO-1	WSN Tools- Overview and Limitations	Basics of time synchronization	Sensor MAC	Geographical Based Routing	Fundamentals of network security
	SLO-2		Time synchronization protocols	Timeout MAC and pattern MAC		
S-8	SLO-1	Contiki -Introduction	Localization	MAC protocols in ContikiOS simulator	Routing protocol simulation in contiki	Network security Challenges
	SLO-2		Ranging Techniques	Nullmac in Contiki simulator	RPL objective function &simulation using DGRM model cooja	
S-9	SLO-1	Characteristics of Contiki WSN simulator	Range based Localization Range Free	CSMA in Contiki simulator	RPL(Routing Protocol for Low-Power and	Attacks Protocols mechanisms for security

		Localization		Lossy Networks) Border Router simulation
	SLO-2	Event driven Localization		in Contiki 2.7 OS

Learning Resources	1. Kazem Sohraby, Daniel manoli , "Wireless Sensor networks- Technology, Protocols and Applications", Wiley InterScience Publications 2013. 2. Waltenegus Dargie, Christian Poellabauer , "Fundamentals of Wireless Sensor Networks, Theory and Practice", Wiley Series on wireless Communication and Mobile Computing, 2011 3. S.Swapna Kumar, "A Guide to Wireless Sensor Networks", kindle Edition, USP publications,2017 4. C.S Raghavendra, Krishna M.Sivalingam, Taieb znati , "Wireless Sensor Networks", Springer Science 2010.	5. Bhaskar Krishnamachari , " Networking Wireless Sensors", Cambridge University Press, 2005 6. https://www.amazon.in/Guide-Wireless-Sensor-Networks-ebook/dp/B072R53JJM 7. https://anrg.usc.edu/contiki/index.php/Contiki_tutorials 8. file:///C:/Users/Administrator.RD27/Downloads/Fundamentals-of-Wireless-Sensor-Networks-Waltenegus-Dargie.pdf

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.Anirban Chowdhry, Director, Frugal Labs	1. Dr. P.T.V. Bhuvaneshwari, Professor, MIT campus, Anna University	1. Dr. Revathi Venkatraman, SRMIST 2. Dr.N.Snehalatha, SRMIST 3. Dr.MB.Mukesh krishnan, SRMIST

Course Code	18CSE452T	Course Name	NETWORK PROTOCOLS AND PROGRAMMING	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	CSE		Data Book / Codes/Standards	Nil	

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

		Learning			Program Learning Outcomes (PLO)															
CLR-1 :	Describe the importance of various Internet protocols like ARP, RARP, ICMP, Multicasting and multi routing, SCTP	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-2 :	Understand the transport layer protocols , application layer protocol and its characteristics																		
CLR-3 :	Learn and Understand IPV6 technologies																		
CLR-4 :	Work with client server sockets and develop related applications to communicate with each other.																		
CLR-5 :	Understand the wide area network protocols																		
CLR-6 :	Learn the basics of MPLS protocol																		

Column headers for Learning: Level of Thinking (Bloom), Expected Proficiency (%), Expected Attainment (%)

PLO column headers: 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

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

		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLO-1 :	Identify the basics of different types of network and transport layer protocols	2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	Design and implement the socket programming	2	75	80	H	H	-	-	-	-	-	-	-	-	-	-	-	2	-
CLO-3 :	Enumerate the types of application layer protocols	2	85	80	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	Analyze and compare the IPv4 and IPv6 protocols	2	80	75	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	Familiarize with wide area technologies	2	75	85	H	-	-	H	-	-	-	-	-	-	-	-	-	-	-
CLO-6 :	Describe the working of MPLS protocol	2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	IP header	Byte ordering	DNS	IPV6 Overview	DSL
	SLO-2	IP fragmentation	Byte ordering conversion functions	DNS in the Internet,	IPV6 Features	Other DSL Technology
S-2	SLO-1	ARP	System calls	DNS Resolution	IPV6 Addressing Modes	DSL Benefits
	SLO-2	RARP	Sockets	DNS Messages	IPV6 Address Types	Cable Technology
S-3	SLO-1	ICMP -introduction	System calls used with Sockets	TELNET	Introduction	Compare DSL Vs Cable
	SLO-2	ICMP-Messages	Iterative and concurrent server	SSH	Address Space Allocation	Frame Relay
S-4	SLO-1	Debugging tools	Socket Interface	FTP	Global Unicast Addresses	ATM Introduction
	SLO-2	ICMP package	Structure and Functions of Socket	TFTP	Autoconfiguration	ATM Cell Format
S-5	SLO-1	UDP Datagram	Remote Procedure Call	WWW Architecture	Renumbering	ATM Layer
	SLO-2	UDP characteristics	RPC Model, Features	WWW Documents	IPV6 Routing Protocols	AAL Layer
S-6	SLO-1	TCP Header	TCP Client Server Program	HTTP	Introduction	ATM Application
	SLO-2	TCP connection establishment process	Input, Output Processing Module	HTTP Request and Reply	IPV6 Packet Format	PPP
S-7	SLO-1	TCP Error Control	UDP Client Server Program	DHCP Operation	Comparison between IPV4 and IPV6 Header	PPP Services, Components
	SLO-2	TCP Congestion Control	UDP Control block table & Module	DHCP Configuration	IPV4 to IPV6 Tunneling	PPP frame and byte stuffing
S-8	SLO-1	TCP Flow Control	UDP Input & Output Module	SMTP	IPV4 to IPV6 Translation Techniques	HDLC
	SLO-2	Multicasting	SCTP Sockets	POP3	NAT Protocol Translation	HDLC Transfer Modes, Frame

S-9	SLO-1	Multicasting and Multicast Routing Protocol	SCTP Services and Features, Packet Format	IMAP	IPV6 Mobility	Types of HDLC Frame
	SLO-2	Stream Control Transmission Protocol	SCTP Client/Server	MIME	Protocols Changed to Support IPV6	MPLS

Learning Resources	1. BehrouzA.Forouzan,"TCPIPProtocolSuite"4thedition,2013,McGraw-HillISBN:0073376043 2. DouglasE.Comer,InternetworkingwithTCP/IP,Principles,protocols,andarchitecture,Vol15th Edition,2006 ISBN: 0131876716, ISBN:978-0131876712	3. Richard Stevens, Unix Network Programming, vol.1, 3rd edition, 2003, McGraw-HillISBN 0-07-246060-1

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
1. Mr.Thamaraiselvam,zoho, thamaraiselvam.s@zohocorp.com	1.Dr.Ema,Anna University Chennai,umaramesh@auist.net	1. Dr. G.Usha,SRMIST,Dr.J.Kalaivani,SRMIST
2.Mr.Mithun, Cognizant,Mithun.SS@cognizant.com	2.Dr.KunvarSingh,NITTrichy,kunwar@nitt.edu	2. Mr.J.GodwinPon,SRMIST

Course Code	18CSE453T	Course Name	NETWORK ROUTING ALGORITHMS	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	18CSC302J	Co-requisite Courses	Nil	Progressive Courses	Nil		
Course Offering Department		Computer Science and Engineering		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 how addressing and routing are tied together and different architectural components are related to routing.
CLR-2 : Gain knowledge on the need for routers, its functionality and different architectures.
CLR-3 : Understand fundamental basis of various algorithms in centralized and distributed point of view.
CLR-4 : Apply the knowledge of IP addressing in various routing algorithms.
CLR-5 : Understand the various types of key routing protocols used in wireless networks.
CLR-6 : Gain knowledge on past experiences and prepare for next generation networks and routing

Column headers for Learning: Level of Thinking (Bloom), Expected Proficiency (%), Expected Attainment (%)

PLO headers: 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

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 knowledge of how data transfer happens in conventional networks	2	80	85	H	M	-	-	L	-	-	-	-	M	-	H		-	-
CLO-2 :	Comprehend Router Architectures and IP Address Lookup Algorithms	2	75	80	H	H	M	M	L	-	-	-	-	-	L	H	-	-	-
CLO-3 :	Compare routing techniques and protocols	2	85	80	H	H	L	M	M	-	-	-	M	-	L	H	-	-	-
CLO-4 :	Examine how different dimensions of routing differ for different types of network	2	80	75	H	H	H	H	H	L	-	M	M	-	-	H	-	-	-
CLO-5 :	Apply various routing algorithms in wireless network scenario.	2	75	85	H	H	H	H	M	-	-	-	M	-	-	H	-	-	-
CLO-6 :	Understand various routing paradigms in next generation	2	80	85	H	H	H	M-	M	L	-	-	-	-	-	H	-	-	-

Duration (hour)	8	9	9	9	10
S-1 SLO-1	Network Routing: An Introduction to Routing algorithms	Router Architectures: Basic Forwarding Functions	Bellman-Ford algorithm: Centralized View	Routers, Networks, and Routing Information: Some Basics	Routing in Wireless Networks: Internet based mobile ad-hoc networking
S-1 SLO-2	Functions of Router	Routing table versus forwarding table	Distance Vector Approach: Distributed View	Routing Table, Communication of Routing Information	Classifications of routing protocols
S-2 SLO-1	IP addressing	Types of router	Dijkstra's Algorithm	Routing Information Protocol, Version 1 (RIPv1)	Table-Driven Routing Protocols: Destination Sequenced Distance-Vector Routing Protocol
S-2 SLO-2	On Architecture: Service Architecture	Elements of Router	Comparison of Bellman-Ford and Distance Vector Approach	Routing Information Protocol, Version 2 (RIPv2)	Cluster-Head Gateway Switch Routing Protocol
S-3 SLO-1	Protocol architecture stack	Packet Flow	Shortest Path Computation with Candidate Path Caching	Interior Gateway Routing Protocol (IGRP)	On-Demand Routing Protocols: Dynamic Source Routing Protocol
S-3 SLO-2	Protocol architecture stack	Packet Processing	Widest Path Computation with Candidate Path Caching	Enhanced Interior Gateway Routing Protocol (EIGRP), Route Redistribution	Ad Hoc On-Demand Distance-Vector Routing Protocol
S-4 SLO-1	Network Topology Architecture	Shared CPU architecture, Shared forwarding Engine Architecture	Widest Path Algorithm	OSPF: Protocol Features	Hybrid Routing Protocols: Core Extraction Distributed Ad Hoc Routing Protocol
S-4 SLO-2	Network Management Architecture	Shared Nothing Architectures, Clustered Architectures	k-Shortest Paths Algorithm	OSPF Packet Format	Zone Routing Protocol
S-5 SLO-1	Public Switched Telephone Network	Impact of Addressing on lookup	Routing Protocol, Routing Algorithm, and Routing Table	Integrated IS-IS	Routing Protocols With Efficient Flooding Mechanisms : Preferred Link-Based Routing Protocols

			Longest Prefix Matching	Routing Information Representation and Protocol Messages	Similarities and Differences Between IS-IS and OSPF	Optimized Link State Routing
S-6	SLO-1	Communication Technologies	Naïve Algorithms, Binary Tries	Distance Vector Routing Protocol	IP Traffic Engineering: Traffic, Stochasticity, Delay, and Utilization	Hierarchical Routing Protocols
					Applications' View	Power-Aware Routing Protocols
S-7	SLO-1	Standard Committees – International Telecommunication Union	Multi-bit Tries	Link State Routing Protocol	Traffic Engineering: An Architectural Framework	Toward Next Generation Routing: Quality of Service Routing
	SLO-2	Internet Engineering Task Force, MFA Forum	Compressing multi-bit strides		Traffic Engineering: A Four-Node Illustration	
S-8	SLO-1	Type Length Value	Search By Length Algorithms	Path Vector Routing Protocol	BGP Operations, configuration, faces of BGP	Multiprotocol Label Switching(MPLS)
	SLO-2	Network Protocol Analyzer	Search By value approaches		BGP Decision Process	Generalized MPLS
S-9	SLO-1		Hardware Algorithms	Network Flow Modeling: Single-Commodity Network Flow	Internal BGP Scalability	Routing and Traffic Engineering with MPLS
	SLO-2		Comparing Different Approaches	Multicommodity Network Flow: Three-Node Example	Protocol Message Format	
S-10	SLO-1					PSTN Call Routing Using the Interne
	SLO-2					

Learning Resources	1. D.Medhi and K.Ramasamy, Network Routing : Algorithms, Protocols and Architectures, Morgan Kaufmann Publishers, First Edition 2007. 2. C.Siva Ram Murthy and B.S.Manoj, Adhoc Wireless Networks, Pearson Education, 2007. 3. D.Medhi and K.Ramasamy, Network Routing : Algorithms, Protocols and Architectures, Morgan Kaufmann Publishers, Second Edition 2017.	4. Steen Strub M, Routing in Communication networks, Prentice Hall International, 1995. 5. Internetworking Technologies Handbook, Inc. Cisco Systems, ILSG Cisco

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. T.Bernald , Senior Consulatant , TCS Chennai. bernald.t@tcs.com (waiting for approval)	Dr. S.Anbuchelian, Anna University. anbuchelian@annauniv.edu	1. Dr.Femilda Josephin J S, SRMIST
		2. Mr.Rajesh Babu, SRMIST
		3. Mr. J.Godwin, SRMIST

Course Code	18CSE454T	Course Name	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		Computer Science Engineering	Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1 :	To learn about Modern Processors and concepts
CLR-2 :	To understand the basic concepts of optimizations
CLR-3 :	To learn about Parallel Computers and programming
CLR-4 :	To understand the basic concepts of parallelization
CLR-5 :	To Study about Memory Parallel Programming using OpenMP
CLR-6 :	To Study about Memory Parallel Programming using and MPI

Learning columns: 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

Course Learning Outcomes (CLO): At the end of this course, learners will be able to:	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLO-1 : Acquire the knowledge of Modern processors and concepts	2	80	85	H	H	-	-	-			-	-	H	-	-	-	-	-
CLO-2 : Understand the basic ideas about Optimizations	2	75	80	-	H	-	-	-	-	-	-	-	-	-	-	-	-	H
CLO-3 : Acquire the ability to identify parallel computers	2	85	80	-	-	H	-	-	-	-	M	-	-	L	-	-	-	-
CLO-4 : Appreciate the concepts of parallelization	2	80	75	-	H	-	-	H	-	-	-	H	-	-	H	-	-	-
CLO-5 : Apply the knowledge on parallel programming using Open MP	2	75	85	-	-	-	H	-	L	L	-	-	-	-	-	-	-	-
CLO-6 : Acquire the knowledge on parallel programming using MPI	2	80	85	-	-	-	-	-	-	-	-	-	-	-	-	H	H	-

Duration (hour)	9	9	9	9	9
S-1 SLO-1	Stored Program Computer Architecture	Scalar profiling- Function- and line-based runtime profiling	Taxonomy of parallel computing paradigms	Introduction to OpenMP	Distributed-memory parallel programming with MPI- Message passing
S-1 SLO-2	General-ptupose cache-based microprocessor architecture	Hardware performance counters .	Shared-memory computers	Parallel execution	introduction to MPI
S-2 SLO-1	Performance based metrics and Benchmarks	Manual instrumentation	Cache coherence	Data scoping	Messages and point-to-point Communication, Collective Communication
S-2 SLO-2	Transistors galore:	Common sense optimizations- Do less work!	UMA – ccNUMA	OpenMP worksharing for loops	Nonblocking point-to-point Communication
S-3 SLO-1	Moore's Law	Avoid expensive operations!	Distributed-memory computers	Synchronization	Virtual topologies
S-3 SLO-2	Pipelining	Shrink the working set!	Hierarchical (hybrid) systems	Reductions	Example: MPI parallelization of a Jacobi solver
S-4 SLO-1	Superscalarity	Simple measures, large impact- Elimination of common subexpressions	Networks- Basic performance characteristics of networks	Loop scheduling, Tasking	MPI implementation
S-4 SLO-2	SIMD	Avoiding branches	Buses, Switched and fat-tree networks	Miscellaneous	Performance properties, MPI performance tools
S-5 SLO-1	Memory hierarchies	Using SIMD instruction sets	Mesh networks, Hybrids	Case study: OpenMP-parallel Jacobi algorithm	Communication parameters
S-5 SLO-2	Cache	The role of compilers	Parallelism- Data parallelism	Advanced OpenMP: Wavefront	Synchronization, serialization, contention

					parallelization	
S-6	SLO-1	*Cache mapping*	*General optimization options*	*Functional parallelism*	*Efficient OpenMP programming*	*Implicit serialization and synchronization*
	SLO-2	*Prefetch*	*Inlining, Aliasing*	*Parallel scalability*	*Profiling OpenMP programs*	*Contention*
S-7	SLO-1	*Multicore processors*	*Computational accuracy*	*Factors that limit parallel execution*	*Performance pitfalls*	*Reducing Communication overhead*
	SLO-2	*Multithreaded processors*	*Register optimizations, Using compiler logs*	*Scalability metrics, Simple scalability laws*	*Ameliorating the impact of OpenMP worksharing constructs*	*Optimal domain decomposition*
S-8	SLO-1	*Vector processors-*	*C++ optimizations- Temporaries*	*Parallel efficiency, Serial performance versus strong scalability*	*Determining OpenMP overhead for short loops*	*Aggregating messages*
	SLO-2	*Design principles*	*Dynamic memory management*	*Refined performance models*	*Serialization*	*Collective Communication*
S-9	SLO-1	*Maximum performance estimates*	*Loop kernels and iterators*	*Choosing the right scaling baseline*	*False sharing*	*Nonblocking vs. asynchronous Communication,*
	SLO-2	*Programming for vector architectures*	*Storage order- Case study: Jacobi algorithm and Dense matrix transpose.*	*Load imbalance*	*Case study: Parallel sparse matrix-vector multiply*	*Understanding intranode point-to-point Communication*

Learning Resources	1. *GeorgHager, GerhardWellein,"IntroductiontoHighPerformanceComputingforScientistsand Engineers", Chapman&Hall/CRCComputationalScienceseries,2011.* 2. *JohnLevesque,GeneWagenbreth,"HighPerformanceComputing:Programmingand Application"CRC Press,2010*	3. *KaiHwang,Zhiweixu"ScalableParallelComputing:Technology,Architecture,Programming",* 4. *CharlesSeverance,KevinDowd,"HighPerformanceComputing", O'ReillyMedia,2ndEdition,1998.*

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.Kesavan, HCL Technologies	1. Dr. Surendran Rajendran, AMA International University, Bahrain	1. J. Godwin Ponsam, SRMIST
2. Mr.R.Celein , Symmantec India Limited		2. Mr.SivakumarSRMIST
		3.. Mr. Jothikumar, SRMIST

Course Code	18CSE455T	Course Name	DATABASE SECURITY AND PRIVACY	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	CSE		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1 :	Understand the fundamentals of security relates to information
CLR-2 :	how security is maintained in information systems
CLR-3 :	Understand the concept of security models in database
CLR-4 :	Implementation of virtual private dtabase
CLR-5 :	Learn the procedures of database auditing
CLR-6 :	Implementation of data mining algorithms for PPDM

Learning

	1	2	3
	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)

Program Learning Outcomes (PLO)

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		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 knowledge of information system and information security	2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	Able to manage the security of information system as well as database	2	75	80	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-3 :	Able to design and develop the security model in database	2	85	80	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	Able to implement VPD in various database	2	80	75	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	Able to audit the database activities, users, security	2	75	85	H	-	-	H	-	-	-	-	-	-	-	-	-	-	-
CLO-6 :	Apply the security mechanism in PPDM using various algorithms	2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Security Architecture: Introduction	Administration of Users-Introduction	Database Application Security Models: Introduction-	Auditing Database Activities-introduction	Privacy Preserving Data Mining Techniques: Introduction
	SLO-2	Information Systems	Authentication	Types of Users	Oracle Database Activities	Data Mining Techniques:
S-2	SLO-1	Database Management Systems	Creating Users	-Security Models	Oracle Database Activities	Privacy Preserving Data Mining Algorithms
	SLO-2	Information Security Architecture	SQL Server User	Application Types	Creating DLL Triggers with Oracle	Privacy Preserving Data Mining Algorithms
S-3	SLO-1	- Database Security	Removing, Modifying Users	-Application Security Models	Creating DLL Triggers with Oracle	General Survey-Data Mining Techniques
	SLO-2	Asset Types and value	Default users	Data Encryption	Auditing Database Activities with Oracle	Randomization Methods
S-4	SLO-1	Security Methods	Remote Users	Virtual Private Databases: Introduction	Auditing Database Activities with Oracle	Randomization Methods
	SLO-2	Operating System Security Fundamentals: Introduction	Database Links	-Overview of VPD	Auditing Server Activity with SQL Server 2000	Group Based Anonymization
S-5	SLO-1	Operating System Overview	Linked Servers	Implementation of VPD using Views	Auditing Server Activity with SQL Server 2000	Group Based Anonymization
	SLO-2	Security Environment	Remote Servers	Application Context in Oracle	Auditing Server Activity with SQL Server 2000	Distributed Privacy Preserving Data Mining
S-6	SLO-1	Security Components	Practices for Administrators and Managers-	Implementing Oracle VPD-	Auditing Server Activity with Oracle	Distributed Privacy Preserving Data Mining
	SLO-2	Authentication Methods	Profiles, Password Policies, Privileges and Roles: Introduction	Implementing Oracle VPD	Auditing Server Activity with Oracle	Curse of Dimensionality

S-7	SLO-1	User Administration	Defining and Using Profiles	Viewing VPD Policies	Security and Auditing	Application of Privacy Preserving Data Mining
	SLO-2	Password Policies	Designing and Implementing Password Policies	VPD using views	Security and Auditing	Application of Privacy Preserving Data Mining
S-8	SLO-1	Vulnerabilities	Best Practices	Application contexts using Data Dictionary	Casestudy: projest security and auditing	Casestudy: on PPDM
	SLO-2	Vulnerabilities	Granting and Revoking User Privileges	Policy manager implementation	Casestudy: projest security and auditing	Casestudy: on PPDM
S-9	SLO-1	Email Security	Creating, Assigning and Revoking UserRoles	Policy Manager Implementing Row and Column level Security with SQL Server	Casestudy: projest security and auditing	Casestudy: on PPDM
	SLO-2	Internet security	Best practices	Policy Manager Implementing Row and Column level Security with SQL Server	Casestudy: projest security and auditing	Casestudy: on PPDM

Learning Resources	1. HassanA.Afyouni,"DatabaseSecurityandAuditing",ThirdEdition,CengageLearning,2009. 2. RonBenNatan,"ImplementingDatabaseSecurityandAuditing",ElsevierDigitalPress,2005	3. Charu C. Aggarwal, Philip S Yu, "Privacy Preserving Data Mining": Models and Algorithms, Kluwer Academic Publishers, 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
1. Mr.SomuChockalingam, Founder and President,Doyensys,Chennai	Dr.K.Vivekanandan,Professor,Pondicherry Engineering College	1. Dr.B.Murugananthan,SRMIST
		2.. Ms.Thenmozhi,SRMIST
		3.. M.Maheswari,SRMIST

Course Code	18CSE456T	Course Name	SOFTWARE DEFINED NETWORKS	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	18CSC302J	Co-requisite Courses	Nil	Progressive Courses	
Course Offering Department	CSE		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 :	cover topics more advanced than a typical undergraduate networking course	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 :	prepare students for a market that is going to demand computer scientists and software engineers to deliver the next generation of network switches																		
CLR-3 :	describe the principles by which large computer networks and applications atop them are designed and maintained																		
CLR-4 :	Make students understand the state-of-the art networking technologies proposed in literature or used throughout industry in a variety of areas																		
CLR-5 :	Make students learn to critique research literature through a number of paper reviews and attempt to improve the state-of-the-art through minor and major projects																		

Course Learning Outcomes (CLO):	At the end of this course, learners will::																		
CLO-1 :	have a knowledge of the technology evolution leading to SDN as well as the Open Source role in SDN and OpenFlow specifications	3	75	80	H	M	H	-	H	-	-	-	-	-	-	H	H	H	H
CLO-2 :	gain a knowledge of the advantages and disadvantages of SDN, API approaches, Hypervisor overlays, and Data Center SDN, SDN WAN etc	3	75	80	H	M	H	-	H	-	-	-	-	-	-	H	H	H	H
CLO-3 :	Understand different network virtualization techniques and can deploy SDN/NFV applications	3	75	80	H	M	H	-	H	-	-	-	-	-	-	H	H	H	H
CLO-4 :	understand the economics of SDN and its impacts in the marketplace	3	75	80	H	M	H	-	H	-	-	-	-	-	-	H	H	H	H

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Introduction	Why SDN? Genesis of SDN	Alternative definitions of SDN	Emerging SDN Models	SDN Ecosystem
	SLO-2	How to Read a Paper (S. Keshav)	How SDN Works	Potential drawbacks of Open SDN	Protocol Models: NETCONF, BGP, MPLS	White-box switching
S-2	SLO-1	Ho to Review a Paper (Timothy Roscoe), How to Disagree (Paul Graham)	SDN Evolution, SDN Basics	SDN via APIs	Controller Models	Open Sourcing SDN
	SLO-2	Networking Basics: Switching, Addressing, Routing	SDN Architecture	SDN via Hypervisor-Based Overlays	Application Models: Proactive, Declarative, External	Open Networking Foundation
S-3	SLO-1	Paper Reading: 4D	Plane Separation	SDN via Opening Up the Device	SDN in Datacenters: Multitenancy, Failure Recovery	OpenDaylight
	SLO-2	Paper Reading: 4D	Simple Device and Centralized Control	Building our own SDN Switch	SDN in Internet eXchange Points (IXPs)	The ONOS Project
S-4	SLO-1	Paper Reading: ALF	Network Automation and Virtualization	SDN on Raspberry Pi, Zodiac Fx	Tunneling and Path Technologies, Ethernet Fabrics in the Data Center	Hypervisors: Background, Types
	SLO-2	Paper Reading: ALF	Openness, Northbound and Southbound APIs	Ryu on Raspberry Pi, Zodiac Fx	SDN Use Cases, Open SDN versus Overlays in the Data Center	OpenStack Deployment
S-5	SLO-1	Switching Architecture: Data, Control, and Management Planes	Paper Reading: OpenFlow: Enabling Innovation in Campus	Network Function Virtualization (NFV)	Real-World Data Center Implementations, SDN in Other Environments	OpenStack Orchestration

			Networks			
	SLO-2	*Hardware Lookup*	*Review 1*	*Review 2*	*Review 3*	*Review 4*
S-6	SLO-1	*Forwarding Rules*	*OpenFlow, Switch-Controller Interaction*	*SDN vs. NFV*	*Wide Area Networks*	*OpenSwitch*
	SLO-2	*Dynamic Forwarding Tables*	*Flow Table, Packet Matching*	*OPNFV*	*Paper Reading: B4: Experience with a Globally-Deployed Software Defined WAN, SIGCOMM, 2013*	*Reactive versus Proactive Applications*
S-7	SLO-1	*Autonomous Switches and Routers*	*Actions and Packet Forwarding*	*Service Creation and Chaining*	*Service Provider and Carrier Networks*	*Analyzing Simple SDN Applications*
	SLO-2	*Internet Architecture*	*Extensions and Limitations*	*NFV Orchestration*	*Campus Networks*	*Other SDN Applications*
S-8	SLO-1	*Control-Data Plane Separation*	*Paper Reading: P4: Programming Protocol-Independent Packet Processors*	*Creating Network Virtualization Tunnels*	*Hospitality Networks, Mobile Networks*	*Future of SDN*
	SLO-2	*Packet Scheduling*	*SDN Controllers: POX, RyuMininet Programming*	*Offloading Flows in the Data Center*	*In-Line Network Functions*	*SDN Security*
S-9	SLO-1	*Paper Reading: The Road to SDN: An Intellectual History of Programmable Networks*	*SDN Controllers: OpenDaylight, Mininet Programming*	*Access Control for the Campus*	*Optical Networks*	*Use Cases*
	SLO-2	*Project Proposal Due*	*SDN Controllers: ONOS, Mininet Programming*	*Traffic Engineering for Service Providers*	*SDN vs. P2P/Overlay Networks*	*Group Project Presentation*

Learning Resources	1. *Software Defined Networks: A Comprehensive Approach, 2nd Edition Morgan Kaufmann, 2016* 2. *SDN: Software Defined Networks, Thomas D. Nadeau, Ken Gray, O'Reilly Media, 2013.*	3. Network Function Virtualization, Ken Gray, Thomas D. Nadeau, Morgan Kaufmann, 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
		1. Dr. Femilda
		2. Mr. K. Venkatesh
		3. Mr. KarthickNanmaran

Course Code	18CSE457T	Course Name	SEMANTIC WEB	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		Computer Science and Engineering		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 :	Learn how the Semantic Web allows new uses of data																		
CLR-2 :	Understand how semantic technologies promote data portability																		
CLR-3 :	Become familiar with semantic standards-RDF,OWL																		
CLR-4 :	Make use of semantic programming techniques to both enrich web application development																		

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 :	Apply flexible approach for integrating and future-proofing systems and data	1	80	85	H	L	H	-	H	-	-	-	-	-	-	-	H	H	-	M
CLO-2 :	Program the Semantic Web provides a standard	3	75	80	H	H	-	-	H	-	-	-	-	-	-	-	H	H	H	M
CLO-3 :	Incorporate existing data sources into semantically aware applications and publish rich semantic data	3	85	80	H	H	H	-	H	-	-	-	-	-	-	-	H	-	-	H
CLO-4 :	Make the machines to find, share, and combine data on the Web	3	80	75	H	H	-	-	H	-	-	-	-	-	-	-	H	H	H	H

Duration (hour)		9	9	9	9	9
S-1	SLO-1	The Semantic Web Vision	Querying the Semantic Web	Web Ontology Language	Logic and Inference: Rules	Applications
	SLO-2	Motivation for the Semantic Web	SPARQL Infrastructure	Requirements for Ontology Languages	Logic and Rules	e-commerce
S-2	SLO-1	Semantic Web Technologies	Matching Patterns	OWL Syntax	Rules on the Semantic Web	
	SLO-2	Explicit Metadata		Formal Semantics	Monotonic Rules	Adoption
S-3	SLO-1	Ontologies	Filters	Expressivity	Monotonic Rules: Syntax	Publication
	SLO-2	RDF,OWL			Rules, Facts	News website application
S-4	SLO-1	Logics-Principles of reasoning	Constructs for Dealing with an Open World	Reasoning Support	Logic Programs	Adoption
	SLO-2	The Semantic Web versus Artificial Intelligence			Monotonic Rules: Semantics	Publication
S-5	SLO-1	A Layered Approach	Organizing Result Sets	Compatibility of OWL2 with RDF/RDFS	Predicate Logic Semantics	Constructing Ontologies Manually
	SLO-2			OWL2 Full: RDF-Based Semantics	OWL2 RL	Reusing Existing Ontologies
S-6	SLO-1	RDF: Data Model	Other Forms of SPARQL Queries	OWL2 DL: Direct Semantics		
	SLO-2				Rule Interchange Format: RIF	Semiautomatic Ontology Acquisition
S-7	SLO-1	RDF/XML	Querying Schemas	The OWL2 primitives	RIF-BLD	
	SLO-2	RDFS: Adding Semantics		OWL2 Syntax	Compatibility with RDF and OWL Semantic Web Rules Language (SWRL)	Ontology Mapping
S-8	SLO-1	Classes and Properties	Adding Information with SPARQL Update	OWL2 Property Types		
	SLO-2	Class Hierarchies and Inheritance	Inserting and Loading Triples	OWL2 Property Axioms		
S-9	SLO-1	Property Hierarchies	Deleting Triples	OWL2 Class Axioms	Rules in SPARQL: SPIN	SemanticWeb Application Architecture
	SLO-2	RDF Schema	Case study	Individual Facts	RuleML	

Learning	1. Grigoris Antoniou and Frank Van Harmelen,-A Semantic Web Primer - The MIT Press, Cambridge,	3. John Hebeler , Matthew Fisher, Ryan Blace, Andrew Perez-Lopez , Mike Dean Semantic Web Programming,

Resources	Massachusetts London, England, Edition 3,2012 2. Toby Segaran, Colin Evans, Jamie Taylor, Programming the Semantic Web Build Flexible Applications with Graph Data, O'Reilly Media,2009	1st Edition,Wiley, 2009. 4. Thomas B. Passin, Explorer's Guide to the Semantic Web, Manning, 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	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. 1. Dr.Harisekharan,CTO,Sri SeshaaTechnologies Pvt. Ltd., Chennai	1. Dr.J.Suresh, SSN College of Engineering	Dr.G.Vadivu
	2. Dr. Sharmila Shankar, Crescent Institute of Science and Technology	Dr.C.N.Subalalitha
		Ms.S.Veena

Course Code	18CSE458T	Course Name	WIRELESS AND MOBILE COMMUNICATION	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	
Course Offering Department		Computer Science and Engineering		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 :	Analyze the fundamental of transmission and cellular systems																		
CLR-2 :	Apply skills in real time engineering problems and can have capability to evaluate the transmission errors																		
CLR-3 :	Comprehend the concept of mobile network, transport layer and wireless technologies																		
CLR-4 :	Differentiate the various types of cellular standard by their unique services.																		
CLR-5 :	Grasp GSM. GPRS, Handover and Localization techniques																		
CLR-6 :	Apply skills in various Routing protocols																		

Column headers for 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

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																		
CLO-1 :	Apply Wireless Technology concepts to Engineering problems related to Communication	3	80	70	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
CLO-2 :	Improve their knowledge on Digital and analog Modulation techniques.	3	85	75	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
CLO-3 :	Equip themselves familiar with principle of Mobile Communication	3	75	70	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
CLO-4 :	Familiarize with Digital Cellular Standards	3	85	80	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
CLO-5 :	Acquaint with routing protocols	3	85	75	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
CLO-6 :	Expose to the emerging wireless technologies	3	80	70	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Introduction to wireless Communication	Cellular Concept	Introduction to GSM	Mobile IP	IEEE 802.11
	SLO-2	Elements of wireless Communication system	Cell area	Frequency Bands and Channels	IP packet delivery	System Architecture
S-2	SLO-1	Frequencies for radio Communication	Signal strength	Frames in GSM	Tunneling – Reverse Tunneling	Protocol Architecture
	SLO-2	Signals, Noise – Types of Noise	Cell parameter	Planes and layers of GSM	IPv6	MAC Layer and Management
S-3	SLO-1	Introduction to modulation and demodulation	Capacity of Cell	Protocols	DHCP	802.11a, 802.11b
	SLO-2	Signals in the modulation	Co channel interference	Localization and calling	Tradition TCP	HIPERLAN
S-4	SLO-1	Introduction to Analog modulation schemes	Frequency reuse	Handoff – Short messaging system	Congestion control	Bluetooth Architecture
	SLO-2	Amplitude Modulation Frequency modulation	Cell splitting Cell sectoring	GPRS EDGE	Classical TCP Snooping ,	IEEE 802.15 IEEE 802.15.4
S-5	SLO-1	Phase Modulation Introduction to Analog modulation schemes	Multiple Radio access protocols Frequencydivision Multiple Access	3G CELLULAR SystemsMMS	Mobile TCPFast retransmit / Fast recovery	MANET characteristicsROUTING
	SLO-2	Amplitude Shift Keying Frequency Shift Keying Phase Shift Keying- BPSK, QPSK	Time division Multiple Access Fixed ALOHA , Slotted ALOHA	UMTS Release and standards UMTS system architecture UTRAN	Transaction oriented TCP TCP over 2.5/3G wireless Networks	AODV Routing VANETCommunications in VANET
S-6	SLO-1	Multiplexing and multiple access techniques	Multiple Access with Collision Avoidance	Handover	Introduction to WAP WAP Architecture	Wireless Sensor Networks
S-7	SLO-1	Frequency-division multiplexing	Space division Multiple Access Code	Satellite System Infrastructure- GEO,	Wireless Datagram ProtocolWireless	RFID TechnologyTwo tags of RFID

			division Multiple Access	LEO, MEO	Transaction Protocol	
	SLO-2	Time-division multiplexing	Spread ALOHA multiple Access	Limitations of GPS	Wireless Session Protocol	Wi-Fi Standards
S-8	SLO-1	Code-division multiplexing	OFDM	GPSBeneficiaries of GPS	Wireless Transport Layer Security	WiMax Standards
	SLO-2	Spread spectrum modulation	Variants of OFDM			
S-9	SLO-1	frequency hopping Spread spectrum	Comparison of Multiple Access Technique	4G Cellular systems	Wireless Markup Language	Fem-to-Cell Network
	SL0-2	Direct Sequence Spread spectrum		4G Standards (LTE/WiMax)	Push Architecture	Push-to-talk technology for SMS

Learning Resources	1. Roy Blake, Wireless Communication Technology" CENGAGE learning, Sixth indian reprint 2013. 2. Dharma Prakash Agarwal, Qing-An Zeng , "Introduction to Wireless and Mobile Systems" CENGAGE learning, First edition 2014. 3. Jochen Schiller, "Mobile Communications", Addision Wesley, 2nd edition 2011. 4. Singal TL, "Wireless Communication", Tata McGraw Hill Education Private Limited. 5. G.I.Papadimitriou, A.S.Pomportsis, P.Nicopolitids, M.S.Obaidat, "Wireless Networks", John Wiley and Sons, 2003	6. Gray J.Mullet "Wireless TeleCommunication System and Networks", CENGAGE learning, reprint 2014. 7. Upena Dalal, "Wireless Communication" Oxford University Press, First edition 2009. 8. Kaveh Pahlavan & Prashant Krishnamurthy, "Wireless Networks" PHI 2002. 9. Martyn Mallick, "Mobile and Wireless Design Essentials", Wiley Dreamtech India Pvt.Ltd., 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.Madan Lakshmanan	Prof. Subra Ganesan	Dr.S.Suresh
Senior Scientist	Professor, Electrical and Computer Engineering	Mrs.Jeya
CEERI, CSIR, Chennai (R&D Industry)	Oakland University, USA	Mr.H.Karthikeyan

Course Code	18CSE459T	Course Name	SERVICE ORIENTED ARCHITECTURE	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		Computer Science and Enginering		Data Book / Codes/Standards		Nil			

Course Learning Rationale (CLR):	The purpose of learning this course is to:		Learning			Program Learning Outcomes (PLO)															
CLR-1 :	Learn service oriented analysis techniques	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-2 :	Learn technology underlying the service design																		
CLR-3 :	Learn advanced concepts in building SOA																		
CLR-4 :	Understand the Java Web services																		
CLR-5 :	To know about various Web services specification standards																		
CLR-6 :																			

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 knowledge on service oriented design technology	2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	Acquire the ability to identify web services in SOA	2	75	80	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-3 :	Understand the basic ideas about building SOA	2	85	80	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	Appreciate the concepts of standards and security on SOA	2	80	75	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	Apply the knowledge in Java based web servise	2	75	85	H	-	-	H	-	-	-	-	-	-	-	-	-	-	-
CLO-6 :	Acquire the knowledge on ASP .NET based web servises.	2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Introduction to SOA , Defining SOA	Introduction to Web Services	Phases of the SOA delivery lifecycle	SOA support in J2EE	Introduction to WS-BPEL
	SLO-2	Necessity of SOA.	Primitive SOA	SOA Delivery Strategies Top- down strategy, Bottom-up strategy	SOA platform basics and building blocks	Basic terms used in the BPEL terminology
S-2	SLO-1	SOA timeline from XML to Web services to SOA	Web Service Framework with respect to SOA	Agile strategy with Pros and cons	Overview of Java API for XML-based web services(JAX- WS)	WS-Coordination overview
	SLO-2	History about XML	Logical components of the Web services framework	Objectives and service-oriented process steps	Java Architecture for XML binding (JAXB)	WS-Choreography
S-3	SLO-1	Web Services and SOA	Service descriptions with WSDL layout	Benefits of a business-centric SOA	Building web services and client with examples	WS-Policy with SOA
	SLO-2	Service Oriented Enterprise (SOE)	Meta data and service contracts	Service- oriented design	Introduction to Java API for XML Registries(JAXR)	WS Security
S-4	SLO-1	Analyze the past architectures	Messaging with SOAP protocol and SOAP nodes	Introduction to WSDL language basics	Java API for XML based RPC (JAX-RPC)	Notification and Eventing
	SLO-2	Scope Of SOA	SOAP message path	Define the structure of WSDL	Web Services Interoperability	Transaction Management
S-5	SLO-1	SOA Reference Model	Message exchange Patterns and Coordination	Implement sample WSDL file	SOA support in .NET	Case study-SOA in cloud
	SLO-2	Key Service characteristics of SOA	Web Services a Activity Management,	Introduction to SOAP basics	NET Platform overview	research focus on SOA and issues

S-6	SLO-1	Anatomy of SOA	Coordination types and protocols	SOAP language basics	ASP.NET Page Handling	Comparative Analysis of SOA and Cloud Computing
	SLO-2	SOA architecture	ACID properties	Structure of SOAP	Post back vs Non post back events	
S-7	SLO-1	Components in SOA interrelate	Analyze atomic transaction with SOA	Implement SOAP style web services in Java.	ASP.NET web services	Case Study On Vehicle management system- create a service for identify the vehicle by entering the vehicle number.
	SLO-2	SOA component and specific behaviors	Business activities and protocols	SOA Composition	Creating a Web Site Using Visual Studio IDE	
S-8	SLO-1	Relationships among these components	Orchestration	service layers and standards	ASP.NET Programming Basics	Case Study on Online Healthcare System- Design an API to help healthcare providers collect, store, retrieve and exchange patient healthcare information more efficiently and enable better patient care.
	SLO-2	Technical Benefits of SOA	Choreography	Entity-centric business service design: List the step-by-step process	Creating a Web Site Using Visual Studio IDE	
S-9	SLO-1	Business Benefits of SOA	Service layer configuration scenarios	Application service design: process steps	Case Studies: Implement the Small Business Customer Management application as a web applications using ASP.NET	Case study on Simple Library Management System using API to get, post, edits and update book data from server.
	SLO-2	Principles of service orientation	Application Service Layer	Task centric business service design process steps	Web Services Enhancements (WSE)	

Learning Resources	1. ThomasErl,"Service-Oriented Architecture: Concepts, Technology, and Design", Pearson Education, 2009. 2. EricNewcomer,Lomow,"UnderstandingSOAwithWebServices",PearsonEducation,2005 3. JamesMcGovern,SameerT yagi, Michael EStevens, Sunil Mathew, Java WebServices Architecture",Elsevier,2003.	4. AchievingService-Oriented Architecture: Applying an Enterprise Architecture Approach, Rick Sweeney, 2010 5. Shankar Kambhampaly, "Service –Oriented Architecture for Enterprise Applications", Wiley India Pvt Ltd, 2008 3.Newcomer, Lomow, "Understanding SOA with Web Services", Pearson Education, 2005 4.Sandeep Chatterjee, James Webber, "Developing Enterprise Web Services, An Architect's Guide", Pearson Education,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

Course Code	18CSE460T	Course Name	NETWORK DESIGN AND MANAGEMENT	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	Computer Science Engineering	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 type of Networks and the Network Management basics																			
CLR-2 :	Understand the Network Management Standards																			
CLR-3 :	Understand the working of Simple Network Management Protocol and its various versions																			
CLR-4 :	Understand the working of Remote Monitoring																			
CLR-5 :	Understand the Network Management Applications																			
CLR-6 :	To Understand Network Designing and Planning																			

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 knowledge on networks and network management	1	70	75	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	Gain knowledge of the various standards	1	75	80	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-3 :	Gain knowledge on the working of SNMP protocol and its various applications	1	85	80	H	-	-	-	M	-	-	-	M	-	-	-	-	-	-
CLO-4 :	To apply the network management tools and gather information from the network	2	75	70	H	-	-	-	M	-	-	-	M	-	-	-	-	-	-
CLO-5 :	To Familiarize with the working of various management applications	2	75	80	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-6 :	Apply the knowledge to create an efficient network	3	70	75	H	H	H	H	H	-	-	-	H	-	-	-	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Telephone Network Management	Introduction to SNMP	Remote Monitoring	Network Management Applications	Network Design and Planning
	SLO-2	Distributed Computing Environment	SNMP v1 model	RMON SMI and MIB	Fault Management -Architecture	Network Design for Enterprise Network
S-2	SLO-1	TCP/IP Based Networks	Organization Model	RMON1	Fault location ,Fault isolation	Network Design Process
	SLO-2	Communication Protocols and Standards	System overview	RMON2	Algorithm	Data Collection
S-3	SLO-1	Protocol Layer and Services	SNMP v1 Information model	System Utilities for Management	Self-healing	Data Generation
	SLO-2	Challenges of IT Managers	Structure of Management Information	Tools	Avoiding failures	Traffic Generators
S-4	SLO-1	Network Management	Managed Objects	Network Statistics Measurement Systems	Configuration setting,	Cost Generators
	SLO-2	Network and System Management	MIB-Object Group	Traffic Load	Configuration discovery and Change Control	Topology
S-5	SLO-1	Network Management System Platform	System Group, Interfaces Group, Address Translation group	Protocol Statistics	Configuration Management Applications	Architecture
	SLO-2	Current status and future of Network Management	IP Group, ICMP Group, TCP Group, UDP Group	Data and Error Statistics	Patch Management	Graph
S-6	SLO-1	Network Management Standards	SNMP v1Communication model	Network Management System	Approaches for Performance Management	Link
	SLO-2	Network Management Model - Organizational model	Functional model	Components, Requirements	Performance Monitoring and Reporting	Algorithms
S-7	SLO-1	Information Model	SNMPv2	System Management	Performance trouble shooting,	Network Design Techniques
	SLO-2	Management Information Trees	System Architecture, MIB, Protocol	Network Management Applications	Capacity Planning	Performance Analysis

S-8	SLO-1	*Communication Model*	*SNMPv3*	*Configuration Management*	*Account Management*	*Queuing Essentials*
	SLO-2	*ASN.1*	*Architecture, Applications, MIB*	*Inventory Management*	*Report Management-System and User Reports*	*Loss and Delay*
S-9	SLO-1	*Terminology, Symbols and Conventions*	*User Based Security Model*	*Performance Management*	*Policy Management*	*Reliability*
	SLO-2	*Functional Model*	*Access Control*	*Tools*	*Service Level Management*	*Network Cost*

Learning Resources	1. *Mani Subramanian "Network Management Principles and Practice", Second Edition, Pearson Publication, 2012.* 2. *DineshChandraVerma,"PrinciplesofComputerSystemsandNetworkManagement",Springer,2009.*	3. *Greg Tomsho, Ed Tittel, David Johnson, "Guide to Network Essentials", Fifth Edition, Cengage Learning, 2010 4.Teresa C.Piliouras ," Network Design Management and Technical Perspectives", Second Edition ,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	40 %	-	40 %	-	20 %	-	30 %	-	40%	-
	Understand										
Level 2	Apply	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
	Analyze										
Level 3	Evaluate	20 %	-	20 %	-	40 %	-	30 %	-	20%	-
	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.Vivekanandan ,Nokia Technology Specialist, anandanviv1@gmail.com*	1.	1. Dr.B.Amutha, SRMIST
2.*Mr.SanthoshKumar.S,Associate Consultant,TCS, santhosh.sansoft@gmail.com*	2.	2.Dr.N.Snehalatha, SRMIST

Course Code	18CSE387T	Course Name	GENETIC ALGORITHM 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		Computer Science and Engineering	Data Book / Codes/Standards	Nil

Course Learning Rationale (CLR):	The purpose of learning this course is to:		Learning			Program Learning Outcomes (PLO)														
CLR-1 :	Evolutionary Computation and Genetic Algorithms		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-2 :	Terminologies and operators of GA and																			
CLR-3 :	Advanced Operators and Techniques in GA and Classification of Genetic Algorithms																			
CLR-4 :	Genetic Programming and Genetic Algorithm Optimization problems																			
CLR-5 :	Applications of Genetic 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 :	Provides a introduction to genetic algorithm including fundamentals of genetic concepts	3	80	75	L	H	-	H	L	-	-	-	L	L	-	H	-	-	-
CLO-2 :	To have a clear view of genetic operators	3	85	75	M	H	L	H	L	-	-	-	M	L	-	H	-	-	-
CLO-3 :	To explore Genetic Algorithm optimization problems	3	80	75	M	H	M	H	L	-	-	-	M	L	-	H	-	-	-
CLO-4 :	Discuss applications of Genetic Algorithms for various optimization problems.	3	85	80	M	H	M	H	L	-	-	-	M	L	-	H	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	The Historical Development of Evolutionary Computing. Genetic Algorithms and Genetic Programming	Terminologies and operators of GA.Key elements, Individuals,	Diploidy, Dominance etc. Inversion and Reordering. Order Crossover and Cycle crossover.	Genetic programming (GP). Comparison of GP and other algorithms. Genetic operators. Tree based GP, Representation of GP.	Specific Applications of Genetic Algorithms. GA in network synthesis, Control systems engineering and Fuzzy based speed control of Brushless DC motor.
	SLO-2		Genes, Fitness, Populations. Data Structures.			
S-2	SLO-1	Features of Evolutionary Computation Advantages of Evolutionary computation.	Breeding, Selection, Crossover, Mutation and Replacement.	Micro operators: Segregation and translocation, Duplications and Deletion, Sexual determination.	Attributes in GP. Steps of GP, Characteristics of GP. What are Human Competitive, High-Return, Routine, and Machine Intelligence?	Feature selection in machine learning using GA. Designing texture filters with GA.
	SLO-2					
S-3	SLO-1	Genetic algorithms-Biological background. Cell, Chromosomes, Genetics, Reproduction and Natural selection.	Search Termination or Convergence criteria.	Non-binary representation, Multi-objective optimization, combined optimization and Knowledge based techniques.	Applications of Genetic Programming	GA based knowledge acquisition in Image Processing. Object localization in image using GA.
	SLO-2					
S-4	SLO-1	Search space, GA world, Evolution and optimization	Best individual, Worst individual, Sum of fitness and Medium fitness.	Classification of GAs. Simple Genetic algorithms (SGA). Parallel and distributed GAs.	GA Optimization problems: Fuzzy optimization problems, Multi objective Reliability Design Problem. Network and bicriteria reliability problems.	Data mining applications such as feature selection in data mining, GA in intrusion detection, etc.
	SLO-2					
S-5	SLO-1	Evolution and genetic algorithms. Conventional optimization and search techniques.	Why do genetic algorithms work? Building block hypothesis	Master-slave, Fine-grained parallel GAs. Multiple-Deme Parallel GAs.	Combinatorial Optimization problems. Linear integer model,	Applications in wireless networks for topology planning. GA application in ATM network.
	SLO-2					

S-6	SLO-1	Gradient based, Random search, Stochastic Hill climbing	A Macro mutation hypothesis. An adaptive mutation hypothesis.	Hierarchical Parallel algorithms. Hierarchical Genetic Algorithms: Crossover, Initialization heuristics. Remove sharp algorithms.	Applications of combinatorial optimization methods.	VLSI design applications Genetic layout optimization using GA.
	SLO-2					
S-7	SLO-1	Simulated Annealing, Symbolic AI. A simple Genetic Algorithm.	The schema theorem	Adaptive GA., Initialization, Evaluation function, Selection operators, Crossover operators, and mutation operators.	Network design and Routing problems	Introduction to Particle Swam Optimization [PSO] and Ant Colony Optimization [ACO].
	SLO-2		Optimal allocation of Trials. Implicit Parallelism			
S-8	SLO-1	Comparison of GA with other optimization techniques.	Advanced operators and techniques in GA,	Independent sampling GA and Breeding Phase.	Planning of passive optical networks, Packet switched networks,	Examples on PSO and ACO.
S-9		Limitations of GA.	Convergence problems in GA	Niched pareto genetic algorithm	Optimal topological design of all terminal networks.	Comparison of GA with PSO and ACO

Learning Resources	1. S.N. Sivanandam and S.N. Deepa , "Introduction to Genetic Algorithms", Springer, 2nd edition (2008) 2. Mitsuo Gen and Runwei Cheng, "Genetic Algorithms and Engineering Optimization", John Wiley, Fourth edition (2010)	3. Michael Negnevitsky, "Artificial Intelligence, A Guide to Intelligent Systems", Second edition ((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
Mr. K. Selvaraj, Caterpillar, Bangalore	Dr. A.P. Shanthi, CSE, Anna University, Chennai	1.Dr. V. Ganapathy SRMIST
	Dr. A. Kannan, CSE, VIT, Vellore.	2.Dr. D. Rajeswari SRMIST
		3.S. Saranya SRMIST

Course Code	18CSE388T	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		Computer Science and Engineering		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 :	Connect Biology with Computers																		
CLR-2 :	Understand components of artificial neural networks																		
CLR-3 :	Understand supervised learning networkparadigms	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-4 :	Understand unsupervised learning networkparadigms																		
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																		
CLO-1 :	Know the purpose of Artificial Neural Networks	1	80	85	H	L	-	-	H-	-	-	-	-	-	-	H	L	L	-
CLO-2 :	Apply the concepts of activation, propogation functions	2	75	80	H	H	-	-	H	-	-	-	-	-	-	H	H	H	H
CLO-3 :	Work with supervised learning network paradigm	3	85	80	H	H	H	-	H	-	-	-	-	-	-	H	H	H	H
CLO-4 :	Work with unsupervised learning network paradigm	3	80	75	H	H	-	-	H	-	-	-	-	-	-	H	H	H	H

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Why neural network?	Components of artificial neural networks	Learning and training samples	Radial basis functions	Unsupervised learning networkparadigms
	SLO-2	Basics of Artificial Neural Networks	The concept of time in neural networks	Paradigms of Learning	Information processing of an RBF network	Structure of a self-organizing map(SOM)
S-2	SLO-1	A brief history of neural networks Biological neural networks	Connections	Using training samples	Training of RBF networks	Functionality
	SLO-2		Propagation function	Gradient Optimization Procedure	Growing of RBF networks	Training
S-3	SLO-1	Biological neural networks	Activation	Hebbian learning rule		Topology function
	SLO-2	The vertebrate nervous system	Threshold value, Activation function	Supervised learning networkparadigms	Compare multilayer perceptrons and RBF	Decreasing Learning Rate
S-4	SLO-1	peripheral nervous system	Common activation functions	The perceptron, back propagation and its variants	Recurrent perceptron-like networks	Variations of SOMs
	SLO-2	Cerebrum, cerebellum, diencephalon,brainstem	Output function, Learning strategies	Singlelayer perceptron	Jordan networks	Neural gas
S-5	SLO-1		Network topologies	Linear Separability	Elman networks	Multi-SOM
	SLO-2	The Neuron	Feedforward networks	Multilayer perceptron	Training recurrent networks	Multi-neural gas
S-6	SLO-1	Components	Recurrentnetworks	Backpropagation of error		Growing neural gas
	SLO-2	Electrochemical processes	Completely linked networks	Selecting learning rate	Unfolding in time	Adaptive resonance theory(ART)
S-7	SLO-1	Receptor cells- Various types	Bias neuron	Resilient Backpropagation	Teacher forcing	Task and structure of an ART network
	SLO-2	Information processing within nervous system	Representing Neurons	Adaption of Weights		
S-8	SLO-1	Light Sensing organs	Orders of Activation	Variations in Backpropagation	Recurrent backpropagation	Resonance
	SLO-2	Neurons in living organisms	Synchronous activation			
S-9	SLO-1	Transition to technical neurons	Asynchronous activation	Multilayer perceptron	Evolutionary algorithms	Learning process of an ART network
	SLO-2		input and outputof data			

| Learning | 1. | David Kriesel, A BriefIntroduction to Neural Networks, dkriesel.com, 2005 | 3. | Raul Rojas, Neural Networks: A Systematic Introduction, 1996. |
| Resources | 2. | GunjanGoswami, Introduction to Artificial Neural Networks, S.K. Kataria& Sons, 2012 | 4. | S. Sivanandam, Introduction to Artificial Neural Networks, 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. Dr.Harisekharan,CTO,Sri SeshaaTechnologies Pvt. Ltd., Chennai	1. Dr.J.Suresh, SSN College of Engineering	Dr.G.Vadivu
	2. Dr. Sharmila Shankar, Crescent Institute of Science and Technology	Dr. D.Rajeswari
		Dr.M.S.Abirami

Course Code	18CSE389T	Course Name	FUZZY LOGIC 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		Computer Science & Engg		Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1 :	Understand the Fuzzy Logic Basics
CLR-2 :	Gain knowledge on the Machine learning concepts
CLR-3 :	Gain knowledge on Fuzzy based clustering concepts
CLR-4 :	Acquire knowledge on Fuzzy Integrated classification
CLR-5 :	Understanding Neuro-Fuzzy Modeling concepts
CLR-5 :	Acquiring better understanding on Fuzzy logic usage
CLR-6	Understanding the fuzzylogics in Machine learning

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
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLO-1 :	Acquire the knowledge on Basics of Fuzzy Logic	2	80	85	H	M	-	H	-	-	-	-	-	-	-	H	L	H	M
CLO-2 :	Understand the basic concepts in Machine learning	2	75	80	H	H	-	H	-	-	-	-	-	-	-	H	L	H	M
CLO-3 :	Apply the knowledge of Clustering in Fuzzy logics	2	85	80	H	-	-	H	-	-	-	-	-	-	-	H	L	H	M
CLO-4 :	Apply the concept of Classification in Fuzzy Logics	2	80	75	H	H	-	H	-	-	-	-	-	-	-	H	L	H	M
CLO-5 :	Acquire the knowledge on Neuro-Fuzzy resoning	2	75	85	H	-	-	H	-	-	-	-	-	-	-	H	L	H	M
CLO-6 :	Acquire the insight of Neuro-Fuzzy Modeling	2	75	85	H	-	H	H	H	-	-	-	-	-	-	H	L	H	M

Duration (hour)	9	9	9	9	9
S-1 SLO-1	Fuzzy Logic Introduction : Comparison of traditional logic and fuzzy logic	Machine learning : Importance of ML	Fuzzy Clustering Basics: Cluster analysis Objective function-based cluster analysis, Fuzzy analysis of data	Fuzzy Integral Classification: Introduction and Notation , Reduction vs. Ordering	Neuro Fuzzy Modeling : ANFIS – Adaptive Neuro Fuzzy Inference system
S-1 SLO-2	Basic History of Fuzzy Logic	Types of MachineLearning : SupervisedLearning-Unsupervised Learning, reinforcement Learning	Special objective functions, A principal clustering algorithm	The Borda Count	ANFIS - architecture
S-2 SLO-1	The case of Imprecision, A Historical perspective	TheCurse of dimensionality Overfitting and linear regression	Classical Fuzzy Clustering Algorithms : The fuzzy c-means algorithm	The Average Rule , The Median Alternative	Hybrid learning algorithm
S-2 SLO-2	The Utility of Fuzzy systems, Limitations of Fuzzy systems		The Gustafson-Kessel algorithm	The Product Rule, The MaxMax and MaxMin Rules	Coactive Neuro fuzzy modeling : Towards generalized ANFIS
S-3 SLO-1	Fuzzy sets and membership	Bias andVariance LearningCurve		The Intersection Method , The Union Rule	Framework
S-3 SLO-2	Chance Vs Fuzziness		The Gath-Geva algorithm	Logistic Regression : The Logit Transform and Maximum Likelihood Estimation	Neuron functions for adaptive netwoks
S-4 SLO-1	Classical sets and Fuzzy sets : Operations on classical sets, properties of classical sets	Classification	Computational effort	Separate Weight Sets	Fuzzy membership functions Vs Receptive field units
S-4 SLO-2	Operations on fuzzy sets, properties of	Error and noise	Linear and Ellipsoidal Prototypes : The fuzzy	Model Selection by Local Accuracy	Non-linear rule

|					
		fuzzy sets		c-varieties algorithm	
S-5	SLO-1	*Classical relations : Cartesian product, crisp relations*	*Measuring(dis)similarity-Evaluating the output of clusteringmethod*	*The adaptive fuzzy clustering algorithm*	*Maximizing the Fuzzy Integral : What Does This Have to Do with Classifier Combination?*	*Neuro-fuzzy spectrum*
	SLO-2	*Fuzzy relations: cardinality of fuzzy relations, operations on fuzzy relations*	*Hierarchical clustering, Agglomerativeclustering - Divisiveclustering*	*Algorithms by Gustafson/Kessel and Gath/Geva*	*Pairwise Coupling - Pairwise Threshold Optimization*	*Analysis of Adaptive learning capability : Convergence based on the steepest descend method alone*
S-6	SLO-1	*Properties of fuzzy relations*	*K-Meansclustering*		*Comparing the Combination Methods :Small Training Set, Three Models*	*Interpretability spectrum*
	SLO-2	*Tolerance and Equivalence relations: crisp tolerance*		*Cluster Estimation Models :AO membership functions*	*Large Training Set, Three Models*	*Evolution of antecedents*
S-7	SLO-1	*Fuzzy Tolerance*	*Perceptrons*	*ACE membership functions*	*Small Training Set, Three Good Models , One Worthless*	*Evolution of consequence*
	SLO-2	*Properties of Membership functions, Fuzzification and defuzzification – Features of the memberfunction*	*Feedforwardnetworks.*	*Hyperconic clustering (dancing cones)*	*Large Training Set, Three Good Models, One Worthless*	*Evolving partitions*
S-8	SLO-1	*Various forms*	*MultilayerNetworks and Back PropagationAlgorithms*	*Cluster Validity : Global validity measures*	*Small Training Set, Worthless and Noisy Models Included*	*Neuro Fuzzy Control : Feedback control systems and Neuro fuzzy control*
	SLO-2	*Defuzzification of crisp sets*	*Linear Models – Linear regression,Logistic regression*	*Solid clustering validity measures, Shell clustering validity measures*	*Large Training Set, Worthless and Noisy Models Included*	*Expert control*
S-9	SLO-1	*Lamda cuts of fuzzy relations, Defuzzification to scalars*	*Tree learning : Decision trees*	*Local validity measures : The compatible cluster merging algorithm, The unsupervised FCSS algorithm*	*Fuzzy Association rules*	*Inverse learning, specialized learning*
	SLO-2	*Conclusion : Benefits of Fuzzy in comparison with crisp*	*Conclusion : Summary of ML concepts*	*Conclusion : Fuzzy based clustering merits*	*Conclusion : Fuzzy based classifier benefits*	*Conclusion : Summary / benefits of Neuro-fuzzy systems*

Learning Resources	1. Vojislav Kecman, Learning and soft computing: Support vector Machines, Neural networks and Fuzzy logic models, A Bradford Book, The MIT Press., 2001, ISBN : 0-262-11255-8 2. Timothy J. Ross,University of New Mexico, USA., Fuzzy Logic with Engineering Applications, 3rd Edition, Wiley, 2010. ISBN 978-0-470-74376-8 3. Frank Höppner, Frank Klawonn, Rudolf Kruse and Thomas Runkler: Fuzzy Cluster Analysis, Wiley (1999)ISBN 0-471-98864-2	4. Timothy Masters, Assessing andImproving Predictionand ClassificationTheory and Algorithms in C++, ISBN-13 (pbk): 978-1-4842-3335-1 ISBN-13 (electronic): 978-1-4842-3336-8 ,https://doi.org/10.1007/978-1-4842-3336-8,2018. 5. Jyh-Shing, Roger Jang, Chuen-Tsai sun, Eiji Mizutani., Neuro fuzzy and softcomputing – A computational approach to learning and machine intelligence, Prentice Hall (1997) , ISBN : 0-13-2610663 6. Kevin P. Murphy,"MachineLearning: AProbabilistic Perspective",MIT Press, 2012 7. EthemAlpaydin,"Introduction to MachineLearning",Prentice Hall ofIndia, 2005 8. TomMitchell,"MachineLearning",McGraw-Hill, 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
1. Dr.R.Gokulakrishnan, Additional Director(EXIM), Software Technology Parks of India , r.gokul@stpi.in 2. Dr.Prabhu, Coherant , US., prabu.balu@coherant.com	Dr.Subrat Kumar Nayak, Associate professor, Institute of Technical education and Research, subratnayak@soa.ac.in	Dr.G.Maragatham , Dr. Manas Ranjan ,Ms.A.Saranya
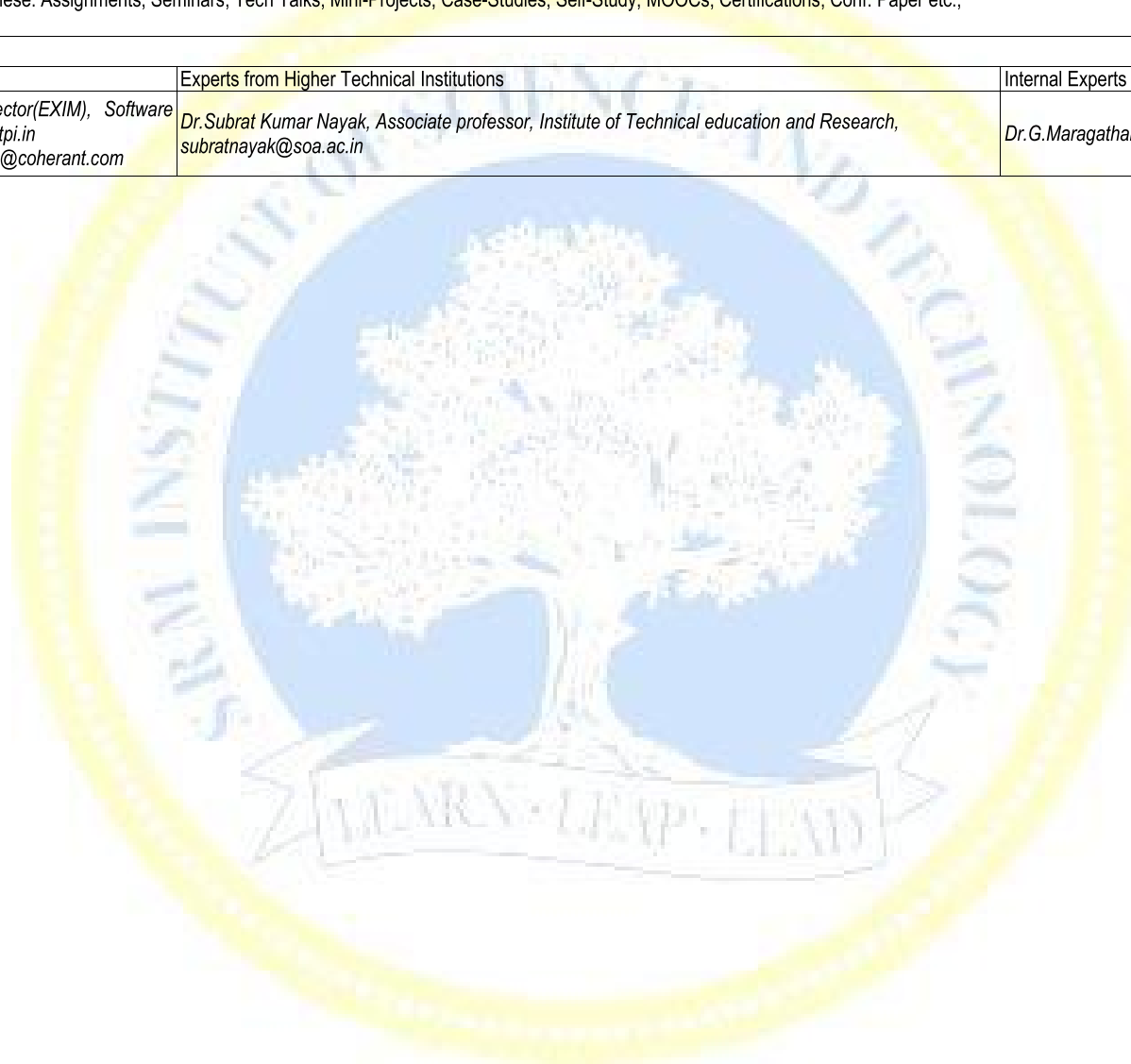
Course Code	18CSE390T	Course Name	COMPUTER VISION	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning			Program Learning Outcomes (PLO)														
CLR-1 :	Recognize and describe both the theoretical and practical aspects of computing with images. Connect issues from Computer Vision to Human Vision	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-2 :	Describe the foundation of image formation and image analysis. Understand the basics of 2D and 3D Computer Vision.																		
CLR-3 :	Become familiar with the major technical approaches involved in computer vision. Describe various methods used for registration, alignment, and matching in images.																		
CLR-4 :	Get an exposure to advanced concepts leading to object and scene categorization from images.																		
CLR-5 :	Build computer vision applications.																		
CLR-5 :	Recognize and describe both the theoretical and practical aspects of computing with images. Connect issues from Computer Vision to Human Vision																		

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 :	Provide an introduction to computer vision including fundamentals of image formation	3	80	75	L	H	-	H	L	-	-	-	L	L	-	H	-	-	-
CLO-2 :	Provide a clear view of image formation	3	85	75	M	H	L	H	L	-	-	-	M	L	-	H	-	-	-
CLO-3 :	Provide a clear view of image processing	3	80	75	M	H	M	H	L	-	-	-	M	L	-	H	-	-	-
CLO-4 :	Provide knowledge about Computational photography	3	85	80	M	H	M	H	L	-	-	-	M	L	-	H	-	-	-
CLO-5 :	Provide knowledge about Image rendering	3	80	75	H	H	M	H	L	-	-	-	M	L	-	H	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Introduction to Computer Vision	Points and patches-An Introduction	Active contours	Triangulation	Motion models
	SLO-2	Image formation	Feature detectors	Snakes	Two-frame structure from motion	Planar perspective motion
S-2	SLO-1	Geometric primitives	Feature descriptors	Dynamic snakes and CONDENSATION	Projective reconstruction	Rotational panoramas
	SLO-2	2D,3D Transformations			Self-calibration	
S-3	SLO-1	3D to 2D Projection	Feature matching	Scissors	Perspective and projective factorization	Gap closing
	SLO-2	Lighting,Reflectance and shading		Level Sets	Bundle adjustment	
S-4	SLO-1	Sampling and aliasing	Feature tracking	Split and merge	Exploiting sparsity	Cylindrical and spherical coordinates
	SLO-2	Image processing Point operators				
S-5	SLO-1	Pixel transforms	Edge detection	Mean shift and mode finding	Constrained structure and motion	Bundle adjustment
	SLO-2	Color transforms				
S-6	SLO-1	Histogram equalization	Edge linking	Normalized cuts	Hierarchical motion estimation	Parallax removal
	SLO-2					
S-7	SLO-1	Linear filtering	Successive approximation	Graph cuts and energy-based methods	Fourier-based alignment	Recognizing panoramas
	SLO-2	Non Linear filtering	Hough transforms			
S-8	SLO-1	Fourier transforms	Hough transforms	2D and 3D feature-based alignment	Incremental refinement	Compositing
S-9	SLO-1	Two-dimensional Fourier transforms, Wiener filtering	Vanishing points	Pose estimation	Case Study	Case Study

Learning Resources	1. RichardSzeliski,"Computer Vision:Algorithms and Applications",Springer,2010. 2. Forsyth/Ponce,"ComputerVision:AModernApproach",PearsonEducationIndia;2edition(2015)	3. S.Nagabhushana,"ComputerVisionandImageProcessing",NewAgeInternationalPvtLtd;First edition(2005) 4. Rafael C. GonzaLez'''Digital Image Processing",Pearson Education; Fourth edition (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. A.P.Shanthi , CEG Campus Anna University	1.Dr.V.Ganapathy,SRMIST
		2.T.Senthil Kumar,SRMIST

Course Code	18CSE479T	Course Name	STATISTICAL MACHINE LEARNING	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		CSE			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 Fuzzy Logic Basics																		
CLR-2 :	Gain knowledge on the Machine learning concepts																		
CLR-3 :	Gain knowledge on Fuzzy based clustering concepts																		
CLR-4 :	Acquire knowledge on Fuzzy Integrated classification	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-5 :	Understanding Neuro-Fuzzy Modeling concepts																		
CLR-5 :	Acquiring better understanding on Fuzzy logic usage																		
CLR-6	Understanding the fuzzylogics in Machine learning																		

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 knowledge on statistical machine learning techniques.	1	80	85	H	-	-	-	-	-	-	-	-	-	-	H	H	-	-
CLO-2 :	Acquire the ability to build model based on logistic regression and random forest techniques	1	75	80	H	H	-	-	-	-	-	-	-	-	-	H	H	-	-
CLO-3 :	Understand the basic ideas of probability and work on probabilistic approaches like Naïve Bayes, Bayes Theorem	1	85	80	H	-	-	-	-	-	-	-	-	-	-	H	H	-	-
CLO-4 :	Apply the knowledge of Kernel functions in practical applications	3	80	75	H	H	H	H	-	-	-	-	-	-	-	H	H	M	H
CLO-5 :	Apply the knowledge of K-means clustering on real world examples	3	75	85	H	-	H	H	-	-	-	-	-	-	-	H	H	M	H
CLO-6 :	Acquire the knowledge on using PCA and SVD with Scikit-learn	2	80	85	H	-	H	H	-	-	-	-	-	-	-	H	H	M	H

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Statistical terminology for model building and validation-Machine Learning,Major differences between statistical modeling andmachine learning	Comparison between regression and machinelearning models	K-nearest neighbors-KNN voter example	Support Vector Machines and Neural Networks-Support vector machines working principles-Maximum margin classifier	K-means clustering-K-means working methodology from first principles
	SLO-2		Compensating factors in machine learning models	Curse of dimensionality-Curse of dimensionality with 1D, 2D, and 3D example		
S-2	SLO-1	Steps in machine learning model developmentand deployment	Assumptions of linear regression Steps applied in linearregression modeling	Curse of dimensionality with 3D example	Support vector classifier	Optimal number of clusters and cluster evaluation
	SLO-2					
S-3	SLO-1	Statistical fundamentals and terminology for model building and validation	Example of simple linear regression from first principles	KNN classifier with breast cancer Wisconsin data example	Support vector machines	The elbow method
	SLO-2					
S-4	SLO-1	Bias versus variance trade-off,Train and test data	Machine learning models - ridge and lasso regression-Example of ridge regression machine learning,Example of lasso regression machine learning model	Naive Bayes	Kernel functions	K-means clustering with the iris data example
	SLO-2					
S-5	SLO-1	Linear regression versus gradient descent Machine learning losses	Logistic Regression Versus Random Forest-Maximum likelihood estimation	Probability fundamentals-Joint probability	Artificial neural networks - ANN	Principal component analysis - PCA-PCA working methodology from first principles
	SLO-2					

S-6	SLO-1	When to stop tuning machine learning models	Terminology involved in logistic regression	Understanding Bayes theorem with conditional probability	Forward propagation and backpropagation	PCA applied on handwritten digitsusing scikit-learn
	SLO-2		Applying steps in logistic regression modeling			
S-7	SLO-1	Train, validation, and test data Cross-validation	Random forest-Example of random forest using German credit data	Naive Bayes classification	Optimization of neural networks-Stochastic gradient descent - SGD	Singular value decomposition - SVD
	SLO-2		Grid search on random forest			
S-8	SLO-1	Grid Search	Variable importance plot	Laplace estimator	Introduction to deep learning-Solving methodology	SVD applied on handwritten digitsusing scikit-learn
	SLO-2					
S-9	SLO-1	Machine learning model overview	Comparison of logistic regression with random forest	Naive Bayes SMS spam classification example	Deep learning software	SVD applied on handwritten digitsusing scikit-learn
	SLO-2					

Learning Resources	1. Pratap Dangeti,"Statistics for Machine Learning":,Packt Publishing Ltd,,2017. 2. Masashi Sugiyama,"Introduction to Statistical Machine Learning",Elsevier,2016	3. Gareth James,Daniela Witten,Trevor Hastie and Robert Tibshirani, An Introduction to Statistical Learning with Applications in R, Springer,2015 4. Hastie Trevor, The Elements of Statistical Learning: Data Mining, Inference, and Prediction, Springer-Verlag New York Inc, February2009

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. Dr.Harisekharan,CTO,Sri SeshaaTechnologies Pvt. Ltd., Chennai	1. Dr.Bagavandas, Cetre for Statistics, SRMIST	1. Dr.G.Vadivu
2. Mr. S. Sudarsun – Chief Scientist, Co-Founder, Buddhealth	2. Dr. Sampath, Professor, Department of Statistics, Madras University	2. Dr.C.Lakshmi
		3.Dr.G.Manju

Course Code	18CSE480T	Course Name	NATURE INSPIRED COMPUTING 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		Computer Science and Engineering		Data Book / Codes/Standards	Nil

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1 :	To Understand the basics of Natural systems
CLR-2 :	To appreciate the concepts of Natural systems and its applications
CLR-3 :	To understand newBasic Natural systems functions(operations)
CLR-4 :	To understand the fundamentals of nature inspired techniques which influence computing
CLR-5 :	To understand an Integration of Hardware and software in Natural applications.
CLR-6:	To Understand practical implementation of Natural design considerations.

Learning: 1 2 3 — Level of Thinking (Bloom), Expected Proficiency (%), Expected Attainment (%)

Program Learning Outcomes (PLO): 1-15 — 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

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLO-1 :	Illustrate the basic concepts of Swarm Intelligenceprocesses	3	80	70	L	H	L	H	L	L	M	L	L	L	M	L	L	L	L
CLO-2 :	Examine the principle of Immuno computing techniques	3	85	75	L	H	L	H	L	L	M	L	L	L	M	L	L	L	L
CLO-3 :	Skills for planning, estimating, and resourcing for Natural design considerations	3	75	70	L	H	L	H	L	L	M	L	L	L	M	L	L	L	L
CLO-4 :	Manage the scope changes of nature inspired techniques which influence computing	3	85	80	L	H	L	H	L	L	M	L	L	L	M	L	L	L	L
CLO-5 :	Ability to identify optimization Techniques as a means to provide functionality and value to apply context in specific case studies	3	85	75	L	H	L	H	L	L	M	L	L	L	M	L	L	L	L
CLO-6 :	Ability to understand the needs and familiarize the DNA Computing	3	80	70	L	H	L	H	L	L	M	L	L	L	M	L	L	L	L

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Introduction	Evolutionary Computing	Swarm Intelligence	Introduction to Immune System	DNA Computing
	SLO-2	Overview of Philosophy		Introduction		
S-2	SLO-1	Nature to Nature Computing	Hill Climbing	Ant Colony Optimization	Physiology and main components	DNA Molecule
	SLO-2			Ant Foraging Behavior		
S-3	SLO-1	A Brief Overview of Three Branches	Simulated Annealing	Ant Colony Optimization	Pattern Recognition and Binding	Adleman's experiment
	SLO-2	Individuals, Entities and agents		SACO algorithm		
S-4	SLO-1	Parallelism and Distributivity Interactivity	Simulated Annealing	Ant Colony Algorithm (ACA)	Immune Network Theory	PAM Model
	SLO-2				Danger Theory	
S-5	SLO-1	Adaptation- Feedback	Genetics Principles	scope of ACO algorithms	Immune Algorithms	Splicing Systems
	SLO-2					
S-6	SLO-1	Self-Organization	Standard Evolutionary Algorithm	Swarm Robotics	Genetic algorithms	From Classical to DNA Computing
	SLO-2	Complexity, Emergence	Genetic Algorithms			
S-7	SLO-1	Bottom-up Vs Top-Down Approach	Reproduction	Social Adaptation of Knowledge	Bone Marrow Models	Universal DNA Computers
	SLO-2		Crossover Mutation			
S-8	SLO-1	Determination	Evolutionary Programming	Particle Swarm Optimization	Forest's Algorithm	Scope of DNA Computing
	SLO-2					

S-9	SLO-1	Chaos and Fractals		Genetic Programming		Particle Swarm Optimization		Artificial Immune Networks		Lipton's Solution to SAT Problem	
	SLO-2										

Learning Resources	1. LeandroNunesdeCastro,"FundamentalsofNaturalComputing,BasicConcepts,Algorithms andApplications",Chapman&Hall/CRC,TaylorandFrancisGroup,2007. 2. FloreanoD.andMattiussiC.,"Bio-InspiredArtificialIntelligence:Theories,Methods,and Technologies", MIT Press, Cambridge, MA,2008.	3. AlbertY.Zomaya,"HandbookofNature-InspiredandInnovativeComputing",Springer,2006 4. Marco Dorrigo,Thomas Stutzle," Ant Colony Optimization", PHI,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
1.Mr.Lokesh Peta,Head Developer,OEConnection,Newbury-UK;Mail:peta.lokesh@gmail.com	Prof. A. Amuthan, Professor, Pondicherry Engineering College, amuthan@pec.edu	Dr.G.Maragatham / Mr. C. SanthanaKrishnan Dr.C.Lakshmi

Course Code	18CSE481T	Course Name	APPLIED MACHINE LEARNING	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	18CSE392T		Co-requisite Courses	Nil		Progressive Courses	Nil			
Course Offering Department		CSE			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 :	Analyze the text data using Machine Learning																		
CLR-2 :	Analyze the audio data using Machine Learning																		
CLR-3 :	Analyze Time series and Sequential data using Machine Learning																		
CLR-4 :	Analyze the Image Content using Machine Learning																		
CLR-5 :	Visualize the data																		

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 :	Identifying patterns in text using topic modeling	3	75	80	H	M	H	-	H	-	-	-	-	-	-	-	H	H	H	H
CLO-2 :	Building a speech recognizer	3	75	80	H	M	H	-	H	-	-	-	-	-	-	-	H	H	H	H
CLO-3 :	Extracting statistics from time series data, Building Conditional Random Fields for sequential text data	3	75	80	H	M	H	-	H	-	-	-	-	-	-	-	H	H	H	H
CLO-4 :	Building an object recognizer	3	75	80	H	M	H	-	H	-	-	-	-	-	-	-	H	H	H	H

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Text Feature Engineering Introduction	Speech Recognition Introduction	Dissecting Time Series and Sequential Data	Image Content Analysis	Biometric Face Recognition
	SLO-2	Cleaning text data	Reading audio data	Introduction	Computer Vision	Face detection from the image and video
S-2	SLO-1	Preprocessing data using tokenization	Plotting audio data	Transforming data into the time series format Pandas and Numpy to convert Time Series data	Operating on images using OpenCV- Python	Capturing and processing video from a webcam Resizing and Scaling
	SLO-2	Tagging and categorising words	Transforming audio signals into the frequency domain	Plotting time series data	Learn to extract and load the image	Building a face detector using Haar cascades
S-3	SLO-1	Sequential tagging, Backoff tagging	Apply Fourier transform signal and plot	Slicing time series data Operating on time series data	Detecting edges Histogram equalization	determine the location of a face in the video frames captured from the webcam
	SLO-2	Creating features from text data- Stemming,	Generating audio signals with custom parameters	Plotting sliced time series data	Sobel filter, Laplacian edge detector, Canny edge detector	Face detector on the grayscale image
S-4	SLO-1	Lemmatising	Generate the time axis	Operating on time series data	Histogram equalization	Building eye and nose detectors
	SLO-2	Bagging using random forests	Synthesizing music	Extracting statistics from time series data	Visualize gray scale image	Face cascade classifier
S-5	SLO-1	Implementing bag of words	Construct the audio sample -amplitude and frequency	Correlation coefficients	Detecting corners	Visualize eye and nose detector
	SLO-2	Testing prepared data	synthesizer function	Plotting and understanding correlations	Understand the output corner detection image	Performing Principal Components Analysis

S-6	SLO-1	Analyze the results	Extracting frequency domain features	Building Hidden Markov Models for sequential data	Detecting SIFT feature points	PCA in face recognition systems
	SLO-2	Building a text classifier	MFCC and filter bank features	Prepare the Time Series data	SIFT feature detection	Convert the dataset from a five-dimensional set to a two-dimensional set
S-7	SLO-1	Analyzing the sentiment of a sentence	Building Hidden Markov Models	Train Gaussian HMM	Visualize the feature detected image	Kernel Principal Components Analysis
	SLO-2	Implement the sentiment analysis of a sentence	HMM training and prediction	Visualizing the model	Building a Star feature detector	Perform Kernel PCA
S-8	SLO-1	Identifying patterns in text using topic modeling	Building a speech recognizer	Building Conditional Random Fields for sequential text data	Detect features using the Star feature detector	Plot the PCA-transformed data
	SLO-2	Implement identifying patterns in text using topic modeling	MFCC features	CRF Model	Visualize keypoints on the input image	Plot Kernel PCA-transformed data
S-9	SLO-1	Case study- Twitter Data	Case study	Analyzing stock market data using Hidden Markov Models	Creating features using visual codebook and vector quantization	Performing blind source separation
	SLO-2	Case study- Twitter Data	Case study	Train the HMM and visualize	Method to quantize the data points	Independent Components Analysis

Learning Resources	1. Prateek Joshiandco,Python:RealWorldMachineLearning,PacktPublishing,2016 2. Sebastian Raschka,Python Machine Learning,PacktPublishing,2013.	3. Richert Coelho,Building Machine Learning Systems with Python,PacktPublishing,2016 4. Michael Bowles,Machine Learning in Python,Wiley&Sons,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.Harisekharan,CTO,Sri SeshaaTechnologies Pvt. Ltd., Chennai	Dr.J.Suresh, SSN College of Engineering	1. Dr.G.Vadivu
Mr. S. Sudarsun – Chief Scientist, Co-Founder, Buddhealth	Dr. Sharmila Shankar, Crescent Institute of Science and Technology	2. Mr.Karthik Nanmaran
		3. Dr.Renukadevi

Course Code	18CSE482T	Course Name	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	Computer Science & Engg	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 to knowWhat happens in your brain when you make a decision		1	2	3		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-2 :	Gain knowledge mathematical and computational models that are used in the field of theoretical neuroscience																				
CLR-3 :	Basics of adaptively and learning,																				
CLR-4 :	Acquire knowledge on Basic models of cognitive processing.																				
CLR-5 :	Acquire knowledge on implementation model for neuro models																				
CLR-6 :	Acquire knowledge on various computational algorithm																				

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 :	To Design Models of single neurons , and small networks	3	80	70	L	H	L	H	H	-	-	-	L	L	-	H	L	H	H
CLO-2 :	Implementation of all simple as well as more complex numerical computations with few neurons.	3	85	75	H	H	L	M	L	-	-	-	M	L	-	H	L	H	H
CLO-3 :	Analyse connected networks in the mean-field limit	3	75	70	H	H	M	H	L	-	-	-	M	L	-	H	L	H	H
CLO-4 :	Formalize biological facts into mathematical models	3	85	80	M	H	M	H	L	-	-	-	M	L	-	H	L	H	H
CLO-5 :	Understand a simple mathematical model of memory formation in the brain	3	85	75	H	H	M	H	L	-	-	-	M	L	-	H	L	H	H
CLO-6 :	Understand a simple mathematical model of decision processes	3	80	70	L	H	-	H	L	-	-	-	L	L	-	H	L	H	H

Duration (hour)		9	9	9	9	9
S-1	SLO-1	History of Computational Neuroscience	Four components of Neural Signaling	From artificial neural network to realistic neural networks - Introduction	Memory Classification Scheme – Declarative, Non-declarative	Hebbian Learning-Hebbian versus Perceptron Learning-
	SLO-2	Models in Computational Neuroscience	Four components of Neural Signaling	Modelling the ventral stream	Auto-associative network and hippo campus - Learning and retrieval phase	Learning by Error Minimization
S-2	SLO-1	Computational Theory of the Brain	Neurotransmission	Modelling the dorsa and auditory stream	Point-attractor neural networks - Network dynamics and training	Gradient Descent Learning
	SLO-2	Biological Background	Population dynamics	Mechanical behavior of ceramics-flexural strength -The Perceptron .	Signal-to-noise analysis - Noisy weights and dilued attractor networks	Stabilizing Hebbian Learning
S-3	SLO-1	Basic synaptic mechanisms and dendritic processing	Modeling the average behavior of neurons	Mapping function	Sparse attractor neural networks and correlated patterns-Sparse patterns and expansion recoding	Principal Component Analysis (PCA)-Eigenvectors-Eigenvalues-Covariance matrix
	SLO-2	The generation of action potentials	Hodgkin	Multi-layer Perceptron	Control of sparseness in attractor networks	Singular Value Decomposition
S-4	SLO-1	Stimulation and rising phase	Modeling the average behavior of neurons	Back-propagation – Initution , Derivation	Chaotic networks-Attractors	Limits and Extensions of PCA
	SLO-2	Peak and falling phase	Huxley Model	Back-propagation –Loss Function	Lyapunov functions - The Cohen-Grossberg theorem	Variations of Hebbian Learning
S-5	SLO-1	After hyperpolarization and Refractory Period	Spiking neuron models - Single	Back-propagation – Limitation	Asymmetrical networks	Nonlinear Hebbian learning
	SLO-2	Hodgkin and Huxley equations - Intro	Spiking neuron models - Detailed	Support Vector Machines - Introduction	Non-monotonic networks	Linsker's Model of the Visual System
S-6	SLO-1	Neuron - axons,dendritesetc, thefour components ofNeural Signaling	Spiking neuron models – 2D Model	Support Vector Machines - Classification	Complementary memory systems	Application of Lateral Inhibition

	SLO-2	Neurotransmission:neurotrasmitter,receptor, ionchannel, channelgating	Integrate and firing model -Leaky integrate-and-fire model	Support Vector Machines - Regression	Distributed model of working memory-Limited capacity of working memory	Lateral Geniculate Nucleus
S-7	SLO-1	Electrophysiology -Nernst potential,resting potential,Goldman-Hodgkin-Katz voltageequation, outline ofthe Hodgkin-Huxley model.	Integrate and firing model -Nonlinear integrate-and-fire model	Support Vector Machines – Kernel Function	The spurious synchronization hypothesis	Striate Cortex
	SLO-2	Modeling ion1 channel kinetics,activation andinactivation gates	Integrate and firing model -Stimulation by synaptic currents	Self-organizing Maps - Introduction	The interacting-reverberating-memory hypothesis	Linsker's model for orientation columns
S-8	SLO-1	Completeformulation ofHodgkin-Huxleymodel. Relationbetween outputfiring and constant input current.Discussion ofregimes. Softwaredemo.	noise in spikingneuron model – part I	Self-organizing Maps - Variable	Motor Learning and Control	Reinforcement Learning -Elements of Reinforcement Learning
	SLO-2	Compartmental models: Cable theory	noise in spikingneuron model – part II	Self-organizing Maps - Algorithm	Feedback controller	Markov decision process-Dynamic programming algorithms for solving MDPs
S-9	SLO-1	Compartmental models: Cable theory – Cable Equation	compartmental modeling - I	Self-organizing Maps – SOM Initialization	Forward and inverse model controller	Algorithms for large state spaces
	SLO-2	Physical Shape of Neurons and Neuron Simulators	compartmental modeling -II	Self-organizing Maps – Kohonen Algorithm	The cerebellum and motor control	Gradient temporal difference learning

Learning Resources	1. Thomas Trappenberg, "Fundamentals of Computational Neuroscience", Oxford University Press, January2010 2. Peter Dayan & LF Abbot, "Theoretical Neuroscience: Computational and Mathematical Modeling of Neural Systems", MIT Pres,2005	3. Richard S. Sutton and Andrew G. Barto, "Reinforcement Learning-An Introduction",2nd Edition,The MIT Press,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
1. Mr.Venkatesan venkatesan.g@tcs.com 2. Ganesan, Associate Consultant Tata Consultancy Services Australia	Dr.Sarulatha.K , Pondicherry Engg college, charuladha@pec.edu.in / Prof. Godfrey Winster, Saveetha Engineering College, godfreywinster@saveetha.ac.in	1. Dr. G.Maragatham / Dr. C.Vijayakumaran

Course Code	18CSE483T	Course Name	INTELLIGENT MACHINING	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		CSE		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 Artificial Intelligence																		
CLR-2 :	Learn basics of Intelligent machining, sensors and machining process																		
CLR-3 :	Understand the design of Intelligent Systems - RTOS																		
CLR-4 :	Understand the computational methods, optimization and reasoning about physical system																		
CLR-5 :	Understand implications of Artificial Intelligence in various 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 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 Artificial intelligence and its problem solving approaches	2	80	85	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	Acquire the knowledge on fundamentals of Intelligent Machining and machining process	2	75	80	H	H	H	H	H	H	-	-	-	-	-	H	-	-	-
CLO-3 :	Acquire knowledge on the design of Intelligent Systemsand RTOS	2	85	80	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	Acquire knowledge on computational methods and optimization	2	80	75	-	H	-	-	H	-	-	-	-	-	-	-	-	-	-
CLO-5 :	Apply the knowledge on Real time applications	2	75	85	-	H	-	-	H	-	-	-	-	-	-	-	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Introduction to Artificial Intelligence and it's techniques	Introduction Intelligent Machining, Basics	Representation of Intelligent systems	Computational methods and optimization	Case Study - Autonomous Vehicle (Driver Less Car)
	SLO-2	Problem Solving with Artificial Intelligence	Open Architecture Machine Control	Control for the Evolution of VLSI Designs		
S-2	SLO-1	AI Models, Data acquisition and learning aspects of AI	Manufacturing Automation Protocol	An Object-Oriented Approach	Neural Network Modelling	Case Study - Defect Prediction , Wear and Tear Prediction in Mechanical devices
	SLO-2	Problem Solving - Problem Solving Process, Formulating Problems	The Evolution of Intelligent Machining			
S-3	SLO-1	Problem types and Characteristics	MOSAIC - NGC	Tools and Techniques for Conceptual Design	Fuzzy set theory	Case Study - Flying Drones
	SLO-2	Problem Space and Search	OSACA - SERCOS	Design Compilers		
S-4	SLO-1	Intelligent Agent	Components of Intelligent Machining	Labelled Interval Calculus	Machining Optimization	Case Study -Cogito
	SLO-2	Rationality and Rational agent with performance measures	Introduction sensors - Machining Process	Knowledge Representations for Design Improvisation		
S-5	SLO-1	Flexibility and Intelligent Agents	Sensing and Monitoring	A knowledge-based Framework for Design	Objective Functions and Constraints	Case Study - Alexa , SIRI
	SLO-2	Task Environment and its Properties	Signal Processing		Optimization Techniques	
S-6	SLO-1	Types of Agents	Transforming Data into Information	Introduction to RTOS - Hardware	Reasoning about physical system	Case Study - Smarter Home robots

			Examples	Components		
	SLO-2	Other aspects of agents	Machining Process Control			
S-7	SLO-1	Constraint satisfaction problem (CSP)	Practical Uses of Machine Learning	Design Principles of RTOS - Interupt Processing - task Management	Temporal Qualitative Analysis	Case Study -Application of AI in CAD/CAM
	SLO-2	Crypto Arithmetic puzzles	Machine Learning Process Control Strategies			
S-8	SLO-1	CSP as a search problem-constraints and representation	Programmable Logic Controllers (PLC)	Task Scheduling -Synchronization tools	Reasoning about Geometry	Case Study - Streamlining Drug Discovery
	SLO-2	CSP- backtracking and Role of heuristic	Closed Loop Process Control Systems	Task Communication - Memory Management		
S-9	SLO-1	CSP - Froward Checking and constraint propogation	Introduction to Adaptive Control	File System	Study of Heuristic knowledge for automatic configuration Generation and Innovation	Case Study - Betterment (Financial Advisor)
	SLO-2	CSP-Intelligent backtracking	Commercially Available Software	Tracing and Debugging		

Learning Resources	1. Farid Meziane, Sunil Vadera, Khiary Kobbacy and Nathan Proudlove, "Intelligent Systems in Manufacturing: Current Developments and Future Prospects", (unit 1) 2. How Netflix Uses Analytics To Select Movies, Create Content, and Make Multimillion Dollar Decisions Author: Zach Bulygo(unit 1) 3. Digital Signal Processing: A Practical Guide for Engineers and Scientists, Steven Smith (unti 2) 4. 4. Artifical Intelligent in Engineering Design: Volume 1 , Gerard Meurant, Springer (Chapter 2,3,5,6,9 - unit3)	5. K.C.Wang, " Embedded and Real-Time Operating Systems (Chapter 10.6- Unit 3) 6. Sam Siewert, John Pratt," Real-Time Embedded Components and Systems with Linux and RTOS", David Pallai Publisher, 2016. (Chapter 8- Unit 3) 7. Machining: Fundamentals and Recent Advances, J. Paulo Davim, Springer. (Chapter 12-unit 4) 8. 8.Artifical Intelligent in Engineering Design: Volume 2 , Gerard Meurant, Springer (Chapter 10-14 - unit 5)

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, Mariappan, Engineering Leader, Amazon, India	Khanna Nehemiah H, Professor, Ramanujam Computing Center, Anna University	1.Dr.C.Lakshmi, SRMIST
		2. Dr.S Prabakaran, SRMIST
		3. Dr. M. Thenmozhi, SRMIST

Course Code	18CSE484T	Course Name	DEEP LEARNING	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		Computer Science and Engineering		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 concepts of Neural Networks and Deep Learning																				
CLR-2 :	Understand Deep neural network and layered learning approach																				
CLR-3 :	Study and understand CNN and RNN for deep learning																				
CLR-4 :	Learn and understand Auto Encoders and its applications																				
CLR-5 :	Understand concept of transfer learning and its applications with keras																				

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 :	Apply basic mathematical concepts in Deep Learning	2	80	85	H	L	-	-	H-	-	-	-	-	-	-	H	H	-	-
CLO-2 :	Work with powerful framework for supervised learning	3	75	80	H	H	-	-	H	-	-	-	-	-	-	H	H	H	M
CLO-3 :	Deal with Convolution Neural Networks	2	85	80	H	H	H	-	H	-	-	-	-	-	-	H	H	H	H
CLO-4 :	Analyze various types efficient data encoders	2	80	75	H	H	-	-	H	-	-	-	-	-	-	H	H	H	H
CLO-5 :	Apply various network models in deep learning	3	75	85	H	H	H	H	H	-	-	-	-	-	-	H	H	H	H

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Historical trends in deep learning – Machine Learning basics	Introduction to Simple DNN	Convolution Neural Networks Introduction	Encoder	Deep Architectures in Vision
	SLO-2	Learning algorithms – Supervised and Unsupervised Training	Platform for Deep Learning	Convolution Operation	Decoder	AlexNet to ResNet
S-2	SLO-1	Linear Algebra for machine learning	Deep Learning Software Libraries	Motivation	Auto Encoders Introduction	Transfer Learning
	SLO-2	Testing - Cross Validation	Deep Feed Forward Networks Introduction	Pooling	Auto Encoders	
S-3	SLO-1	Dimensionality Reduction	Learning XOR	Normalization	Under Complete Auto Encoder	Siamese Networks
	SLO-2	Over fitting /Under Fitting	Gradient-Based Learning	Applications in Computer Vision - ImageNet	Regularized Auto Encoder	
S-4	SLO-1	Hyper parameters and validation sets	Various Activation Functions, ReLU, Sigmoid – Error Functions	Sequence Modelling –VGGNet, LeNet	Stochastic Auto Encoder	Metric Learning
	SLO-2	Estimators – Bias - Variance	Architecture Design	Recurrent Neural Networks	Denoising Auto Encoder	Ranking / Triplet Loss
S-5	SLO-1	Loss Function-- Regularization	Differentiation Algorithms	RNN topologies- Difficulty in Training RNN	Contractive Auto Encoder	RCNNs with keras
	SLO-2	Biological Neuron – Idea of Computational units	Regularization methods for Deep Learning		Auto Encoder Applications	
S-6	SLO-1	McCulloch-Pitts units and Thresholding logic	Early Stopping	Long Short Term Memory	Dimensionality Reduction and Classification using Auto encoders	CNN-RNN

	SLO-2	*Linear Perceptron*	*Drop Out*		*Recommendation*	
S-7	SLO-1	*Perceptron Learning Algorithm*	*Difficulty of training deep neural networks*	*Bidirectional LSTMs*	*Optimization for Deep Learning-Optimizers–RMS prop for RNNs*	*Applications in captioning and Video tasks*
	SLO-2	*Convergence theorem for Perceptron Learning Algorithm*				
S-8	SLO-1	*Linear Separability*	*Greedy layer wise training*	*Bidirectional RNNs*	*SGD for CNNs*	*3D CNNs*
	SLO-2	*Multilayer perceptron –The first example of network with Keras code*				
S-9	SLO-1	*Backprobagation*	*Optimization methods for Neural Networks-Adagrad, Adam*	*Application case study -Handwritten digits recognition using deep learning, LSTM with Keras – sentiment Analysis*	*Application case study – Image dimensionality reduction using encoders LSTM with Keras – sentiment Analysis*	*Application case study – Image recognition using RCNN and transfer learning*
	SLO-2					

Learning Resources	1. IanGoodfellow,YoshuaBengio,AaronCourville,"DeepLearning",MITPress,2016. 2. KevinP.Murphy,"MachineLearning:AProbabilisticPerspective",MITPress,2012.

3. *Neural Networks: A Systematic Introduction, RaulRojas, 1996.*
4. *ChristopherandM.Bishop,"PatternRecognitionandMachineLearning",SpringerScienceBusinessMedia, 2006.*
5. *JasonBrownlee,"DeepLearningwithPython",ebook,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
1.	1.	1. Dr.E.Poovammal
2.	2.	2. Dr.G.Vadivu
		3. Mr.Joseph James

Course Code	18CSE485T	Course Name	ROBOTICS: COMPUTATIONAL MOTION PLANNING	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		Computer Science and Engineering		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 knowledge of Bug algorithms and configuration Space																		
CLR-2 :	Acquire knowledge of Potential functions and Navigations																		
CLR-3 :	Acquire knowledge of Sampling Algorithms																		
CLR-4 :	Gain knowledge of filtering techniques																		
CLR-5 :	Gain knowledge about Trajectory and Motion Planning																		
CLR-6 :	Design motion plan for Robot in the path specified																		

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 :	Apply knowledge of Bug algorithms and configuration Space	3	80	70	M	H	-	H	L	-	-	-	L	L	-	H	-	-	-
CLO-2 :	Apply knowledge of Potential functions and Navigations	3	85	75	M	H	L	M	L	-	-	-	M	L	-	H	-	-	-
CLO-3 :	Apply knowledge of Sampling Algorithms	3	75	70	M	H	M	H	L	-	-	-	M	L	-	H	-	-	-
CLO-4 :	Gain knowledge of filtering techniques	3	85	80	M	H	M	H	L	-	-	-	M	L	-	H	-	-	-
CLO-5 :	Gain knowledge about Trajectory and Motion Planning	3	85	75	H	H	M	H	L	-	-	-	M	L	-	H	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Over view of Motion Planning	Potential Function: Addictive Attractive/Repulsive Potential	Sampling - Based Algorithms- Probabilistic Road Maps: Basic PRM	Linear Kalman Filtering	Trajectory Planning : Preliminaries
	SLO-2	Bug1 And Bug 2	Gradient Descent	Implementation of basic PRM		
S-2	SLO-1	Tangent Bug	Computing Distance From Implementation In The Plane	PRM sampling Strategies	Kalman Filter : Example	Decoupled Trajectory Planning
	SLO-2	Implementation: The Tangent Line		PRM connection Strategies		
S-3	SLO-1	Distance On Gradient	Local Minima Problem	Single-Query Sampling Based Planners: Expensive Spaces Trees	Bayesian Methods : Localization	Direct Trajectory Planning: Optimal Control
	SLO-2	Continuation Method	Wave-Front Planner	Rapidly Exploring Random Trees	Basic Idea Probabilistic Localization	Nonlinear Ptimization
S-4	SLO-1	Robot Configuration Specification	Navigation Potential Function: Sphere- Space Star-Space	Connection Strategies and SBL Planner	Probabilistic Localization As Recursive Bayesian Filtering	Grid-Based Search
	SLO-2					
S-5	SLO-1	Circular Mobile Robot	Potential Functions for Rigid-Body Robots	Integration Of Planners Sampling Based Roadmap	Derivation Of Probabilistic Localization	Nonholonomic And Underactuated Systems : preliminaries
	SLO-2	Two joint planer arm	Path Planning for Articulated Bodies			Control Systems
S-6	SLO-1	Dimension Of The Configuration Space	Visibility Graph	Analysis Of PRM	Representation Of Posterior	Controllability
	SLO-2					
S-7	SLO-1	Topology of configuration space: Homeomorphisms and Diffeomorphisms	Deformation Retracts : Generalized Voronoi Diagram	Control based Planning	Sensor Model	Motion Planning: Optimal Control
	SLO-2			Multiple Robots		

S-8	SLO-1	*Differentiable Manifolds*	*Retract -Like Structure: Generalized Voronoi Graph*	*Manipulation Planning*	*Mapping:: Mapping with known locations*	*Steering Chained -Form Systems Using Sinusoids*
	SLO-2					
S-9	SLO-1	*Examples*	*Piecewise Retracts: The Rod Hierarchical Generalized Voronoi GraphSilhouette Methods*	*Assembly Planning*	*Bayesian Simultaneous Localization and Mapping*	*Nonlinear Optimization*
	SLO-2					

Learning Resources	1. HowieM.Choset,Seth Hutchinson, Kevin M.Lynch, George Kantor, Wolf ram Burgard, LydiaE. Kavraki, Sebastian Thrun, "Principles of Robot Motion: Theory, Algorithms, and Implementation" 2. Jean-ClaudeLatombe,"RobotMotionPlanning",SpringerScience&BusinessMedia,2012	3. http://robotics.stanford.edu/~latombe/cs326/2009/schedule.htm

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.R.Annie Uthra
		Dr.P. Supraja

Course Code	18CSE486T	Course Name	ADVANCED ALGORITHMS		Course Category	E	Professional Elective	L	T	P	C
								3	0	0	3

Pre-requisite Courses	18CS201J		Co-requisite Courses	Nil			Progressive Courses	Nil	
Course Offering Department		Computer Science and Engineering			Data Book / Codes/Standards		Nil		

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

Learning columns: 1, 2, 3 (Level of Thinking (Bloom), Expected Proficiency (%), Expected Attainment (%))

PLO columns: 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 : Understand different asymptotic notations to analyze an algorithms
CLR-2 : Utilize various data structures in developing applications
CLR-3 : Utilize stack and queues in processing data for real-time applications
CLR-4 : Understand various data structures to handle graph theory related real-time applications
CLR-5 : Understand various probabilistic algorithms and randomized algorithms for real-time programming applications
CLR-6 : Understand various Complexity classes like P-Type, NP-Type, NP-Complete, NP-Hard problems

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

CLO	Description	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	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 :	Understand complexity of various algorithms	3	80	70	L	H	-	H	L	-	-	-	L	L	-	H	-	-	-
CLO-2 :	How efficiently a problem can be solved with respect to time and space	3	85	75	M	H	L	M	L	-	-	-	M	L	-	H	-	-	-
CLO-3 :	To find the appropriateness of Data structure for real time applications	3	75	70	M	H	M	H	L	-	-	-	M	L	-	H	-	-	-
CLO-4 :	Representation and Solving Graph algorithms	3	85	80	M	H	M	H	L	-	-	-	M	L	-	H	-	-	-
CLO-5 :	Understand approximation methods to solve very difficult problems	3	85	75	H	H	M	H	L	-	-	-	M	L	-	H	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Introduction-Basic Terminology	Elementary data structures-Array	Graph algorithms-Representation of graphs	Approximation algorithms	Complexity classes-Introduction
	SLO-2	Complexity of algorithms- Space and time complexity issues- Growth of functions	Operations on Arrays – Insertion and Deletion	BFS-DFS	The vertex-cover problem	Various definitions
S-2	SLO-1	Introduction of various asymptotic notations like Ө,ω,O, Ω	Stack-Various ADT operations- Uses of stack-Various examples	Strongly connected components	The traveling-salesman problem	NP-Completeness and the classes of P and NP
	SLO-2	Designing algorithm-Analysis of Insertion sort-Best case, worst case, average case analysis	Queue ADT- Insertion-deletion and various operations on Queue	Minimum Spanning tree-Introduction Prim's algorithm	Example	Continued
S-3	SLO-1	Various Problem solving techniques	Linked List- Deletion and Search-Doubly linked list-Various operations on linked list	Kruskal algorithm	The set-covering problem –With an example	A Formal language framework-Polynomial time verification
	SLO-2	Divide and Conquer paradigm	Polynomial Arithmetic	Single source Shortest path problem	The subset-sum problem	Continued
S 4-5	SLO-1	Recurrence relations-Construction of recurrence relation for various examples- Towers of Hanoi Problem, Fibannacci series	Hashing-Hash functions Open addressing- Perfect Hashing	The Bellman-Ford algorithm - Single-source shortest paths in directed acyclic graphs -Dijkstra's algorithm	String Matching- The naive string-matching algorithm	p-type and NP-type problems NP-Completeness-Various examples
	SLO-2					
S-6	SLO-1	Solution by Substitution method	Various hashing methods	Shortest paths and matrix multiplication	Example	NP-Completeness-reducibility
	SLO-2	Recursion Tree Method	Collision in hashing-Avoiding Collision –	The Floyd-Warshall algorithm	The Rabin-Karp algorithm	Continued

			Various methods			
S-7	SLO-1	Mater Theorem-Proof	Binary search tree	An example	Continued	NP-Completeness-reducibility
	SLO-2	Simple examples	Insertion-Deletion-Finding max,min	Johnson's algorithm for sparse graphs	The Knuth-Morris-Pratt algorithm	Continued
S-8	SLO-1	Probabilistic analysis of an algorithm	Red Black tree	Example	An example	NP-completeness proofs Continued-Satisfiability of boolean formulas is NP-complete.
	SLO-2	Hiring assistant problem	Insertion-Deletion	Flow network-example	Computational Geometry- Finding Convex hull- Finding the closest pair of points	3-CNF satisfiability problem-NP Complete
S-9	SLO-1	Probabilistic analysis Quick sort with illustration	Properties of RBT	Continued	Continued	NP-Hard problem-Definition and various examples-continued
	SLO-2					

Learning Resources	1. Cormen,ThomasH.;Leiserson,CharlesE.;Rivest,RonaldL.;Stein,Clifford(2009) Introduction to Algorithms (3rd ed.). MIT Press and McGraw-Hill 2. Ananyleviton, Introduction to the Design and Analysis of Algorithms, Kindleedition 2017.	3. Harowitz,SahaniandSangudevarRajasekaran,Fundamentalsofcomputeralgorithm, Universities Press; Second edition2008 4. Mark Allen Weiz, Data structures and algorithm analysis, Pearson Education India 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
	1. Dr.Masila Mani.V IIITDM, Kancheepuram,noor@iiitdm.ac.in	1. K..Senthil Kumar, SRMIST
		2. Dr.Thenmozhi , SRMIST

Course Code	18CSE355T	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		CSE		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 concepts of Data Mining																		
CLR-2 :	Familiarize with Association rule mining																		
CLR-3 :	Familiarize with various Classification algortihms																		
CLR-4 :	Understand the concepts of Cluster Analysis																		
CLR-5 :	Familiarize with Outlier analysis techniques																		
CLR-6 :	Familiarize with applications of Data mining in different domains																		

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 :	Gain knowledge about the concepts of Data Mining	2	80	85															
CLO-2 :	Understand and Apply Association rule mining techniques	2	75	80															
CLO-3 :	Understand and Apply various Classification algortihms	2	85	80															
CLO-4 :	Gain knowledge on the concepts of Cluster Analysis	2	80	75															
CLO-5 :	Gain knowledge on Outlier analysis techniques	2	75	85															
CLO-6 :	Understand the importance of applying Data mining concepts in different domains	2	80	85															

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Why Data mining? What is Data mining ?	Mining frequent patterns: Basic concepts	Classification: Basic concepts	Cluster Analysis: Introduction	Outliers: Introduction
	SLO-2	Kinds of data meant for mining	Market Basket Analysis	General approach to Classification	Requirements and overview of different categories	Challenges of outlier detection
S-2	SLO-1	Kinds of patterns that can be mined	Frequent itemsets, Closed itemsets	Decision tree induction	Partitioning method: Introduction	Outlier detection methods: Introduction
	SLO-2	Applications suitable for data mining	Association rules-Introduction	Algorithm for Decision tree induction	k-means	Supervized and Semi-supervized methods
S-3	SLO-1	Issues in Data mining	Apriori algorithm-theoritical approach	Numerical example for Decision tree induction	k-medoids	Unsupervized methods
	SLO-2	Data objects and Attribute types	Apply Apriori algorithm on dataset-1	Attribute selection measure	Hierarchical method: Introduction	
S-4	SLO-1	Statistical descriptions of data	Apply Apriori algorithm on dataset-2	Tree pruning	Agglomerative vs. Divisive method	Statistical and Proximity based methods
	SLO-2		Generating Association rules from frequent itemsets	Scalability and Decision tree induction	Distance measures in algorithmic methods	
S-5	SLO-1	Need for data preprocessing and data quality	Improving efficiency of Apriori	Bayes' Theorem	BIRCH technique	Statistical approaches
	SLO-2			Naïve Bayesian Classification		
S-6	SLO-1	Data cleaning	Pattern growth approach	IF-THEN rules for classification	DBSCAN technique	Statistical data mining
	SLO-2	Data integration		Rule extraction from a decision tree		
S-7	SLO-1	Data reduction	Mining frequest itemsets using Vertical data format	Metrics for evaluating classifier performance	STING technique	Data mining and recommender systems
	SLO-2		Strong rules vs. weak rules	Cross validation		

S-8	SLO-1	*Data transformation*	*Association analysis to Correlation analysis*	*Bootstrap*	*CLIQUE technique*	*Data mining for financial data analysis*
	SLO-2			*Ensemble methods-Introduction*		
S-9	SLO-1	*Data cube and its usage*	*Comparison of pattern evaluation measures*	*Bagging and Boosting*	*Evaluation of clustering techniques*	*Data mining for Intrusion detection*
	SLO-2			*Random Forests: Introduction*		

Learning Resources	1.	*Jiawei Han and Micheline Kamber, " Data Mining: Concepts and Techniques", 3rd Edition, Morgan Kauffman Publishers, 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
1. Mr.V.Selvakumar, Hexaware Technologies, selvakumarv@hexaware.com	1. Dr.Latha Parthiba, Pondicherry University, lathaparthiban@yahoo.com	1. Mr.L.N.B.Srinivas, SRMIST
2.	2.	2. Mr.S.Karthick, SRMIST
		3. Dr.V.V.Ramalingam, SRMIST

Course Code	18CSE391T	Course Name	BIG DATA TOOLS AND 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		Computer Science and Engineering		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 :	Gain knowledge about the various tools and techniques used in big data analytics																		
CLR-2 :	Learn the fundamentals of Hadoop and the related technologies																		
CLR-3 :	Understand the basics of development of applications using MapReduce, HDFS, YARN																		
CLR-4 :	Learn the basics of Pig, Hive and Sqoop																		
CLR-5 :	Learn the basics of Apache Spark, Flink and understand the importance of NoSQL databases																		
CLR-6 :	Learn about Enterprise Data Science and data visualization tools																		

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 :	Use the various tools and techniques in big data analytics	2	80	85	L	-	H	-	H	-	-	-	-	-	-	-	-	-	-
CLO-2 :	Apply Hadoop and related technologies to big data analytics	2	75	80	L	H	H	M	H	-	-	-	-	-	-	-	-	-	-
CLO-3 :	Apply MapReduce, HDFS and YARN develop big data applications	2	85	80	L	-	H	-	H	-	-	-	-	-	-	-	-	-	-
CLO-4 :	Develop applications using Pig, Hive and Sqoop	2	80	75	L	H	H	-	H	-	-	-	-	-	-	-	-	-	-
CLO-5 :	Apply Apache Spark and Flink to applications and understand the importance of NoSQL databases	2	75	85	L	-	H	M	H	-	-	-	-	-	-	-	-	-	-
CLO-6 :	Understand the applications of Enterprise Data Science and data visualization tools	2	80	85	L	-	H	-	H	-	-	-	-	-	-	-	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Overview of Big Data Analytics	MapReduce	Setting up a Hadoop cluster	Introducing Oozie	Enterprise Data Science Overview
	SLO-2	Introduction to data analytics and big data	Analyzing data with Unix tools and Hadoop	Cluster specification and setup		
S-2	SLO-1	Big data mining	Scaling Out – Data Flow, Combiner Functions	Hadoop configuration	Apache Spark	Data Science Solutions in the enterprise
	SLO-2	Technical elements of the Big Data platform	Hadoop Streaming	YARN configuration		
S-3	SLO-1	Analytics Toolkit, Components of the analytics toolkit	HDFS	Introduction to Pig	Limitations of Hadoop and overcoming the limitations	Enterprise data science – Machine Learning and AI
	SLO-2	Distributed and Parallel Computing for Big Data		Installing and running pig	Core components and architecture of Spark	Enterprise Infrastructure solutions
S-4	SLO-1	Cloud computing and Big Data	Hadoop filesystems	Basics of Pig Latin	Introduction to Apache Flink	Visualizing Big Data
	SLO-2		Java Interface to Hadoop		Installing Flink	
S-5	SLO-1	In-Memory Computing Technology for Big Data	YARN	Introduction to Hive	Batch analytics using Flink	Using Python and R for visualization
	SLO-2		Job Scheduling	Installing and running Hive		Big Data Visualization Tools
S-6	SLO-1	Fundamentals of Hadoop	Hadoop I/O	Introduction to HiveQL	Big Data Mining with NoSQL	Data Visualization with Tableau
	SLO-2	Hadoop Ecosystem				
S-7	SLO-1	The core modules of Hadoop	Data Integrity	Introduction to Zookeeper	Why NoSQL?	Case Studies: Hadoop

	SLO-2		*Compression*	*Installing and running Zookeeper*	*NoSQL databases*	
S-8	SLO-1	*Introduction to Hadoop MapReduce*	*Serialization*	*The Zookeeper Service*	*Introduction to HBase*	*Case Studies: Spark*
	SLO-2		*File based Data Structures*	*Flume Architecture*		
S-9	SLO-1	*Introduction to Hadoop YARN*	*Developing a MapReduce Application*	*Introduction to Sqoop*	*Introduction to MongoDB, Cassandra*	*Case Studies: NoSQL*
	SLO-2					

Learning Resources	1. *TomWhite,Hadoop:The Definitive Guide,3rdEdition,O'Reilly,2012.* 2. *Sridhar Alla,Big Data Analytics with Hadoop3,Packt,2018.*	3. *NatarajDasgupta,Practical Big Data Analytics,Packt,2018.* 4. *DTEditorialServices,Big Data:Black Book,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 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

Course Code	18CSE392T	Course Name	MACHINE LEARNING - I	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	CSE		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:		Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-1 :	To provide basic concepts of machine learning				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 :	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:	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 :	Understand the concepts of machine learning	2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	Learn and understand machine tools and libraries of machine learning	2	75	80	H	H	H	-	H	-	-	-	-	-	-	-	-	-	-
CLO-3 :	Learn and understand the linear learning models and classification in machine learning	2	85	80	H	H	-	-	H	-	-	-	-	-	-	-	-	-	-
CLO-4 :	Understand the clustering techniques and their utilization in machine learning	2	80	75	H	H	-	-	H	-	-	-	-	-	-	-	-	-	-
CLO-5 :	Study the tree based machine learning techniques and to appreciate their capability	2	75	85	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	Machine learning python libraries		Evaluating output of clustering methods	
S-2	SLO-1	Supervised Learning	Scikit-learn	Maximum likeliwood estimation (least squares)	Spectral clustering	Basic decision tree learning algorithm
	SLO-2	Unsupervised Learning	training data – testing data – validation data		Hierarchical clustering	
S-3	SLO-1	Reinforcement learning	k-fold cross validation	principal component analysis	Agglomerative clustering	Inductive bias in decision tree
	SLO-2	The Curse of dimensionality	Features		Divisive clustering	
S-4	SLO-1	Over fitting and under fitting	Performance metrics	Bayesian classifier	Choosing the number of clusters	Decision tree construction
	SLO-2	linear regression	MSE, accuracy, confusion matrix, precision		Clustering datapoints and features	
S-5	SLO-1	Bias and Variance tradeoff	recall, F- score	Support vector machine	Bi-clustering	Issues in decision tree
	SLO-2	Testing – cross validation				
S-6	SLO-1	Regularization	Linear Regression with multiple variables	Support vector machine + kernels	Multi-view clustering	Classification and regression trees (CART)
	SLO-2	Learning Curve				
S-7	SLO-1	Classification	Logistic Regression	Multi class classification	K-Means clustering	Random Forest
	SLO-2	Error and noise				Random Forest with scikit-learn
S-8	SLO-1	Parametric vs. non-parametric models	spam filtering with logistic regression	K nearest neighbour classification	K-meloids clustering	Multivariate adaptive regression trees (MART)
	SLO-2					Introduction to Artificial Neural Networks
S-9	SLO-1	Linear Algebra for machine learning	Naive Bayes with scikit-learn	Application: face recognition with PCA	Application: image segmentation using K-means clustering	Perceptron learning
	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.G.Vadivu Dr. UshaKiruthika Mr.S.Joseph James

Course Code	18CSE393T	Course Name	TEXT MINING	Course Category		Professional Elective	L	T	P	C
							3	0	0	3

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

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

CLR-1 : Understand the fundamentals of text mining
CLR-2 : Utilize text for prediction techniques
CLR-3 : Understand the relevance between information retrieval and text mining
CLR-4 : Understand the goals of information extraction
CLR-5 : Analyze different case studies related to text mining

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

CLO	Description	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	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 knowledge on fundamentals of text mining	2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	Perform prediction from text and evaluate it	2	80	80	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-3 :	Perform document matching	2	80	75	H	M	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	Identify patterns and entities from text	2	75	85	H	-	M	-	M	-	-	-	-	-	-	-	-	-	-
CLO-5 :	Understand how text mining is implemented	2	80	85	H	-	-	-	-	-	-	-	-	-	-	L	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Overview of text mining	Labels for the Right Answers	Linear scoring Methods	Clustering Documents by similarity	Ideal Model of Data
	SLO-2	Special about Text Mining	Feature selection by attribute ranking	Evaluation of Performance	Similarity of composite documents	Practical Data Sourcing
S-2	SLO-1	Structured Data	Sentence Boundary Determination	Estimating current and future performance	K-means Clustering	Prototypical Examples
	SLO-2	Unstructured Data	Part of speech Tagging	Getting the most from a Learning Method	Hierarchical Clustering	Hybrid Example
S-3	SLO-1	Is text different from numbers	Word Sense Disambiguation	Errors and Pitfalls in Big data Evaluation	The EM Algorithm	Mixed Data in Standard Table Format
	SLO-2	Types of Problem can be solved.	Phrase Recognition	Graph models for social Networks	Goals for Information Extraction	Case study: Market Intelligence from the web
S-4	SLO-1	Document Classification	Named Entity Recognition	Information Retrieval and Text Mining	Finding Patterns and Entities from Test	Case Study: Lightweight Document Matching for Digital Libraries
	SLO-2	Informational Retrieval	Parsing	Keyword search	Entity Extraction as Sequential Tagging	Generating Model cases for Help desk Application: case study
S-5	SLO-1	Prediction and Evaluation	Feature Generation	Nearest- Neighbor Methods	Tag Prediction as Classification	Assigning topics to news articles: Case study
	SLO-2	From Textual Information to Numerical Vectors	Using text for prediction	Measuring Similarity	The maximum Entropy method	E-mail Filtering: Case study
S-6	SLO-1	Collecting Documents	Recognizing that document Fit a pattern	Shared Word Count	Linguistic Features and Encoding	SearchEngines : case study
	SLO-2	Document Standardization	Document Classification	Word count and Bonus	Local Sequence Prediction Models	Extracting Named Entities from Documents
S-7	SLO-1	Tokenization	Learning to Predict from Text	Cosine Similarity	Global sequence Prediction Models	Mining Social Media

	SLO-2	Lemmatization	Similarity and Nearest-Neighbor Method	Web based Document Search	Coreference and relationship Extraction	Customized Newspapers
S-8	SLO-1	Inflectional Stemming	Document Similarity	Link Analysis	Template Filling And Database Construction	Emerging Directions
	SLO-2	Stemming to a Root	Decision Rules	Document Matching	Commercial Extraction System: Application	Different ways of collecting samples
S-9	SLO-1	Vector Generation for Prediction	Decision trees	Inverted List	Criminal Justice : Application	Learning to Unlabeled data
	SLO-2	Multiword Features	Scoring by Probabilities	Evaluation of Performance	Intelligence Applicaton	Distributed Text Mining

Learning Resources	1. By Sholom M. Weiss, Nitin Indurkhya, Tong Zhang.,Fundamentals of Predictive Text Mining	

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.E.Poovammal, SRMIST
		Mr.L.N.B.Srinivas, SRMIST
		Mr.D.Vivek, SRMIST

Course Code	18CSE394T	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	CSE		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 :	Familiarize with Business Intelligence, Analytics and Decision Support	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 technologies for Decision making																		
CLR-3 :	Familiarize with predictive modeling techniques																		
CLR-4 :	Familiarize with sentiment analysis techniques																		
CLR-5 :	Understand about Multi-criterai Decision making systems																		
CLR-6 :	Familiarize with Automated decision systems																		

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLO-1 :	Gain knowledge on Business Intelligence, Analytics and Decision Support	2	80	85															
CLO-2 :	Understand the technologies for Decision making	2	75	80															
CLO-3 :	Apply predictive modeling techniques	2	85	80															
CLO-4 :	Apply sentiment analysis techniques	2	80	75															
CLO-5 :	Gain knowledge on Multi-criterai Decision making systems	2	75	85															
CLO-6 :	Gain knowledge on Automated decision systems	2	80	85															

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Information Systems Support for Decision Making	Decision Making:	Basic Concepts of Neural Networks	Decision Support Systems modeling	Automated Decision Systems
	SLO-2		Introduction and Definitions	Developing Neural Network	Structure of mathematical models for decision support	The Artificial Intelligence field
S-2	SLO-1	An Early Framework for Computerized Decision Support	Phases of the Decision	Based Systems	Decision making under certainty	Basic concepts of Expert Sysytems
	SLO-2		Making Process	Illuminating the Black Box of ANN with Sensitivity	Uncertainty and Risk	
S-3	SLO-1	The Concept of Decision Support Systems	The Intelligence Phase	Support Vector Machines	Decision modeling with spreadsheets	Applications of Expert Sysytems
	SLO-2			A Process		
S-4	SLO-1	A Framework for Business Intelligence	Design Phase	Based Approach to the Use of SVM	Mathematical programming optimization	Structure of Expert Sysytems
	SLO-2			Nearest Neighbor Method for Prediction		
S-5	SLO-1	Business Analytics Overview	Choice Phase	Sentiment Analysis Overview	Decision analysis-introduction	Knowledge Engineering
	SLO-2					
S-6	SLO-1	Brief Introduction to Big Data Analytics	Implementation Phase	Sentiment Analysis Applications	Decision tables	Development of Expert Sysytems
	SLO-2					
S-7	SLO-1	Clickstream Analysis	Decision Support SystemsCapabilities	Sentiment Analysis Process	Decision Trees	Location based Analytics
	SLO-2	Metrics				

S-8	SLO-1	*Clickstream Analysis*	*Decision Support SystemsClassification*	*Sentiment Analysis*	*Multi-criteria decision making*	*Cloud Computing*
	SLO-2	*Practical Solutions*				
S-9	SLO-1	*Competitive Intelligence Analysis*	*Decision Support SystemsComponents*	*Speech Analytics*	*Pairwise comparisons*	*Business Intelligence*
	SLO-2					

Learning Resources	1. Ramesh Sharda, Dursun Delen, EfraimTurban, J.E.Aronson,Ting-Peng Liang, David King, "Business Intelligence and Analytics: System for Decision Support", 10th Edition, Pearson Global Edition, 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
1. Mr.V.Selvakumar,Hexaware Technologies, selvakumarv@hexaware.com	1.	1. Mr.L.N.B.Srinivas, SRMIST
2.	2.	2. Ms.S.Nagadevi, SRMIST

Course Code	18CSE395T	Course Name	WEB 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		CSE		Data Book / Codes/Standards	Nil

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1 :	Understand the topics of Web Intelligence
CLR-2 :	Study models of information retrieval, semantic webs, search engines, and web mining.
CLR-3 :	Gain knowledge on the algorithmic aspect of Web Intelligent systems
CLR-4 :	Acquire knowledge on Data mining techniques
CLR-5 :	Understand the impact of Social Network Design for Web Intelligence
CLR-6 :	Gain Knowledge on different approaches required for studying the impact of social network for Web Intelligence

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
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLO-1 :	Acquire the knowledge on topics and benefits of Web Intelligence	2	80	85	H	-	-	-	-	-	-	-	-	-	-	H	H	H	-
CLO-2 :	Acquire the ability to build models of information retrieval, semantic webs, search engines, and web mining.	2	75	80	H	H	H	-	H	-	-	-	-	-	-	H	H	H	M
CLO-3 :	Understand the basic ideas of Multimedia Information Retrieval	2	85	80	H	-	-	-	-	H	-	-	-	-	-	H	H	H	H
CLO-4 :	Acquire knowledge to use web crawlers and fetch relevant information	2	80	75	H	H	H	M	M	-	-	-	-	-	-	H	H	H	H
CLO-5 :	Acquire knowledge to refine the social network design approached used for developing intelligent web	2	75	85	H	-	-	H	H	-	-	-	-	-	-	H	H	H	H
CLO-6 :	Apply the knowledge of different web intelligence based algorithms in practical applications	2	80	85	H	-	H	-	-	H	-	-	-	-	-	H	H	H	H

Duration (hour)	9	9	9	9	9
S-1 SLO-1	Introduction to Web Intelligence What is Web Intelligence? Benefits of Intelligent Web:What applications can benefit from web intelligence	Information Retrieval- Introduction, Document Representation	Data Mining Techniques-Classification	Web Content Mining-Web Crawlers	Social Network Design for Web Intelligence:Introduction: Social Network Design for Web Intelligence
S-1 SLO-2					
S-2 SLO-1	Wisdom Web	Retrieval Models	Data Mining Techniques-Clustering and Association	Web Crawlers	Overview of Social Intelligence Design: Groups and Communities, Issues of Social Intelligence Design, Applications of Social Intelligence Design
S-2 SLO-2					
S-3 SLO-1	Ingredients of Intelligent Web	Retrieval Models	Data Mining Techniques- Association	Search Engines	The Travelling Conversation Model
S-3 SLO-2					
S-4 SLO-1	Topics of Web Intelligence	Evaluation of Retrieval Performance	Web Usage Mining- Web-Log processing	Personalization of Web Content	A Broadcast-Based Approach
S-4 SLO-2					
S-5 SLO-1	How can I build intelligence in my own application?	Semantic Web-Introduction, The Layered-Language Model	Web Usage Mining -Analyzing Web Logs	Multimedia Information Retrieval	A Conversational Agent-Based Approach
S-5 SLO-2					
S-6 SLO-1	Examples of intelligent web applications	Metadata and Ontologies	Applications of Web Usage Mining Clustering of Web Users	Web Structure Mining- Modeling Web Topology	Smart Environment based approach
S-6 SLO-2					
S-7 SLO-1	Fallacies of Intelligent applications	Ontology Languages for the Web	Applications of Web Usage Mining-Classification Modeling of Web Users	PageRank Algorithm	Psychological Evaluation, Technical Issues
S-7 SLO-2					
S-8 SLO-1	Related Technologies	Tool Environment for the Ontology RDFferret-	Applications of Web Usage Mining-	Hyperlink-Induced Topic Search	Case Study-Putting it all together : an

			Full Text Search and RDF Querying.Onto Share-Community support Onto Edit-Ontology Development	Association Mining of Web Usages	(HITS)	intelligent news portal
	SLO-2					
S-9	SLO-1	Related Technologies	OntoView-Change Management for Ontologies Sesame-Repositories for Ontologies and Data CORPORIUM-Information Extraction	Sequence-Pattern Analysis of Web Logs	Random Walks on the Web	Case Study-Applying Web Intelligence for Business Intelligence
	SLO-2					

Learning Resources	1. Akerkar, R. & Lingras, P. (2008). Building an Intelligent Web: Theory and practice. Jones and Bartlett Publishers, Sudbury, Massachusetts. ISBN-13: 978-0- 7637-4137-2 2. Marmanis & Babenko: Algorithms of the Intelligent Web, Manning Publications, 2009, ISBN:978-1933988665 3. Witten, Ian H. & Frank, E. (2005). Data Mining: Practical Machine Learning Tools and Techniques. 2nd Edition, Morgan Kaufman. ISBN 0120884070, 9780120884070	4. Bing Liu: Web Data Mining, Springer, 2nd ed. 2011 (view online or download fromSpringerlink) 5. Manning, Raghavan and Schuetze: Introduction to Information Retrieval, CambridgeUniversityPress,2008(bookavailableonline) N. Zhong, J.M. Liu, Y.Y. Yao, Web Intelligence (Springer, 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. Dr.B.Sathiya, Data Scientist,SPi Global - Analytics & AI,Adyar, Chennai	1. Dr.S.RenugaDevi, Assistant Professor(Sl.Gr.),College of Engineering,Guindy,AnnaUniversity,Chennai	1. Dr.G.Manju
		2.Mr.K.Vijayakumar
		3.Mr.LNB.Srinivas

Course Code	18CSE396T	Course Name	DATA SCIENCE	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	Computer Science and Engineering	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1 :	Able to apply fundamental algorithmic ideas to process data
CLR-2 :	Understand the Data Analytics lifecycle
CLR-3 :	Able to construct predictive models to classify new data set
CLR-4 :	Learn to apply hypotheses and data into actionable predictions
CLR-5 :	Document and communicate the results effectively to different stakeholders
CLR-6 :	Effectively communicate the findings using visualization techniques

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
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLO-1 :	Able to comprehend basic methods of processing data from real world problems	2	85	80	L	M	L	L	H	L	L	L	L	L	L	M	M	H	M	L
CLO-2 :	Able to convert data into actionable insights	2	80	75	M	H	L	M	M	L	L	M	M	M	M	H	M	M	M
CLO-3 :	Build clustering and classification models using R environment	3	85	80	H	M	H	H	H	L	L	M	H	M	H	M	M	H	M
CLO-4 :	Apply statistical techniques for evaluation	3	75	70	M	H	H	H	H	L	M	M	H	H	H	H	M	H	H
CLO-5 :	Analyze and validate the models using appropriate performance metrics	4	80	75	H	H	M	H	M	L	M	M	H	M	H	H	M	H	H
CLO-6 :	Present the results using effective visualization techniques	4	85	80	M	M	M	H	H	M	L	H	H	H	H	H	M	M	H

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Data science process	Approaching Analytics Problems	Introduction to R	Choosing and evaluating models	Documentation
	SLO-2	The roles in a data science project	Key roles for successful Analytics project	R Graphical user interfaces	Schematic model construction and evaluation	Knitr package
S-2	SLO-1	Stages in data science project	Discovery	Data Import and Export	Mapping problems to machine learning	Deploying models
	SLO-2	Define, Collect, Build, Evaluate, Present and Deploy	Business domain, Resources, Problem framing, Key stakeholders, Analytics sponsors, Initial hypotheses, Data sources	Attributes and Data Types	Solving classification problems, working without known targets	Deploying R HTTP services and exporting
S-3	SLO-1	Working with data from files	Data Preparation	Vectors	Evaluating classification models	Presenting your results to the project sponsor
	SLO-2	Structured data, other data formats and Transforming data in R	Learning about the data, conditioning	Arrays and Matrices	Accuracy, precision, Recall, sensitivity and specificity	Summarizing the project goals and stating the results
S-4	SLO-1	Working with relational databases and NoSQL databases	Model Planning	Data Frames	Evaluating clustering models	Presenting your model to end user
	SLO-2	Staging and Curating the data	Data exploration, Model selection	Lists	Intracluster distance, cross cluster distance	Presenting your work to other data scientist
S-5	SLO-1	Exploring data	Model Building	Factors	Validating models	Introduction to data analysis
	SLO-2	Using summary statistics to spot	Common tools for model building	Contingency Tables	Overfitting, Quantifying model	Visualization before Analysis

		problems			soundness, Ensuring model quality	
S-6	SLO-1	Managing data	Communicate Results	Descriptive statistics	Memorization methods	Dirty data
	SLO-2	Cleaning data	Analysis over the different models	Model building, Evaluation and Deployment	Using single variable and multi variable	Visualizing a single variable
S-7	SLO-1	Sampling for modeling and validation	Operationalize	Hypotheses Testing	Linear regression	Examining multiple variables
	SLO-2	Training and test set split, Sample group column, Record grouping, Data provenance	Moving the model to deployment environment	Null hypotheses and Alternative hypotheses	Building a linear regression model and predicting	Dotchart and Barplot
S-8	SLO-1	Data Structures	Analytics Plan	Difference of means	Logistic regression	Box and Whisker plot
	SLO-2	Structured, Semi-structured, Quasi-structured and Unstructured data		Student t-test, Welch's t-test	Building a logistic regression model and predicting	Hexbinplot for large datasets
S-9	SLO-1	Drivers of big data	Key deliverables of analytics project	Wilcoxon Rank-Sum test	Unsupervised methods	Scatterplot matrix
	SLO-2	Devices – Mobile, smart devices	Presentation: Project sponsors, Analysts, Code, Technical specifications	Type I and II errors	Cluster analysis	Analyzing a variable over time

Learning Resources	1. David Dietrich, Barry Heller, Beibei Yang, "Data Science and Big Data Analytics" , EMC Education Services,2015 2. NinaZumel,JohnMount,"PracticalDataSciencewithR",ManningPublications,2014 3. JureLeskovec,AnandRajaraman,JeffreyD.Ullman,"MiningofMassiveDatasets",Cambridge University Press,2014	4. MarkGardener,"BeginningR-TheStatisticalProgrammingLanguage",JohnWiley&Sons,Inc,2012 5. W.N.Venables,D.M.SmithandtheRCoreTeam,"AnIntroductiontoR",2013 6. Tony Ojeda, Sean Patrick Murphy, Benjamin Bengfort, Abhijit Dasgupta, "Practical Data Science Cookbook", Packt Publishing Ltd.,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 Understand	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
Level 2	Apply Analyze	30 %	-	40 %	-	30 %	-	40 %	-	40%	-
Level 3	Evaluate Create	30 %	-	30 %	-	40 %	-	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
1. Dr. Pethuru Raj, Reliance Jio Infocomm Ltd, peterindia@gmail.com	1. Prof. P.Marikkannu, IT HOD, Anna University Regional centre, Coimbatore, pmarikkannu@gmail.com	1. Dr. G. Vadivu, SRMIST
	2. Prof. E.Ilavarasan, Pondicherry University, eilavarasan@pec.edu	2. Dr.B.Baranidharan, SRMIST
		3. Mr.D.Vivek, SRMIST

Course Code	18CSE487T	Course Name	DATA WAREHOUSING 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		Computer Science and Engineering	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 idea of data warehouse	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 :	To learn step by step approach to design a data warehouse																		
CLR-3 :	Understand ETL Process																		
CLR-4 :	To learn building process of data warehouse and implementation of data mart																		
CLR-5 :	Identify the Data mining concepts with various domains																		
CLR-6 :	To learn case studies to bring out practical aspects of data warehouse																		

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																		
CLO-1 :	Acquire the knowledge, Architecture and schema and OLAP Tool concepts.	2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	Acquire knowledge to design a data warehouse.	2	75	80	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-3 :	Implement ETL Process in various data warehouse applications.	2	85	80	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	Acquire knowledge to implement a data warehouse.	2	80	75	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	Implement the various concepts and applications of data mining rules and technology.	2	75	85	H	-	-	H	-	-	-	-	-	-	-	-	-	-	-
CLO-6 :	To Implement the data warehouse concepts in various organizations.	2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Introduction to dataware housing	Data Warehouse Schema-Introduction	Building a data warehouse - Introduction	DATA MINING-introduction – Data – Types of Data – Data Mining Functionalities	Data Warehouse in Tamil Nadu government
	SLO-2	Introduction to data ware housing	Dimensional Modeling	Critical success factor	Integrating Data Mining with Data Warehouse	Data warehouse for ministry of commerce
S-2	SLO-1	Data warehousing Components	The Star Schema	Requirement Analysis	Data Mining Task Primitives	Data warehouse for the government of Andhra Pradesh
	SLO-2	Need for Data warehousing	The Snowflake Schema	Planning for the data warehouse	Data Preprocessing	Data warehouse for the government of Andhra Pradesh
S-3	SLO-1	Benefits and application of data warehouse	Aggregate Tables	Data warehouse design stage	Association rule mining and classification	Data warehouse in Hewlett Packard
	SLO-2	Data Warehouse Architecture Goals	DBMS Schemas for Decision Support	Building and implementing data marts	Frequent pattern Mining	Data warehouse in Hewlett Packard
S-4	SLO-1	Data Warehouse Architecture and Characteristics	Data Extraction	Building data warehouse	Apriori algorithm	Data warehouse in Levi Strauss
	SLO-2	Data Warehouse Architecture and Characteristics	Data transformation: Basic tasks	Backup and Recovery	Frequent pattern Mining without candidate generation	Data warehouse in Levi Strauss
S-5	SLO-1	Data Mart	Major transformation types	Establish the data recovery quality framework	Mining Multilevel Association Rules	Data warehouse in World Bank
	SLO-2	Data Mart	OLAP definition,	Operating the warehouse	Mining Multidimensional Association Rule, Correlation Analysis Rule	Data warehouse in World Bank

S-6	SLO-1	*Classification of data mart, Implementation*	*Dimensional Analysis*	Recipe for a successful data warehouse	Classification: Decision Tree	*HARBOR-A highly available data warehouse*
	SLO-2	*Classification of data mart, Implementation*	*Hypercube*	Data warehouse pitfalls	Bayesian Classification-Naïve Bayes Classification	*HARBOR-A highly available data warehouse*
S-7	SLO-1	*Gathering the business requirement*	*OLAP operations*	*Meta Data – Introduction*	SVM Linear and Non linear data	*A Typical Business Data Warehouse for a trading company*
	SLO-2	Planning and project management- Project principles	Drill down	Meta Data – Data Management	Text Mining Temporal Data Mining and Spatial Data mining	A Typical Business Data Warehouse for a trading company
S-8	SLO-1	Data ware house readiness assessment, project team	Roll up	Meta Data – Query Generation	Cluster Analysis-Introduction	Customer Data warehouse of world's first and largest online bank in united kingdom
	SLO-2	Selecting the operating system	Slice	Meta Data – Query Generation	K-means– Partitioning Methods	Customer Data warehouse of world's first and largest online bank in united kingdom
S-9	SLO-1	Selecting the database software	OLAP models	Meta Data and Tools	Hierarchical Methods	A German supermarket Edeka's Data warehouse
	SLO-2	Selecting the tools	MOLAP	Meta Data and Tools	Data Mining Applications	A German supermarket Edeka's Data warehouse

Learning Resources	1. *PaulrajPonniah,―DataWarehousing:FundamentalsforITProfessionals,WileyIndia.,2001.* 2. *Reema Theraja "Data Warehousing" by Oxford UniversityPress-2011.* 3. *DataMiningandDataWarehousingbyMs.KhushbooSaxena,Mr.Sandeepsaxena,Dr.AkashSaxenafirst edition 2015,BPBpublication,India*	4. *Prabhu CSR ,Data Warehousing Concepts, Technique, Product and application, PHI Learning private Ltd, Third Edition,2013.* 5. *SamAnahory,DennisMurray,DataWarehousingintheRealWorld,Pearsonpublication-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
K Selvanayagam, System Analyst, project Lead, Preludesys, Siruseri, Kancheepuram Dist.	V.Masillamani, Asst Prof,IIITDM, Kancheepuram ,chennai	1.A.M.J Muthu Kumaran
		2. S.A Saranya

Course Code	18CSE488T	Course Name	FUNCTIONAL PROGRAMMING	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		Computer Science and Engineering	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 building blocks of stream processing	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 :	Explore the data ingestion options into stream processing engines																		
CLR-3 :	Process streaming data in real time																		
CLR-4 :	Utilize NOSQL storage options to store real time data																		
CLR-5 :	Deliver stream processing results to end users																		
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																		
CLO-1 :	Comprehend the usage of basic constructs of a functional programming language	3	80	70	L	H	H	H	H	-	-	-	L	L	-	H	-	-	-
CLO-2 :	Create the different types of functions and evaluate its operations	3	85	75	M	H	L	M	M	-	-	-	M	L	-	H	-	-	-
CLO-3 :	Create patterns and match the same with traits and case classes	3	75	70	M	H	M	H	H	-	-	-	M	L	-	H	-	-	-
CLO-4 :	Create lists and collections, evaluate its operations	3	85	80	M	H	M	H	H	-	-	-	M	L	-	H	-	-	-
CLO-5 :	Construct functional design for real world applications using common structures	3	85	75	H	H	M	H	M	-	-	-	M	L	-	H	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Programming Paradigms	Modules, Objects and Namespaces	Traits – Purpose and Syntax	Lists – Java vs Scala Lists	Functors - Purpose and Use
	SLO-2	Different types of programming paradigms, Functional vs OOP	Demo - Modules, Objects and Namespaces	Define a trait	Lists definitions and usage demo	Writing a simple functor
S-2	SLO-1	Scala Language Basics - Variables,	Anonymous Functions	Interface types	Working with Lists	Functor Laws
	SLO-2	Expressions	Polymorphic Functions, Nested Functions	Interface types examples	Constructing Lists	Applicatives – Concepts and use
S-3	SLO-1	Functions	Demo – Anonymous , Polymorphic and Nested Functions	Thick Interfaces	Basic operations on lists	Defining an applicative
	SLO-2	Recursion	Closures	Thin Interfaces	head, tail, isEmpty demo, List Patterns	Demo of Applicatives
S-4	SLO-1	Call By Name	Demo - Closures	Comparison - Thick vs Thin Interfaces	Lists - First Order methods	Traversable functors
	SLO-2	Call By Value	Repeated Parameters	Ordered trait	Examples of First Order Methods	Example – Traversable Functors
S-5	SLO-1	Conditionals	Tail Recursion	Demo – Ordered trait, Trait Comparisons	Lists - Higher Order methods	Monads
	SLO-2	Looping – for each and for	Demo – Tail Recursion	Traits for modifying interfaces	Examples of Higher Order Methods	Defining Monads
S-6	SLO-1	Significance of vals	Define a tail recursive function	Stacking modifications	Sequences – Overview and operations	Monad Laws
	SLO-2	Classes	Tracing tail-recursive functions	Recap – Traits and operations	Demo - Sequences	Demo – Monads and Monad Laws
S-7	SLO-1	Types	Demo – Tracing tail-recursive functions	Mixin – Purpose & Composition	Tuples - Overview and operations	Monoid – Concept, Purpose and Use
	SLO-2	Fields	Limits of tail-recursive functions	Mixin Example	Demo - Tuples	Examples of Monoid
S-8	SLO-1	Methods	Curried Functions	Case Classes – Use, Definition	Sets and Maps – Overview and operations	Recap with more examples -Monads and Functors
	SLO-2	Variable scope	Demo - Curried Functions	Pattern Matching, Example	Demo – Sets and Maps	Recap with more examples -Applicatives
S-9	SLO-1	Objects	Higher Order Functions - Definition and Uses	Sealed Classes, Option Type	Recap – Lists and Collections	Applications – Functors, Monads

	SLO-2	*Singleton object, Variables of objects*	*Higher Order Functions Example*	*Applications – Sealed Classes and Option Type*	*Examples – Lists and Collections*	*Applciations - Monads*

Learning Resources	1. *Chiusano.P,BjarnasonR,FunctionalProgramminginScala,ManningPublications,2015* 2. *OderskeyM,SpoonL,VennersB,"ProgramminginScala",Thirdedition.*	3. *Hortsmann, C., Scala for the Impatient, 2nd ed., Addison-Wesley,2016.* 4. *Raychaudhuri R, Scala in Action, 1st ed. Manning Publications,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
		Ms. K.Sornalakshmi
		Mr.R.Rajkumar

Course Code	18CSE489T	Course Name	STREAMING ANALYTICS	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	
Course Offering Department		Computer Science and Engineering	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 building blocks of stream processing			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 :	Explore the data ingestion options into stream processing engines																				
CLR-3 :	Process streaming data in real time																				
CLR-4 :	Utilize NOSQL storage options to store real time data																				
CLR-5 :	Deliver stream processing results to end users																				
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																				
CLO-1 :	Comprehend the concepts and terminologies in stream processing			3	80	70	L	H	H	H	H	-	-	-	L	L	-	H	-	-	-
CLO-2 :	Create the data ingestion pipeline for a stream processing application			3	85	75	M	H	L	M	M	-	-	-	M	L	-	H	-	-	-
CLO-3 :	Create stream processing applications using Apache Storm and Spark Streaming			3	75	70	M	H	M	H	H	-	-	-	M	L	-	H	-	-	-
CLO-4 :	Store real time data using NoSQL databases			3	85	80	M	H	M	H	H	-	-	-	M	L	-	H	-	-	-
CLO-5 :	Construct stream data visualizations for users			3	85	75	H	H	M	H	M	-	-	-	M	L	-	H	-	-	-
				3	80	70	L	H	H	H	H	-	-	-	L	L	-	H	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Introduction to Stream Processing	Getting Started with Kafka	Apache Storm – Introduction	Apache Spark Streaming Introduction	NoSQL Data Bases
	SLO-2	Batch vs Stream Processing, Examples of stream processing	Why Kafka ? Publish Subscribe messaging model	Features of Storm	Spark's Memory Usage	Introduction to MongoDB
S-2	SLO-1	Map Reduce, Scalability and Fault Tolerance	Kafka Architecture	Storm Components	Understanding Resilience and Fault Tolerance in a Distributed System	MongoDB's Key Feature
	SLO-2	Applications of stream processing	Messages and Batches, Schemas	Nimbus, Supervisor Nodes	Spark's cluster manager	Data Model, Adhoc queries
S-3	SLO-1	Stateful Stream Processing	Topics and Partitions,	Zookeeper cluster	Data Delivery Semantics in Spark	Indexes, Querying
	SLO-2	Stream Processing Model	Producers and consumers	Storm Data Model	Data Delivery Semantics in Spark Applications	Replication, Speed and Durability
S-4	SLO-1	Data Sources, Stream processing pipelines, Sinks	Brokers and Clusters	Definition of a Storm topology, Operation modes in Storm	Microbatching	Scaling, MongoDB Change Streams
	SLO-2	Transformations and Aggregation	Multiple Clusters, Data Ecosystem	Storm – Prerequisites and Setting up a storm cluster, Developing a hello world example	Dynamic Batch Interval	Real-time data changes with Change Streams
S-5	SLO-1	Window Aggregations	Sending messages with producers	Storm topology options, Demo of Hello world in Storm	Structured Stream processing model	Visualizing Streaming data – Events, Logs, Records
	SLO-2	Stateless and stateful processing	Steps & Example - Sending messages with producers	Introduction to Storm UI	Spark Streaming Resilience Model	Dashboards

S-6	SLO-1	Effect of time in stream processing	Receiving messages with consumers	Cluster, Nimbus, Supervisor, Topology Summary. Nimbus Configuration	Data Structures in Spark – RDDs and DStreams	Visual Elements and Properties
	SLO-2	Lambda Architecture	Steps & Example - Receiving messages with consumers	Storm Scheduler	Spark Fault Tolerance Guarantees	Data Density
S-7	SLO-1	Kappa Architecture	Developing Kafka Streams Application	Types of schedulers	First Steps in Structured Streaming	Dividing time, Time to Live, Context
	SLO-2	Examples – Lambda & Kappa Architectures	Phases in a Kafka Streams Applciation Development	Applications of schedulers	Streaming Analytics Phases	Examples of Streaming Data Visualization
S-8	SLO-1	Streaming vs Batch Algorithms	Constructing a topology	Storm Cluster Monitoring	Acquiring streaming data	Visual Distractions and Visual Deception
	SLO-2	Applications – Streaming and Batch Algorithms	Streams and State – Applying stateful operations	Integration of Storm with Kafka	Transforming streaming data	Example – Stream processing visualization dashboards
S-9	SLO-1	Use of a Batch-Processing Component in a Streaming Application	Example application development with Kafka Streams	Integration of Storm with Kafka example	Output the resulting data	Streaming Visualization Techniques
	SLO-2	Recap – Stream Processing Fundamentals	Demo – Kafka Streams	Recap – Storm in Stream Processing	Demo – Stream Processing with Spark Streaming	Demo – Stream Processing visualizaton

Learning Resource s	1. Ellis B, Real-Time Analytics – Techniques to analyze and visualize streaming data, 1st ed., John Wiley & Sons Inc,2014 2. Andrade.H.C, Gedik B, Turaga D.S, "Fundamentals of Stream Processing: Application Design, Systems, and Analytics", 1st ed., Cambridge University Press,2014. 3. Narkhede N, Shapira .G, and Palino T., Kafka: The Definitive Guide - Real-Time Data and Stream Processing at Scale, 1st ed., O'Reilly Media, Inc.,2017.	4. Jain.A, Mastering Apache Storm, 1st ed., Packt Publishing,2017. 5. Garillot F and Mass. G.,, Stream Processing with Apache Spark, 1st ed., O'Reilly Media, Inc.,2019. 6. https://docs.mongodb.com/manual/changeStreams/ 7. Banker K., Bakkum P., Verch S., Garret D., Hawkins T., MongoDb in Action, ", 1st ed., Manning Publications, 2016 8. Arageus A, Visualizing Streaming Data, 1st ed., O'Reilly Media, Inc.,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 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
		Ms.K.Sornalakshmi
		Ms.A.Saranya, Dr.Manju

Course Code	18CSE490T	Course Name	BIG DATA VISUALIZATION	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	Computer Science and Engineering	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 key techniques used in visualization which includes data models, graphical perception and techniques specifically for visual encoding and interaction																		
CLR-2 :	Obtain an exposure to common data domains and the corresponding analysis tasks which includes multivariate data and text																		
CLR-3 :	Get hands-on experience in building and evaluating visualization systems																		
CLR-4 :	Gain knowledge in data visualization aides																		
CLR-5 :	Understand the significance of data by placing it in a visual context																		
CLR-6 :	Utilize the knowledge by reading and discussing research papers from the visualization literature																		

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 :	Design and exploring the result with data visualizations	3	75	70	L	M	M	M	L	-	-	-	M	L	M	M			
CLO-2 :	Conducting exploratory data analysis using visualization techniques and tools.	3	75	70	M	H	M	M	M	-	-	-	M	L	M	M			
CLO-3 :	Visual presentations of data for effective Communication.	3	80	75	M	M	H	H	M	M	-	-	M	M	H	H			
CLO-4 :	Designing and evaluating color palettes for visualization based on principles of perception.	3	85	80	M	M	M	H	H	-	-	-	M	M	H	H			
CLO-5 :	Using the knowledge of perception and cognition to evaluate visualization design alternatives	3	85	80	M	H	M	H	H	-	-	-	M	M	H	H			
CLO-6 :	Identifying opportunities for the application of data visualization in various domains.	3	85	80	M	H	H	H	H	-	-	-	M	M	H	H			

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Introduction to Big Data Visualization	Definitions and explanations of visualization categories	An Introduction to Visualization tools	Introduction to D3	Case Studies: 1: Color considerations with a dark background
	SLO-2	Challenges of Big Data Visualization	Exploring R In big data	Visualization tools and big data	D3 and big data	
S-2	SLO-1	Categorization	Example with Patient Medical History	Example 1 – Sales transactions	Basic Examples	2: Leveraging animation in thevisuals you present
	SLO-2	Visualization Philosophies	Digging in with R	Adding more context	Getting started with D3	
S-3	SLO-1	Approaches to Big Data Visualization	No looping	Wrangling the data	D3 visualization sample templates	3: Logic in order
	SLO-2	Quality of Visualization	Comparisons and Contrasts	Trifacta Script panel	Big data visualization using D3	
S-4	SLO-1	Infographics versus Data Visualization	Tendencies	A visualization dashboard	Displaying Results Using D3	4: Strategies for avoiding thespaghetti graph
	SLO-2	Exploration versus Explanation	Dispersion	Experimenting with the data and build the visualization	Create a summary file for visualization	
S-5	SLO-1	Informative versus Persuasive versus Visual Art	Data quality categorized	Data pane_core details	Visualization using HTML document	5: Alternatives to pies
	SLO-2	Ingredients of Successful Visualizations	Data Manager	Constructing Dashboards	Data visualization showing the stacked view	
S-6	SLO-1	Choose Appropriate Visual Encodings-Natural Ordering, Distinct Values	Data Manager and big data	Saving and Presenting the work	Visual transitions	Final Thought
	SLO-2	Redundant Encoding ,Defaults versus	Example-Reformatting-A little Setup	Visualization re-coloring, resizing, adding or		

		Innovative Formats ,Readers' Context		*changing labels*		
S-7	SLO-1	*Compatibility with Reality ,Patterns and Consistency*	*Adding Script Code*	*Filters and Measure Names*	*Multiple donuts*	*Where to go from here*
	SLO-2	*Selecting Structure*	*Executing the scene*	*Example-Promotion Spend Effect on Sales*	*Another twist on bar chart visualizations with examples*	
S-8	SLO-1	*Position: Layout and Axes*	*Status and relevance*	*Sales and spend*		
	SLO-2	*The Meaning of Placement and Proximity*	*Naming the nodes*	*Sales v Spend and Spend as % of Sales Trend*	*D3 Stacked Area via Nest template*	*Building storytelling with data competency in yourteam or organization*
S-9	SLO-1	*Patterns of Organization-Specific Graphs, Layouts, and Axis Styles*	*Consistency ,Reliability ,Appropriateness*	*ables and indicators*	*Adopting the sample*	
	SLO-2	*Appropriate Use of Circles and Circular Layouts*	*Accessibility and Other Output nodes*		*Visualization changes format*	

Learning Resources	1. Big Data Visualization,James D. Miller,Copyright © 2017 Packt Publishing 2. Designing Data Visualizations,by Noah Iliinsky and Julie Steele,Copyright © 2011 Julie Steele and Noah Iliinsky. All rights reserved.Printed in the United States of America	3. Storytelling with data - a data visualization guide for business professionals by cole nussbaumer knaflic, Wiley publications 4. Tableau Your Data! by Daniel G. Murray and the InterWorks BI Team, Wiley publications

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
Valiyullasha, Bugtreat Technologies, UK, ceo@bugtreat.com	*Prof.Shiv ram Dubey, IIIT Sricity, srdubey@iiits.in*	*Dr.Mangalraj,SRMIST,*
Saravanakarthick,Hewlett-Packard, India, saravanakarthick.chinniah@dxc.com	*Prof. Bhawana Rudra, NITK suratkal,bhawanarudra@nitk.edu.in*	*Dr.K.P.Vijayakumar,SRMIST*

Course Code	18CSE491T	Course Name	MACHINE LEARNING - II	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	18CSE392T	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department		CSE		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 machine Learning Experiments	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 and implement Ensemble learning methods																		
CLR-3 :	To provide deeper understanding of Reinforcement Learning and its Elements																		
CLR-4 :	Understand and Implement Neural Network Algorithms																		
CLR-5 :	Understand the concepts of Deep Learning Algorithms																		

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																		
CLO-1 :	Design and Analyze Machine Learning Experiments	2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	Learn and Understand Graphical Model Learning and ensemble learning	2	75	80	H	H	-	-	H	-	-	-	-	-	-	-	-	-	-
CLO-3 :	Understand the concept of Reinforcement learning	2	85	80	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	Study the neural network systems for machine learning	2	80	75	H	H	-	-	H	-	-	-	-	-	-	-	-	-	-
CLO-5 :	Learn and Implement Deep Learning algorithms	2	75	85	H	H	-	H	H	-	-	-	-	-	-	-	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Introduction to machine learning	Graphical Models	Reinforcement Learning	Neural Networks representations	Feature selection
	SLO-2	Basic probability theory	Bayesian belief networks	K-Armed Bandit	McCulloch-Pitts units	Feature extraction
S-2	SLO-1	linear algebra	Markov random fields	Elements of reinforcement learning	Thresholding logic	Deep Learning
	SLO-2			Model based learning	Perceptron	Deep learning python libraries
S-3	SLO-1	Factors		Value iteration	Feed forward networks	Simple DNN
	SLO-2	Response and strategy of Experimentation	Naïve Bayes classifiers	policy iteration	Multi-layer perceptron	Activation functions
S-4	SLO-1	Randomization, Replication and Blocking	Markov models	Temporal difference learning	Back propagation algorithms	Regularization methods
	SLO-2	Guidelines for machine learning Experiments	Hidden Markov models	Exploration strategies		
S-5	SLO-1	Cross validation and resampling methods	Ensemble learning methods	Deterministic and Non-deterministic rewards and actions	Convergence and Hidden layer representation in back propagation	Convolutional Neural Networks
	SLO-2	Measuring classifier performance	Voting, Boosting, Adaboost		Optimization Algorithms	
S-6	SLO-1	Interval estimation	Gradient Boosting	Semi-supervised learning	Gradient Decent	Recurrent Neural Networks
	SLO-2	Hypothesis testing	Bagging		Stochastic gradient	
S-7	SLO-1	Assessing a Classification Algorithm's performance	Random Forest	Computational learning theory	Adam, Adagrad	LSTM
	SLO-2	Comparing two classification Algorithms			RMSProp	Sentiment analysis with LSTM keras code

S-8	SLO-1	Comparing multiple Algorithms	Fine Tuning Ensemble	VC dimension	Drop out	Auto encoders
	SLO-2		Cascading		Batch Normalization	
S-9	SLO-1	Comparison over multiple Datasets	Application Face recognition using Ensemble techniques	PAC learning	Application Face recognition using Neural Networks	Dimensionality reduction using Auto Encoders
	SLO-2					

Learning Resources	1. KevinP.Murphy,"MachineLearning:AProbabilisticPerspective",MITPress,2012. 2. EthemAlpaydin,"IntroductiontoMachineLearning",PrenticeHallofIndia,2005 3. Tom Mitchell, "Machine Learning", McGraw-Hill,1997.	4. Sebastian Raschka, VahidMirjilili,"Python Machine Learning and deep learning", 2nd edition, kindle book,2018 5. IanGoodfellow,Yoshua Bengio ,Aaron Courville,"DeepLearning",MITPress,2016. 6. JasonBrownlee,"DeepLearningwithPython",ebook,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 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
		1. Dr.G.Vadivu
		2. DrUshaKrithika
		3. Mr. S. JosephJames

Course Code	18CSE341T	Course Name	COMMUNICATION SYSTEMS ENGINEERING	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		Computer Science and Engineering	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 principles of Communication systems engineering																		
CLR-2 :	Gain knowledge on the basics of Communication system components																		
CLR-3 :	Acquire knowledge on encoding, decoding techniques																		
CLR-4 :	Understand the fundamentals of Fiber Optic Communication																		
CLR-5 :	Understand the basics of Satellite Communication																		
CLR-6 :																			

Column headers (Learning): Level of Thinking (Bloom), Expected Proficiency (%), Expected Attainment (%)

PLO headers: 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

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLO-1 :	Understand the basic ideas about Communication and its types	1	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	Acquire the knowledge on applications of Communication systems	2	75	80	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-3 :	Gain knowledge on information sources and source coding algorithms	2	85	80	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	Understand the concepts of coding for reliable Communication	2	80	75	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	Ability to apply/appreciate the skills learnt during the design and integration of the fibre optic mode of Communication in any system under development	2	75	85	H	-	-	H	-	-	-	-	-	-	-	-	-	-	-
CLO-6 :	Ability to apply/appreciate the skills learnt during the design and integration of the satellite mode of Communication in any system under development	2	80	85	H	-	-	H	-	-	-	-	-	-	-	-	-	-	-

Duration (hour)		9	6	9	9	9
S-1	SLO-1	Significance of human Communication, Communication systems, transmitter	Introduction to information sources and source coding	Coding for reliable Communication	Fibre Optic Communication: Introduction Through Optical Fiber	Satellite Communication: Introduction
	SLO-2	Communication channel, Receivers, Transceivers	Modeling of information sources	Tight bound on error probability of orthogonal signals	Electromagnetic Spectrum	Basic Satellite Transponder Kepler's Laws Kepler's First Law Kepler's Second Law Kepler's Third Law
S-2	SLO-1	Attenuation, Noise	Measure of Information	The promise of coding	Types of Optical Fibres	Satellite Orbits: Low Earth Orbit Satellite Medium Earth Orbit Satellite
	SLO-2	Types of electronic Communication, simplex	Joint and Conditional Entropy	Linear block codes	Propagation of Light	Satellite Orbital Patterns Inclined Orbits Equatorial Orbit, Polar Orbits
S-3	SLO-1	Full duplex, half duplex	Source coding theorem	Theorem on Linear code	Single Mode Fibre	Geostationary Satellites
	SLO-2	Analog signals, Digital signals	Source coding algorithms	Hamming Codes	Multimode Fibre	Geosynchronous Satellite—Advantages and Disadvantages
S-4	SLO-1	Modulation and multiplexing, Baseband transmission	The Huffman source coding algorithm	Decoding and performance of linear block codes	Losses Within an Optical Fibre: Attenuation Loss	Power Systems
	SLO-2	Broadband transmission	Huffman Encoding Algorithm	Soft decision decoding	Absorption Loss	Altitude Control: Spin Stabilized

			Examples on Huffman Encoding Algorithm	Hard decision decoding	Radiation Loss	Spun/de-spun Stabilization Method
S-5	SLO-1	Multiplexing	Examples on Huffman Encoding Algorithm	Hard decision decoding	Radiation Loss	Spun/de-spun Stabilization Method
	SLO-2	Electromagnetic spectrum	The Lempel-Ziv source coding algorithm	Error detection and Error correction	Dispersion Loss	Three-axis Stabilized Method
S-6	SLO-1	Frequency and wavelength	Rate distortion theory	Burst error correcting codes	Rayleigh Scattering Loss	Altitude Control Components: Sensors, Actuators
	SLO-2	Optical spectrum	Mutual information	Cyclic codes, The structure of cyclic codes	Modal Dispersion Loss	Satellite System Parameters
S-7	SLO-1	Bandwidth	Differential Entropy	The generator matrix, Encoding of cyclic codes	Coupling Losses	Equivalent Noise
	SLO-2	Channel bandwidth	Rate distortion function	BCH Codes, Reed-Solomon Codes	Fibre Optic Transmission System: Fibre Optic Cable Light Sources	Temperature Carrier-to-Noise Density Ratio
S-8	SLO-1	Spectrum management	Examples on Rate distortion function	Convolutional Codes	Types of Fibre Optic Transmitters, Optical Detectors, Optical Repeater	Energy of Bit-to-Noise Density Ratio
	SLO-2	Standards	Digital audio transmission and digital audio recording	Basic properties of convolutional codes, Encoding, The transfer function	Optical Point-to-point Communication System:	Satellite System Link Models
S-9	SLO-1	Communication applications survey - Simplex	Digital audio in telephone transmission systems	Catastrophic codes	Single Channel System Amplified Single Channel System	Satellite System Link Equation 636 Uplink Power Budget Calculation
	SLO-2	Communication applications survey - Duplex	Digital audio recording	Optimum decoding of convolutional codes - The Viterbi algorithm	Wavelength Division Multiplexing (WDM) Systems	Satellite Radio Navigation

Learning Resources	1. Louis E. Frenzel, Principles of Electronic Communication Systems, 4th Edition, Tata McGraw Hill Education, 2019. (Unit -I) 2. John G. Proakis, Masoud Salehi , Communication Systems Engineering, 2nd edition, Pearson Education International, 2015. (Unit - II & Unit -III)	3. Communication Systems , V. Chandra Sekar, Oxford University Press, 2015(Unit - IV &Unit-V)

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
Mr. Ramesh Somasundaram,Director & Head, IT Sourcing Management & Supplier Governance, Energica, Chennai	Dr.M.P Chitra, HOD/ECE, Panimalar Institute of Science and Technology	Dr.Annapurani.K, Dr.M.Prakash
Mr. Umakanthan Velayutham, Senior Partner & Head, Transform Advisory Services, Energica, Chennai	Dr.Dhalia Sweetlin, Asst.Prof(Sr.G), IT Dept, MIT,Chennai	Mrs.Kayalvizhi Jeyavel

Course Code	18CSE342T	Course Name	DIGITAL COMMUNICATION 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		Computer Science and Engineering	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 model of digital Communication system.	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-2 :	Gain the knowledge about digital coding, signal compression and its application																		
CLR-3 :	Gain knowledge on digital modulation , baseband and band-pass modulation																		
CLR-4 :	To know the fundamentals of error control coding																		
CLR-5 :	To learn the importance of Multiplexing and Multiple Access																		

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 knowledge on digital Communication, signals and systems	1	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	Acquire the knowledge on sampling, Quantization, encoding and Signal Compression	2	75	80	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-3 :	Understand the various digital modulation techniques	2	85	80	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	To understand the error Detection and Correction codes	2	80	75	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	Understand the behavior of various multiplexing techniques	2	75	85	H	-	-	H	-	-	-	-	-	-	-	-	-	-	-
CLO-6 :		2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Introduction Digital Communication System, advantages of Digital Communication	Introduction to digital coding	Introduction to Digital Modulation	Introduction-Types and Measure of Error- Shannon-Hartley Capacity Theorem	Introduction to Multiplexing-Types
	SLO-2	Regeneration of Digital Signals, Power Efficiency of Digital Modulators	Digitizing Analog Signals	Baseband Modulation	Methods of Error Control-Classification of Error Correcting Codes	Frequency Division Multiplexing
S-2	SLO-1	Bandwidth Compression, Multimedia: Unification of Signals	Sampling	Pulse Modulation Systems	Linear Block Codes-Hamming Distance, Weight, Error Detection, Correction	Time Division Multiplexing
	SLO-2	Performance, Technology	Quantization	Baseband Signaling	Linear Block Codes-Generator Matrix, Systematic codes, Parity Check Matrix	Frame Synchronization
S-3	SLO-1	Time and Frequency Representation	Encoding	Correlative Coding: Duo-Binary Coding	Standard Array - Implementing the decoder	Primary Multiplexing in Digital Telephony
	SLO-2	Fourier Series, Fourier Transform	Signal Compression,	Modified Duo-Binary Coding	Cyclic Codes-Generator Polynomial for cyclic code	Higher Order Multiplexing
S-4	SLO-1	Discrete-time Fourier Transform	Signal Statistics and Redundancy	Digital Phase Modulation(Phase Shift Keying): Bi-phase shift keying modulation	Systematic Cyclic code	Multiple Access-Frequency Division Multiple Access
	SLO-2	Discrete Fourier Transform	Companded PCM	Differential coding in Bi-phase shift keying	Polynomial Multiplication and division	Time Division Multiple Access
S-5	SLO-1	Convolution	Predictive Coding	Scarmbling	Importance of Block Codes-Hamming Codes	Code Division Multiple Access
	SLO-2	Correlation	Transform Coding	Bi-phase shift keying modulator, Quadrature	Problem solving session	Random Access

				and Offset Quadrature phase shift keying		
S-6	SLO-1	Hilbert Transform	Parametric Coding	Digital Frequency Modulation(Frequency Shift Keying)	Golay-Reed Solomon Codes	Carrier Sense Multiple access/Collision Detection
	SLO-2	Problem solving session	Perceptual Coding	Minimum Shift Keying	Convolutional codes, Convolutional Encoder	Fixed Assignment Multiple Access
S-7	SLO-1	Low-pass and Band-pass Representations,	Application of Digital Coding-Digital	Minimum Shift Keying Modulator, Gaussian	Convolutional Decoding, Maximum	Demand Assignment Multiple Access
		Band-pass Signals and Systems	Speech	Minimum Shift Keying, Continuous Phase Modulation	like hood Decoding	
	SLO-2	Analytic Signals	Adaptive Delta Modulation Codec	Power Spectral Density of Baseband Signals	Viterbi algorithm	Introduction to Pseudo-Noise Sequence
S-8	SLO-1	Low-pass Equivalent Signals	Pulse Code modulation Codec	Power Spectral Density of Band-pass Signals	Sequential Decoding and Fano Algorithm	Properties of PN Sequences
	SLO-2	Problem solving session	Digital Audio: MP3 Coding	Problem solving session	Practical Applications of Error Correcting codes	Direct Sequence Spread Spectrum Transmitter and Receiver, Interface Rejection
S-9	SLO-1	Signal Space Representations: Vector Space	Digital Video: Run Length Coding, variable Length Coding	Comparison of Basic Modulations	Deep Space Communication	Frequency hopping Spread Spectrum, Frequency hopping Spread Spectrum Transmitter and receiver
	SLO-2	Problem solving session	MPEG1	Orthogonal Frequency Division Multiplexing	Satellite Communication	Spread Spectrum Applications

Learning Resources	1. R.N. Mutagi, Digital Communication – Theory, Techniques and Applications, 2nd Edition, Oxford University Press,2014. 2. John R. Barry, Edward A. Lee, David G. Messerschmitt, Digital Communication, 3rd Edition, Springer International Edition, Springer,2011	3. JohnG.Proakis,MasoudSalehi,DigitalCommunications,5thEdition,McGrawHillEducation,2015

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 %	

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Course Designers		
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Mr. Ramesh Somasundaram,Director & Head, IT Sourcing Management & Supplier Governance, Energica, Chennai	Dr.M.P Chitra, HOD/ECE, Panimalar Institute of Science and Technology	Dr.Annapurani.K, Dr.M.Prakash
Mr. Umakanthan Velayutham, Senior Partner & Head, Transform Advisory Services, Energica, Chennai	Dr.Dhalia Sweetlin, Asst.Prof(Sr.G), IT Dept, MIT,Chennai	Mrs. M. Safa, Mrs. D. Anitha

Course Code	18CSE378T	Course Name	PRINCIPLES OF 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		Computer Science and Engineering		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 fundamental ideas behind Cloud Computing, the evolution of the paradigm, its applicability; benefits, as well as current and future challenges	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-2 :	Learn cloud enabling technologies and get exposure to advanced clouds																		
CLR-3 :	Explore cloud storage technologies and relevant distributed file systems, NoSQL databases and object storage;																		
CLR-4 :	Understand the cloud security threats and protective mechanism for cloud computing																		
CLR-5 :	Participate in team-based peer reviews to analyze the security development life cycle and mitigate risks and vulnerabilities																		

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 :	Explain terms used in secured software development and life cycle process	3	80	70	H	H	H	H	H	-	-	-	L	L	-	H	-	-	-
CLO-2 :	Apply fundamental concepts in cloud infrastructures to understand the cloud system, network and virtualization and outline their role in enabling the cloud computing system model.	3	85	75	M	H	L	M	H	M	-	-	M	L	-	H	-	-	-
CLO-3 :	Illustrate the fundamental concepts of cloud storage and demonstrate their use in storage systems such as Amazon S3 and HDFS	3	75	70	M	H	M	M	H	-	-	-	M	L	-	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	M	H	L	H	M	-	-	-	M	L	-	H	-	-	-
CLO-5 :	Analyze various cloud programming models and apply them to solve problems on the cloud.	3	85	75	H	H	M	H	H	M	-	-	M	M	-	H	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Introduction to Cloud Computing Evolution of cloud computing	Cloud enabling technologies- Broadband networks and Internet architecture	Introduction to Cloud Data Storage, The evaluation of storage technology	Fundamental Cloud Security	Cloud Application Development and Architectural Styles
	SLO-2				Basic Terms and Concepts	
S-2	SLO-1	Network-Centric Computing	Data Center Technology	Storage Models	Threat Agents, Cloud Security Threats	MapReduce Programming Model
	SLO-2	Network-Centric Content				
S-3	SLO-1	Origin of Cloud Computing, Basic Concepts and Terminology	Web Technology	File Systems and databases	Cloud Security Mechanisms	Case Study: the GrepTheWeb Application
	SLO-2		Multitenant Technology			
S-4	SLO-1	Goals and Benefits	Service Technology Virtualization Technology	Distributed File Systems Google File System	Encryption Hashing	Hadoop: Yarn and Tez
	SLO-2	Risks and Challenges, Roles and Boundaries, Cloud Characteristics				
S-5	SLO-1	Cloud Service Models	Virtual Machines	HDFS	Digital Signature, Public Key Infrastructure	SQL on Hadoop: Pig, Hive, and Impala
	SLO-2	Cloud Deployment Models		NoSQL Databases		
S-6	SLO-1	Cloud Service Providers and the Cloud Ecosystem	Full Virtualization and Para-virtualization	Cloud Databases (HBase, MongoDB, Cassandra, DynamoDB)	Identity and Access Management, Single Sign-On: Kerberos authentication	Current Cloud Applications and New Opportunities
	SLO-2					

S-7	SLO-1	*Amazon Web Services(AWS), Google Clouds,*	*Hardware Support for Virtualization*	*Cloud Object Storage (Amazon S3, OpenStack Swift, Ceph)*	*One-time password, Basic cloud data security mechanisms*	*Design approaches with Case Study*
	SLO-2	*Microsoft Azure Cloud*				
S-8	SLO-1	*SLA Management in Cloud Computing: A Service*	*Kernel-Based Virtual Machine, Hypervisors*	*Data Storage for Online Transaction Processing Systems*	*Virtual Machine Security, Security of Virtualization, A Trusted Hypervisor*	*Design methodology for IaaS Service Model*
	SLO-2	*Providers Perspective*				
S-9	SLO-1	*Case Study on Open Source & Commercial*	*Containers; Docker Containers, Kubernetes*	*Disk Locality versus Data Locality in Computer Clouds*	*Mobile Devices and Cloud Security*	*Google API, AWS EC2 Instances.*
	SLO-2	*Clouds: Eucalyptus, OpenStack, Aneka*				

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. *Thomas Erl, ZaighamMahmood, and RichardoPuttini, "Cloud Computing: Concepts, Technology & Architecture", Prentice Hall/PearsonPTR, Fourth Printing, 2014, ISBN: 978013338752.*	4. *K. Chandrasekaran, "Essentials of Cloud Computing", Chapman and Hall/CRC Press, 2014, ISBN 9781482205435* 5. *Arshdeep Bahga, Vijay Madisetti, "Cloud Computing: A Hands-On Approach", University Press, 2016, ISBN-13: 978-0996025508.*

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
SuriyadeepanRamamoorthy *Research Engineer at Saama Technology* *Puducherry, Puducherry, India* *Information Technology and Services*	*Dr.E. Ilavarasan* *Professor,CSE* *Pondicherry Engineering college.*	1.Mrs Krishnaveni,SRMIST,KTR-SWE
		2.Dr.S.Ramamooorthy,SRMIST,KTR-CSE
		3.Mr.K. Venkatesh,SRMIST,KTR-IT
		4.Mr. S.VidhyaSagar,SRMIST,Vadapalani campus

Course Code	18CSE377T	Course Name	DATA CENTRIC 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		Computer Science and Engineering	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 :	Critically discuss data center networking technologies																			
CLR-2 :	Evaluate key concepts in modern Layer 2 & Layer 3 data center networks																			
CLR-3 :	Concepts related to networking technologies in modern data centers.																			
CLR-4 :	Design, build and configure complex routed and switched networks																			
CLR-5 :	Expose to implementing the networking solutions in a virtualized environment																			

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 :	apply networking technologies in data centers	1	90	85	L	-	-	M	-	-	-	-	-	-	-	-	H	L	-	-
CLO-2 :	Design modern data centers which incorporate all dynamic routing protocols.	3	85	80	M	M	H	H	H	-	-	-	-	-	-	-	H	M	H	-
CLO-3 :	Design layer 2 and layer 3 protocols.	3	85	80	M	H	H	H	H	-	-	-	-	-	-	-	H	M	H	-
CLO-4 :	design and configure the data centers	3	80	75	M	H	H	H	H	-	-	-	-	-	-	-	H	H	H	-
CLO-5 :	implement various network solutions for data centers	3	80	75	H	H	H	H	H	H	-	M	-	-	-	H	M	H	H

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Data centric networking from different perspectives	Introduction to data center architectures	Introduction to server Architectures	Introduction to Layer 2 Networks	Introduction to Layer 3 Networks
	SLO-2					
S-2	SLO-1	Content-Centric Networking (CCN)	Top of rack (TOR)network connectivity	Clustering in server architectures	IEEE 802.3ba standards	Layer 3 Data Center technologies
	SLO-2					
S-3	SLO-1	Content Distribution Networks (CDN)	End of rack(EOR) network connectivity	scaling in server architectures	40 Gbps and 100 Gbps Ethernet	LocatorIdentifier Separation Protocol (LISP)
	SLO-2					
S 4-5	SLO-1	Requirements for modern data centers	Solutions that reduce cabling in architecture	Optimization in server architectures	IEEE 802.1D Spanning Tree Protocol (STP)	Layer 3 Multicasting
	SLO-2					
S-6	SLO-1	Design for flexibility	Solutions that reduce power in architecture	Stand-alone blades	RSTP protocol	Protocols; IPv4, IPv6
	SLO-2					
S-7	SLO-1	Design for scalability	TIA/EIA-942. Structured cabling standards	Redundant Layer 2 and Layer 3 designs	PVST protocol	Protocols; MPLS, OSPF
	SLO-2	Design for environmental control			MSTP protocol	
S-8	SLO-1	Design for electrical power	Cable management	Limitation of traditional server deployments	TRILL protocols	Protocols; IS-IS, BGP
	SLO-2	Design for Backup	Bandwidth requirements		IEEE 802.1Qbg Edge Virtual Bridging	
S-9	SLO-1	Flooring in data centers	I/O connectivity	Case study	Fiber Channel over Ethernet (FCoE) vs Internet	OTV& VPLS layer 2 extension
	SLO-2					

| Learning Resources | 1. MouricioArregoces,"Data Centre Fundamentals",CiscoPress,2003
2. SilvanoGai,Claudio DeSanti,"I/O Consolidation in the Data Center" Cisco Press;1 edition [ISBN:9781587058882].2009.
3. KevinCorbin,Ron Fuller,DavidJansen,"NX-OSand CiscoNexus Switching:Next-Generation Data Center Architectures"CiscoPress;1 edition [ISBN:9781587058929],2010.
4. Silvano Gai,Tommi Salli,RogerAndersson,"Cisco Unified Computing System" CiscoPress;1edition,[ISBN:9781587141935],2010. | 5. NashDarukhanawalla,Patrice Bellagamba,"Interconnecting Data Centers Using VPLS"CiscoPress;1edition,[ISBN:9781587059926],2009.
6. RobertW.Kembel,Roger Cummings(Introduction),"The Fibre Channel Consultant" Northwest Learning Assoc;3rdedition,[ISBN:0931836840],1998.
7. Robert W Kembal"FiberChannelSwitchedFabric"Northwest Learning Associates,inc.[ISBN:0931836719],2009.
8. JohnL.Hufferd,"ISCSI",Addison-WesleyBoston[ISBN:978-0201784190],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
Dr.M.S.Sricharan/Wipro Technologies		Dr. B.Amutha, Professor and Head, Department of CSE, SRM IST
		Dr. G.Vadivu, Professor and Head, Department of IT, SRM IST

Course Code	18CSE343T	Course Name	WEB APPLICATION 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		Computer Science		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 :	Generate web pages using HTML,CSS, AJAX, JQUERY																			
CLR-2 :	Design and implement dynamic web page with validation using JavaScript objects and by applying different event handling mechanisms.																			
CLR-3 :	Understand web site dynamic behavior and server side Programming																			
CLR-4 :	Generate dynamic web pages using databases																			
CLR-5 :	To understand the different web development frameworks																			

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 knowledge of HTML,CSS, AJAX, JQUERY	2	80	85	M		H	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	Design the dynamic web page with validation using JavaScript objects and by applying different event handling mechanisms	2	75	80	M		H		-	-	-	-	-	-	-	-	-	-	-
CLO-3 :	Acquire the knowledge of web site dynamic behavior and server side Programming	2	85	80	M		H		H	-	-	-	-	-	-	-	-	-	-
CLO-4 :	Develop the dynamic web pages using databases	2	80	75	M		H	-	-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	Understand the web development frameworks	2	75	85	M	-	H		H	-	-	-	-	-	-	-	-	-	-

Duration (hour)		11	9	9	7	9
S-1	SLO-1	Introduction: Rich Internet Applications	Introduction Angular JS	Overview of JSP2	Struts Architecture	Web Services
	SLO-2					
S-2	SLO-1	Introduction to HTML	Expression	Overview of SERVLET	Struts classes , Action Forward	Consuming a RESTfull Web Service Java desktop application /JSP
	SLO-2	HTML5 : Responsive web design			Action Form	Building REST Service with spring
S-3	SLO-1	Introduction about CSS	Module ,Directive Databinding	Creating dynamic web pages using JSP	Action Servlet	Spring Security Architecture
	SLO-2	CSS types			Action classes	
S-4	SLO-1	Introduction to JavaScript	Controllers,Scope-Filter	Standard-Tag Library	Understanding struts	Accessing relational data using JDBC with spring
	SLO-2			Java Beans , Custom Tags	config.xml	
S-5	SLO-1	Control structure	Introduction to Mongo, DB-Documents	Relational Database	Understanding Action Mappings, Struts flow with an example application	Uploading Files using spring application
	SLO-2			Introduction to MYSQL		
S-6	SLO-1	Objects	Collection-Database	JBDC-Driver	Struts Tiles Framework	Validating form input
	SLO-2					Handling form submission
S-7	SLO-1	Events	Datatypes	Understanding JDBC ODBC Connection Management	Struts Validation Framework	Creation of Batch Service
	SLO-2					Securing web application
S-8	SLO-1	Basic AJAX, History of AJAX	Creating, Updating	Resultset, Statements		Integrating Data
	SLO-2	AJAX - using XMLHttpRequest object				Accessing data with MongoDB
S-9	SLO-1	XML- and DOM , creating a full scaled web design	Deleting documents-Querying	Prepared statement, Callable Statement.		Creating asynchronous method,

	SLO-2	AJAX- Enabled Application using JSON.					Using WebSocket to build an interactive web application
S10	SLO-1	JQuery basic					
	SLO-2	jQuery core, events, effects,					
S11	SLO-1	plugins- user interface using jQuery.					
	SLO-2						

Learning Resources	1. Deitel ,Deitel and Nieto, "Internet and World Wide Web – How to program",4th Edition, Pearson Education Publishers,2009 2. EricFreeman,Elisabeth Robson,"HTML5Programming",firstedition,O'ReillyPublishers, 2011. 3. RobinNixon,"LearningPHP,My SQL, JavaScript, CSS & HTML5 "ThirdEdition, O'REILLY, 2014. 4. Marty Hall, "Core Servlet &Java Sever Pages " SunMicrosystems, 5. JamesHolmes"Struts:The Complete Reference,"2ndEdition2007McGrawHillProfessional. 6. Patrick Naughton, "COMPLETE REFERENCE: JAVA2", 7th edition,Tata McGraw-Hill, 2010.	7. ThomasApowell,"ThecompletereferenceHTML&CSS",5thEdition. 8. CraigWalls,"SpringinAction,4thEditionKindleEdition,ManningPublication,2015. 9. JobineshPurushothaman,"RESTfulJavaWebServices"SecondEdition,Packt Publishing,2015 10. https://www.w3schools.com/angular/angular_filters.asp 11. KristinaChodorow,MongoDB:TheDefinitiveGuide,2ndEdition,2013,OReilly.

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.M.Prakash Team Lead(Associate Consultant) ,Virtusa ,Chennai, prakashpm@virtusa.com	1. Dr.KHANNA NEHEMIAH , Professor, Ramanujan Computing, Anna University	1. Dr. M.UMA, Assistant Professor, SWE
		2. Dr.Madhavan, Associate Professor/CSE
		3.K.Navin AP/IT

Course Code	18CSE344T	Course Name	CLOUD ARCHITECTURE		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		Computer Science and Engineering	Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:		Learning			Program Learning Outcomes (PLO)															
CLR-1 :	Observe the fundamentals of cloud architecture		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-2 :	Observe the Technologies used in cloud platforms																			
CLR-3 :	Understand the advanced cloud architecture and storage arrays																			
CLR-4 :	Understand the importance of cloud architecture design																			
CLR-5 :	Gain knowledge in virtualization architecture																			
CLR-6 :	Gain knowledge in future trends and technologies in cloud structures																			

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 :	To understand the concept of basic cloud computing paradigms	2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	To interpret the concepts of Cloud service structures	2	75	80	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-3 :	To Analyze the components of cloud computing showing how business agility in an organization can be created	2	85	80	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	To be familiar with the market service providers in cloud.	2	80	75	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	To understand the technologies of data center cloud structures.	2	75	85	H	-	-	H	-	-	-	-	-	-	-	-	-	-	-
CLO-6 :	To work with robust cloud architectural patterns	2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Introduction to cloud computing fundamentals	Service Oriented Architecture	Introduction to cloud storage infrastructures	Management Of Cloud Services	Introduction to Cloud Architecture patterns
	SLO-2	Cloud Computing definition	REST	Concept, planning and Design	Reliability, availability and security of services deployed from the cloud	Horizontally Scaling Compute Pattern-Cloud Significance
S-2	SLO-1	Cloud deployment models	Systems of Systems	Business continuity	Performance and scalability of services	Queue-Centric Workflow Pattern
	SLO-2	Private, Public , Hybrid, community cloud	Web Services	Basic concepts of information security	Tools and technologies used to manage cloud services deployment	Auto-Scaling Pattern
S-3	SLO-1	Cloud services:	Publish-Subscribe Model	Managing VDC and cloud environments and infrastructures	Cloud Economics	Eventual Consistency Prime
	SLO-2	IaaS, PaaS, SaaS	Basics of Virtualization	Securing storage in virtualized and cloud environments	Cloud Computing infrastructures available for implementing cloud based services	MapReduce Pattern
S-4	SLO-1	Enabling technologies of cloud computing	Types of Virtualization	Monitoring and management	Economics of choosing a Cloud platform for an organization	. Database Sharding Pattern
	SLO-2	Benefits and challenges of cloud computing	Implementation Levels of Virtualization	Security auditing and SIEM	Runtime Support Services	Node Failure Pattern
S-5	SLO-1	Business Agility:	Virtualization Structures	Storage Network Design	Resource Provisioning and Platform Deployment-Provisioning of Compute Resources (VMs)	Network Latency Primer
	SLO-2	Benefits and challenges to Cloud architecture.	Tools and Mechanisms	Architecture of storage, analysis and planning.	Resource Provisioning Methods	CDN Pattern.

S-6	SLO-1	Cloud Applications	Virtualization of CPU Memory	Storage network design considerations	NIST Cloud Computing Reference Architecture	Multisite Deployment Pattern
	SLO-2	Application availability	I/O Devices	NAS and FC SANs	Demand-Driven, Event-Driven Resource Provisioning	Network connectivity optimization evolution: Top of rack (TOR), end of rack (EOR), connectivity.
S-7	SLO-1	Performance	Virtualization Support and Disaster Recovery	Hybrid storage networking technologies	Popularity-Driven Resource Provisioning	Stand-alone, blades, stateless,
	SLO-2	Security and disaster recovery	Server Virtualization	iSCSI, FCIP, FCoE	Dynamic Resource Deployment	clustering
S-8	SLO-1	Next generation of Cloud Applications.	Parallel Processing	Design for storage virtualization in cloud computing	Storage-as-a-Service	scaling
	SLO-2	Virtualization	Vector Processing	host system design considerations	Advantages of Cloud Storage - Global Exchange of Cloud Resources	optimization, virtualization.
S-9	SLO-1	Types of virtualization in cloud computing	Symmetric Multiprocessing Systems	Cloud Applications	Application Development	Limitation of traditional server deployments
	SLO-2	Advantages and Disadvantages	Massively Parallel Processing Systems	Technologies and the processes required when deploying web services	Service creation environments to develop cloud based applications	Case studies

Learning Resources	1. GautamShroff,"EnterpriseCloudComputingTechnologyArchitectureApplications",Cambridge University Press; 1 edition, [ISBN: 978-0521137355],2010. 2. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing, A Practical Approach" McGraw-Hill Osborne Media; 1 edition [ISBN: 0071626948],2009 3. Greg Schulz, "Cloud and Virtual Data Storage Networking", Auerbach Publications [ISBN: 978-1439851739],2011 4. EMC,"InformationStorageandManagement"Wiley;2edition[ISBN:978-0470294215],2012. 5. VolkerHerminghaus,AlbrechtScriba,"StorageManagementinDataCenters"Springer;editioN[ISBN: 978-3540850229].2009.	6. KlausSchmidt,"HighAvailabilityandDisasterRecovery"Springer;edition[ISBN:978-3540244608],2006. 7. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, "Distributed and Cloud Computing, From Parallel ProcessingtotheInternetofThings",MorganKaufmannPublishers,2012. 8. Rittinghouse, John W., and James F. Ransome, ―Cloud Computing: Implementation, Management and Security‖, CRC Press, 2017. 9. SilvanoGai,ClaudioDeSanti,"I/OConsolidationintheDataCenter"CiscoPress;1edition[ISBN: 9781587058882].2009. 10. 2. Bill wilder, Cloud Architecture patterns,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
Mr. Anil Nayer, JPA solutions	Dr. Kanagachidambaresan, Professor, PSG-Tech	Mr K. Venkatesh, SRMIST
		Dr Ramamoorthy, SRMIST
		Mr Vinoth, SRMIST

Course Code	18CSE441T	Course Name	CLOUD APPLICATION 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		Computer Science and Engineering		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 :	Utilize the different types of cloud services																		
CLR-2 :	Utilize the different storage services																		
CLR-3 :	Utilize different algorithms for cloud computing																		
CLR-4 :	Utilize virtualization techniques																		
CLR-5 :	Utilize real-time cloud services from different vendors																		
CLR-6 :	Utilize and understand cloud services with real-time cloud 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 Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO – 1	PSO – 2	PSO – 3
CLO-1 :	Understand different cloud architecture and models	3	80	70	L	H	-	H	L	-	-	-	L	L	-	H	-	-	-
CLO-2 :	Create the different types of cloud applications using different languages	3	85	75	M	H	L	M	L	-	-	-	M	L	-	H	-	-	-
CLO-3 :	Understand the concepts of virtualization	3	75	70	M	H	M	H	L	-	-	-	M	L	-	H	-	-	-
CLO-4 :	Create simple cloud applications and deploy	3	85	80	M	H	M	H	L	-	-	-	M	L	-	H	-	-	-
CLO-5 :	Understanding cloud application paradigms	3	85	75	H	H	M	H	L	-	-	-	M	L	-	H	-	-	-
CLO-6 :	Analyze different cloud technologies and its implementations	3	80	70	L	H	-	H	L	-	-	-	L	L	-	H	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Introduction to cloud computing	Cloud Computing: Applications	Server virtualization	Amazon Web Services: EC2 Instances	Case studies – IaaS, PaaS, SaaS
	SLO-2	Cloud deployment models	Challenges for Cloud Computing	Hypervisor- based virtualization	Connecting Clients to Cloud Instances Through Firewalls	IaaS
S-2	SLO-1	business drivers for Cloud Computing	Existing Cloud Applications and New Application Opportunities	Techniques for Hypervisor	Security Rules for Application Layer Protocols in EC2	Storage as a Service
	SLO-2	cloud computing Delivery Models	Architectural Styles for Cloud Applications	Hardware support for Virtualization	Security Rules for Transport Layer Protocols in EC2	Storage as a Service – Amazon storage service S3
S-3	SLO-1	cloud computing Services	Workflows: Coordination of Multiple Activities	VMware virtualization software	How to Launch an EC2 Linux Instance and Connect to it	Compute as a service
	SLO-2	challenges of cloud computing	Coordination Based on a State Machine Model	XenServer Virtual Machine Monitor	How to Use S3 in Java	Compute as a service – Amazon EC2
S-4	SLO-1	Cloud Infrastructure : cloud computing at Amazon	The Zookeeper	Storage Virtualization	How to Manage SQS Services in C#	PaaS
	SLO-2					
S-5	SLO-1	Cloud computing The Google perspective	Scalable data storage techniques	File virtualization	How to Install the Simple Notification Service on Ubuntu	Microsoft Azure
	SLO-2	Microsoft Windows Azure	The MapReduce Programming Model	Example	Example	Google App Engine
S-6	SLO-1	Microsoft Windows Azure services	RIAs, simple Hello world example	Block Virtualization	How to Create an EC2 Placement Group	Apache hadoop

	SLO-2	Open-Source Software Platforms for Private Clouds	Client-server example , RSS Feed Reader	Examples	How to Use MPI	Yahoo Mashups
S-7	SLO-1	Cloud Storage Diversity, Cloud Storage Vendor lock-in	Advanced platform functionality	Grid Computing	Hadoop Ecosystem	SaaS : CRM as a Service
	SLO-2	Cloud Computing Inter-operability	Clouds for Science and Engineering	Grid Technologies	How to Install Hadoop on Eclipse on aWindows System	Salesforce.com
S-8	SLO-1	The inter cloud , Responsibilities of User	High-Performance Computing on a Cloud , social Computing , Digital Content	comparing Grid and Cloud	Cloud-Based Simulation of a Distributed Trust Algorithm	Social Computing services : What Constitutes Social computing?, Case study - Facebook
	SLO-2					
S-9	SLO-1	Responsibilities of service provider	Cloud computing	Creating sample hello world application in OpenShift	A Cloud Service for Adaptive Data Streaming	Micro Blogger : Twitter
	SLO-2	Responsibility Sharing Between User and Cloud Service Provide	A Case Study: The GrepTheWeb Application	Example	Cloud-Based Optimal FPGA Synthesis	Document services

Learning Resources	1. Dinkar Sitaram, Geetha Manjunath, Moving To The Cloud: Developing Apps in the New World of Cloud Computing, Syngress,2013. 2. DanC.Marinescu,CloudComputing:TheoryandPractice.,MorganKaufman,2013	3. AMichael P. McGrath, Understanding PaaS: Unleash the Power of Cloud Computing, O'Reilly Media,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
Mr. Venkatesh Varalu, New YorkTimes, USA	Dr. Balaraman Ravindran, Professor, IITM	Mr. Venkatesh, SRMIST Dr Pradeep Mohan Kumar, SRMIST Mrs Krishnaven, SRMISTi

Course Code	18CSE442T	Course Name	CLOUD SECURITY		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	Computer Science and Engineering	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1 :	To understand the concept of cloud security
CLR-2 :	The issues related to virtualized infrastructure security
CLR-3 :	To have knowledge on the various issue in cloud security
CLR-4 :	To Learn the methods to improve virtualization security and technologies in security
CLR-5 :	Understand the cloud contracting Model and case study of commercial cloud

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
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLO-1 :	Articulate the main concepts of cloud security	3	80	70	L	H	L	H	L	M	H	L	L	L	L	H	H	L	M
CLO-2 :	Explain the architecture design of cloud storage.	3	85	75	H	H	L	M	L	M	H	L	M	L	H	H	L	H	L
CLO-3 :	Explain the core issues of cloud management and security	3	75	70	H	H	H	H	H	M	L	L	M	L	M	H	M	M	M
CLO-4 :	Be able to install and use current cloud Technologies.	3	85	80	H	H	H	H	H	L	L	L	M	L	M	H	L	L	H
CLO-5 :	Apply secure design for cloud Models	3	85	75	H	H	H	H	L	M	L	L	M	L	M	H	L	M	L

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Cloud Security Fundamentals-Infrastructure Security	Layered Cloud Architecture Design	Confidentiality, privacy, integrity, authentication,	IBM security virtual server protection	Authentication in cloud computing
	SLO-2	Network level security				
S-2	SLO-1	Host level security	NIST cloud computing Reference Architecture	non-repudiation, availability,	virtualization-based sandboxing	Client access in cloud
	SLO-2	Application level security				
S-3	SLO-1	Data security and Storage	Public ,Private and Hybrid Cloud	access control, defence in depth, least privilege,	Cloud Storage	Cloud contracting Model
	SLO-2		IaaS,PaaS,SaaS			
S-4	SLO-1	Data privacy and security Issues,	Architectural design Challenges	How these concepts apply in the cloud, what these concepts mean and their importance in PaaS, IaaS and SaaS.	Security- HIDPS	Commercial and business considerations
	SLO-2					
S-5	SLO-1	Jurisdictional issues raised by Data location	Cloud Storage	Cryptographic Systems- Symmetric cryptography	log management	Case Study on Open Source & Commercial Clouds
	SLO-2					
S-6	SLO-1	Identity & Access Management	Storage-as-a-service	stream ciphers, block ciphers, modes of operation	Data Loss Prevention	X.509 certificates, OpenSSL.
	SLO-2					
S-7	SLO-1	Access Control	Advantages of Cloud storage	Public-key cryptography, hashing	Security Governance	Eucalyptus
	SLO-2					
S-8	SLO-1	Trust, Reputation	Cloud storage Provider	digital signatures, public-key infrastructures	Cloud security Challenges	Microsoft Azure
	SLO-2					
S-9	SLO-1	Risk	Storage Provider-S3	key management	Virtual Machine Security	Amazon EC2
	SLO-2					

Learning Resources	1. Tim Mather, SubraKumaraswamy, ShahedLatif, "Cloud Security and Privacy:An Enterprise Perspective on Risks and Compliance" O'Reilly Media; 1edition [ISBN: 0596802765], 2009. 2. Rittinghouse, John W., and James F. Ransome, ―Cloud Computing: Implementation, Management and Security, CRC Press, 2017. 3. Kai Hwang, Geoffrey C Fox, Jack G Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.	4. Ronald L. Krutz, Russell Dean Vines, "Cloud Security" [ISBN: 0470589876],2010. 5. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing – A Practical Approach, Tata Mcgraw Hill, 2009. 6. George Reese, "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud: Transactional Systems for EC2 and Beyond (Theory in Practice), O'Reilly, 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
Mr.T.Madhan, Team Leader, Tata Consultancy Services, siruseri Campus, Chennai.	Dr. R.Shyamala, Associate Professor [HOD-IT], Anna University College of Engineering Tindivanam.	1. Dr.R.Naresh
		2. Dr.MB.Mukesh krishnan

Course Code	18CSE443T	Course Name	BIG DATA ESSENTIALS	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		Computer Science and Engineering		Data Book / Codes/Standards	Nil

Course Learning Rationale (CLR):	The purpose of learning this course is to:		Learning			Program Learning Outcomes (PLO)														
CLR-1 :	Quick and easy approach to learn the fundamental concept of big data analytics	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-2 :	Understand the concept of Hadoop and installation																		
CLR-3 :	Get to know the concept of key value pair programming																		
CLR-4 :	Learn about Map Reduce and its features																		
CLR-5 :	Understanding and solving of case studies																		

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 :	The main objective is to provide the students the knowledge of big data analytics	1	90	85	L	-	-	M	-	-	-	-	-	-	-	H	L	-	-
CLO-2 :	The students are trained to have knowledge about the architecture, installation and command execution of Hadoop	3	85	80	M	M	H	H	H	-	-	-	-	-	-	H	M	H	-
CLO-3 :	Able to develop a Map Reduce application	3	85	80	M	H	H	H	H	-	-	-	-	-	-	H	M	H	-
CLO-4 :	Identify knowledge of Map Reduce and develop real world map reduce application	3	80	75	M	H	H	H	H	-	-	-	-	-	-	H	H	H	-
CLO-5 :	Apply knowledge and solve various case study problems	3	80	75	H	H	H	H	H	H	-	M	-	-	-	H	M	H	H

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Data, Data storage and Analysis	Introduction of Big data programming Hadoop, History of Hadoop	Introduction of Map Reduce	Map Reduce Types	Case studies
	SLO-2	Comparison with other systems- Distributed computing vs Big data Framework	The eco system and stack	Configuration API	Default Map Reduce map	Healthcare
S-2	SLO-1	Basis of Distributed computing, Need for Big data framework	The Hadoop Distributed File System (HDFS)	Configuring the Development Environment, Writing a Unit Test, Running Locally on Test Data	Input Formats	Telecom
	SLO-2					
S-3	SLO-1	Introduction to Big Data- Big data definition	Hadoop file system	Running on a Cluster	Output formats	Privacy preserving Data analytics: Smart Homes
	SLO-2	enterprise / structured data, social / unstructured data, unstructured data needs for analytics	Java interfaces to HDFS	Running on a Cluster	Output formats	Privacy preserving Data analytics: Smart Homes
S 4-5	SLO-1	What is Big Data, Big Deal about Big Data	Architecture overview	Tuning a Job ,Map Reduce Workflows How Map Reduce Works, The Map Reduce Anatomy of a Map Reduce Job run	Map reduce features- counters, built in counters, user defined java and streams counters	Data analytics in Intelligent transport system
	SLO-2					
S-6	SLO-1	Big Data Sources, Industries	Hadoop installation	Failures, Job Scheduling	Sorting	Detection and identification of

	SLO-2	using Big Data, Big Data challenges.				influential spreaders in social media data streams
S-7	SLO-1	Big Data Technology	Hadoop commands execution	Shuffle and Sort	Joins	Predictive analytics in insurance
	SLO-2	Old vs. New Approaches	Hadoop commands execution	The Map Side	Programming Real-World Map Reduce	Predictive analytics in insurance
S-8	SLO-1	Data Discovery	Hadoop I/O	The Reduce Side, Configuration Tuning	Weather dataset	Pricing analytics in consumer products
	SLO-2	Open-Source Technology for Big Data Analytics	Data Integrity	Task Execution	data with Unix	Pricing analytics in consumer products
S 9	SLO-1	The Cloud and Big Data	Compression	Task Execution	data with Hadoop	Analytics in banking sector
	SLO-2					

Learning Resources	1. MichaelMinelli,Michele Chambers,AmbigaDhiraj,"BigData,BigAnalytics-Emerging Business Intelligence and Analytic Trends forToday's Businesses",Wiley. 2. TomWhite,"Hadoop–TheDefinitiveGuide",O'Reilly	3. FrankOhlhorst,"BigDataAnalytics-TurningBigDataintoBigMoney",Wiley AlanAderson,David Semmelroth,"Statistics for BigData for Dummies",JohnWiley&sons

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. B.Amutha, Professor and Head, Department of CSE, SRM IST
		Dr. G.Vadivu, Professor and Head, Department of IT, SRM IST

Course Code	18CSE444T	Course Name	CLOUD STRATEGY PLANNING AND MANAGEMENT	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	Computer Science and Engineering	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 learn the concepts and technological advances fueling the rapid adoption of cloud computing today.	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-2 :	To provide the students with the skills and knowledge required to plan and manage a Cloud Computing strategy within an organization.	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 enable students to evaluate the strategic value of Cloud Computing using IT Governance and Compliance.																		

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																		
CLO-1 :	Strategically assess how cloud computing enables IT Transformation and business value in an organization.	2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	Analyze the role that cloud computing can play in the business process.	2	75	80	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-3 :	Evaluate how cloud computing and Service Oriented Architecture (SOA) can deliver business agility.	2	85	80	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	Implement IT governance to manage business realization from cloud IT services.	2	80	75	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	Critically appraise how the incorporation of cloud computing in an IT strategy can deliver on strategic business objectives.	2	75	85	H	-	-	H	-	-	-	-	-	-	-	-	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	The four pillars of cloud computing	Moving to a cloud architecture and strategy to achieve business value.	Develop an IT strategy to deliver on strategic business objectives in the business strategy	Shared services delivered by a Service Oriented Architecture (SOA) in a Private or Public Cloud	Benefit Realization and it Governance
	SLO-2	Cloud applications and Platforms				
S-2	SLO-1	Providing the cloud infrastructure	BPM, IS, Porter's Value chain model and BPR as a means of delivering business value	IT Project planning in the areas of ITaaS is essential in delivering a successful strategic IT Plan	Services, Databases and Applications on demand	Managing resources (people, process, technology), to realize benefit from Private/Public Cloud IT services
	SLO-2	Cloud computing, Spectral efficiency, Sensors and perspiration				
S-3	SLO-1	Strategic inflection points in information Technology	Developing Business Strategy: Investigate business strategy models to gain competitive advantage for organizations	IT Project planning in the areas of SaaSis essential in delivering a successful strategic IT Plan	The effect on Enterprise Architecture and its traditional frameworks such as Zachman).	Gartner's 5 pillars of benefit realization
	SLO-2	Cloud computing and its slogans	SWOT/PEST, Economies of scale, Porter's 3 Strategies and 5 Competitive Forces, D'Aveni's hyper competition models	IT Project planning in the areas of PaaSis essential in delivering a successful strategic IT Plan	The Open Group Architecture Framework (TOGAF).	IT governance as a service in measuring the delivery of IT Strategy from Cloud IT Services using Sarbannes Oxley (CobiT) and other commonly-used approaches
S-4	SLO-1	User centered solution and cloud computing	Emphasize the roles of the strategic IS/IT leaders such as Chief Information Officer (CIO)	IT Project planning in the areas of IaaSis essential in delivering a successful strategic IT Plan	Customer Relationship Management	High Technology for private banking and Asset Management
	SLO-2	For cloud vendors inflection point Is risk and opportunity				

S-5	SLO-1	Potential customers of cloud technology	The Chief Technology Officer (CTO) in planning and managing IT Strategic development in the organization.	Searching for an open architecture	Enterprise Resource Planning	Cloud Software for Private Banking
	SLO-2					
S-6	SLO-1	The cloud interests Small and Medium enterprises	Budgeting for cloud computing	Infrastructure as a Utility	Just-in-Time Inventories	Leadership Is based on Fundamentals
	SLO-2					
S-7	SLO-1	Virtual companies and the cloud	Service level agreements	Cloud System Architecture and its primitives	Machine-to-Machine and RFID Communications	Cloud Software For Asset Management
	SLO-2	Virtual networked objects				
S-8	SLO-1	Consumer technologies and the cloud	Outsourcing, Infrastructural inter dependencies, and the cloud	The User Organizations Business Architecture	Challenges Presented by Organization	Cloud Technology can Improve Fund Management
	SLO-2					
S-9	SLO-1	Social networks and multimedia messaging	Human resources at the CIO level	Financial Services Applications Architecture	Challenges Presented by Commercial vision	Criteria of Success in Asset Management Technology
	SLO-2		The transition from legacy to competitive system			

Learning Resources	1. Dimitris N. Chorafas: Cloud Computing Strategies, CRC Press, 2011. 2. Arnold J Cummins, "Easiest Ever Guide to Strategic IT Planning" http://strategicitplanningguide.com/.	3. David S. Linthicum, "Cloud Computing and SOA Convergence in Your Enterprise", Addison Wesley [ISBN: 0136009220], 2009. 4. Charles Babcock, "Management Strategies for the Cloud Revolution", 1st Ed., Tata McGraw/Hill [ISBN: 0071740759],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
Mr.Saju G Nair, IBM,Bangalore,sajugnair@gmail.com	Dr.Khanna Nehemiah H, Professor, Ramanujan Computing Centre, Anna University	Mrs.J D Dorathi Jayaseeli,CSE,SRM IST

Course Code	18CSE375T	Course Name	DISTRIBUTED 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		CSE		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 :	Layout foundations of Distributed Systems.																		
CLR-2 :	Get familiar with the idea of middleware and related issues																		
CLR-3 :	Understand in detail the system level and support required for distributed 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-4 :	Understand the issues involved in studying data and cryptographic algorithms																		
CLR-5 :	Expose to the concept of design and implementation of distributed file systems																		

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																		
CLO-1 :	Fundamentals of Distributed System Concepts and access System	2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	An ability to familiar with various architecture models and Distributed File access techniques	2	75	80	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-3 :	An ability to understand the security aspects of distributed system	2	85	80	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Introduction to Distributed Systems	Distributed Computing Model	Remote Procedure Call	Introduction of Security systems in distributed system	Distributed File Systems –Introduction
	SLO-2				Potential attacks and threats on computer systems	
S-2	SLO-1	Characterization of Distributed Systems	Workstation model	Remote method invocation	Cryptography	File Service Architecture
	SLO-2	Examples of Distributed Systems	Workstation server model		Symmetric cryptosystem algorithm –DES	
S-3	SLO-1	Architecture of Distributed Systems	Process pool model	Client server model basics concepts	Asymmetric cryptosystems	File Models
	SLO-2	Shared and Distributed Memory Architechture	Comparison of Distributed computing model	Client server addressing		
S-4	SLO-1	Focus on resource sharing the web	Interprocess Communication	Client server implementations	Secure Channels-Authentication	DFS Design
	SLO-2				Message Integrity and confidentiality	
S-5	SLO-1	Challenges in Distributed Systems	External data representation and multicast Communication	Client Server Architecture	Access control	DFS implementation
	SLO-2					
S-6	SLO-1	Design issues in Distributed systems	API for Internet protocol	Group Communication publish and subscribe systems	Security Management	File catching in DFS
	SLO-2				Issues in key distribution	
S-7	SLO-1	Networking and Internetworking basic introduction Types of Network	Network Virtualization and overlay networks	Shared memory approach	Secure group management	Implementation in DFS
	SLO-2			Distributed objects	Authorization management	

S-8	SLO-1	Network Principles	Case Study : interprocess Communication in UNIX	Case study : java RMI	Case study - Kerberos	Case study – Sun network File systems
	SLO-2					
S-9	SLO-1	Internet protocol	Case study - MPI	Case Study - CORBA	Case study - Epayment	Case study - Google File systems
	SLO-2					

Learning Resources	1. GeorgeCoulouris,JeanDollimore,TimKindberg,"DistributedSystemsConceptsandDesign"Fifth edition – 2011- AddisonWesley 2. SunitaMahajan,SeemaShah,"DistributedComputing"SecoundEdition–OxfordPress	3. Liu M.L., "Distributed Computing, Principles and Applications", Pearson and education,2004. 4. Tanenbaum A.S., Van Steen M., " Distributed Systems: Principles and Paradigms" , PearsonEducation,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
1. Mr. M.Ravichandran,CEO, Terafast	1.. Dr.K.Vivekanadan, Professor,PEC,k.vivekanandan@pec.edu	1. Dr. A.Murugan , SRMIST
2.		2. Dr. G.Maragatham,SRMIST 3. Ms. S. Aruna ,SRMIST

Course Code	18CSE376T	Course Name	OPTICAL 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		CSE			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 :	Study the fundamentals of optical networks																		
CLR-2 :	Gather knowledge about different types of components																		
CLR-3 :	Learn single hop and multi hop networks	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-4 :	Acquire knowledge about different WDM network design																		
CLR-5 :	Understand about OADM architecture																		
CLR-6 :	Gather knowledge about optical TDM and CDMA																		

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																		
CLO-1 :	Acquire knowledge about basic fundamentals of optical networks	2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	Understand various classifications of optical components	2	75	80	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-3 :	Develop the ability to apply optical concepts in single and multihop networks	2	85	80	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	Gather knowledge about various multiplexing techniques	2	80	75	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	Acquire knowledge about OADM concept	2	75	85	H	-	-	H	-	-	-	-	-	-	-	-	-	-	-
CLO-6 :	Apply various techniques to handle spectrum with a different perspective	2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Introduction to optical networks	Components :Couplers – Principle of operation	Broadcast optical networks – characteristics of single hop networks	WDM Network Elements :Optical line terminals	Optical TDM Networks
	SLO-2	TeleCommunication Network Architecture and services	Conservation of energy	Experimental WDM Systems	optical line amplifiers	Basics of TDM
S-2	SLO-1	Optical Networks- Multiplexing Techniques	Isolators	Other Non – Pretransmission Coordination protocols	Optical Add/Drop Multiplexers	Optical TDM
	SLO-2	Second Generation Optical Networks	Circulators	Pretransmission coordination protocols	OADM Architecture	Optical Sources
S-3	SLO-1	Optical Layer	Multiplexers – Gratings, Diffraction Patterns	Special Case: Linear Bus with Attempt- and-Defer Nodes	Optical crossconnects	Modulation
	SLO-2	Optical packet switching	Bragg and Fiber Gratings	AMTRAC and multichannel probabilistic scheduling	OXC Configurations	multiplexing
S-4	SLO-1	Transmission Basics – wavelengths, Frequencies, and channel spacing	Filters – fabryperot filters	Single- Hop Case study : IBM Rainbow Protocol	WDM Network Design: Cost trade-offs	Transmission of Ultrafast OTDM signal using soliton
	SLO-2	Standards, optical power and loss	Mach-Zehnder Interferometers, Arrayed Waveguide gratings	Model, Analysis	LTD and RWA problems	Demultiplexing
S-5	SLO-1	WDM Networking Evolutions	Optical Amplifiers – Emissions	Multihop Networks: characteristics, topological optimization studies	Light path topology design	Clock Recovery
	SLO-2	WDM Network Constructions	Erbium -Doped fiber amplifiers, Raman Amplifiers and Semiconductor optical amplifiers	Regular structures	Routing and wavelength assignment and conversion	Optical processing

S-6	SLO-1	Optical Fiber- Transmission	Transmitters – Lasers, Light emitting diodes,tunable lasers	Near- Optimal Node Placement	Dimensioning Wavelength	Optical TDM network Architectures
	SLO-2	Single mode vs Multimode fiber	Direct and external modulation, pump sources	Shared- channel multihop systems	Routing Networks	Optical TDM proposals
S-7	SLO-1	Attenuation in Fiber	Detectors – photo detectors	Multihop case study – GEMNET	Statistical Dimensioning Models : First passage model	Optical CDMA Networks:
	SLO-2	Dispersion in Fiber	Front end amplifiers	GEMNET Architecture and properties	Blocking model	Basics of CDMA
S-8	SLO-1	Non Linear Effects – self phase modulation	Switches – large optical switches, optical switch technologies	Channel sharing	Maximum load dimensioning model : offline lightpath requests	Spread spectrum
	SLO-2	Cross phase modulation	Large electronic switches	Multicasting	Online RWA in rings	Code sequences
S-9	SLO-1	Solitons	Wavelength converters – optoelectronic Approach, optical gating	Shared – channel Multihop GEMNET	Access Networks : Network Architecture overview	CDMA Example
	SLO-2	Dispersion- Managed Solitons	Interferometric techniques, wave mixing	Performance Evaluation	Enhanced HFC	Optical CDMA

Learning Resources	1. Rajiv Ramaswami, Kumar N. Sivarajan, Galen H. Sasaki, Optical Networks A Practical Perspective, thirdEdition 2. OpticalSwitchingNetworks:Mayer&Martin,CambridgeUniversityPress,2008.	3. U.Black,"OpticalNetworks:ThirdGenerationTransportSystems"/PearsonEducations 4. R.Ramaswami,&K.N.Sivarajan,"OpticalNetworksaPracticalperspective",MorganKaufmann Publishers, 3rdEd.

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. Madhumaran, NOKIA digital and Networking, Technical Lead, p.madhumaran@nokia.com	1. Prof. NilanjanDey, Techno India College of Technology , Kolkata, nilanjan.dey@tict.edu.in	1. Prof. V.Sivakumar, SRMIST
2. Mr. N.Ramkumar, TCS Assistant Consultant, ram.kumarn@tcs.com	2. Prof. E.Rajesh, GalgotiasUniversity,Delhi, rajesh.e@galgotiasuniversity.edu.in	2. Prof. P.Visalakshi, SRMIST

Course Code	18CSE379T	Course Name	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		CSE		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 IoT and its possible application areas																		
CLR-2 :	Understand the various IoT architectures along with compute and management stack across layers																		
CLR-3 :	Understand the architecture dissected at physical, Communication and Access levels																		
CLR-4 :	Introduce existing toolkits, available platforms, boards, software and laguages for easy development of IoT products																		
CLR-5 :	Understand the various enabling technologies for IoT including Big data analytics, Machine learning, Cloud and Streaming analytics																		
CLR-6 :	Understand the underlying business model for IoT and also acquire skills for DiY (Do it Yourself)																		

Column headers for Learning: Level of Thinking (Bloom) / Expected Proficiency (%) / Expected Attainment (%)

Column headers for PLO: 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

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

		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLO-1 :	Appreciate the omnipotent presence of IoT in all fields across globe	2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	Compare and contrast various architectures and be able to justify the right choice for adoption	2	75	80	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-3 :	Choose appropriate protocols for various levels/layers based on the requirement in hand	2	85	80	H	M	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	Implement using the available resources and demonstrate quick to deployment sills wherever applicable	2	80	75	H	H	H	M	-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	Apply the tools and techniques towards integration in relevant areas of IoT product development	2	75	85	H	M	H	M	H	-	-	-	M	-	-	H	-	-	-
CLO-6 :	Showcase DiY approach given any implementable idea to product	2	80	85	H	M	H	H	H	-	-	-	H	-	-	H	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Introduction to IOT	Drivers Behind New Network Architectures	Smart Objects: The "Things" in IoT	Data Analytics for IoT- Overview	Business Models for IoT: Introduction
	SLO-2	What, Where and How of IoT?	Comparing IoT Architectures	Sensors, Actuators, and Smart Objects	IoT Data Analytics Challenges	Business Models
S-2	SLO-1	Data Flow of IoT	The IoT World Forum (IoTWF) Standardized Architecture	Micro-Electro-Mechanical Systems (MEMS)	Relevance of ML and IoT- Overview	Business Model Innovation
	SLO-2	Definition and characteristics of IOT	IT and OT Responsibilities in the IoT Reference Model	Smart Objects,Smart Objects: A Definition	Relevance of Big data and IoT- Overview	Value Creation in IoT
S-3	SLO-1	Architecture of Internet of Things: Physical- Things	A simplified IoT architecture	Trends in Smart Objects	ML and getting Intelligence from Big Data	Laws of Information
	SLO-2	Architecture of Internet of Things: Protocols-an Introduction	The core IoT functional stack	Sensor Networks	Big data analytics tools and techniques for IoT: Overview	Revenue Generation in the Internet of Things
S-4	SLO-1	Architecture of Internet of Things: Logical- Functional Blocks	Layer 1: Things: Sensors Layer	Wireless Sensor Networks (WSNs)	MPP, NoSQL	Exemplary Business Model Scenarios for the Internet of Things
	SLO-2	Architecture of Internet of Things: Logical- Communication Models	Layer 1: Things: Actuators Layer	Communication Protocols for WirelessSensor Networks- a Introduction	Hadoop and YARN	Scenario 1: Product as a Service (PaaS)
S-5	SLO-1	Architecture of Internet of Things: Logical- Communication API	Layer 2: Communications Network Layer: Access, Gateway	Communication Criteria- Introduction	Hadoop Eco system	Scenario 2: Information Service Providers
	SLO-2	IOT enabling technologies	Layer 2: Communications Network Layer: Network, Management	Communication Criteria- Definitions	Apache Kafk, Spark, Storm, Flink,	Scenario 3: End-user Involvement

S-6	SLO-1	Introduction to IoT Levels and Deployments	Layer 3: Applications and Analytics Layer:	IoT Access Technologies-Introduction	Lamba Architecture	Scenario 4: Right-time Business Analysis and Decision making
	SLO-2	IoT Deployment Levels: 1 to 6	Analytics Versus Control Applications,	IoT Access Technologies-Definitions	Edge Streaming Analytics for IoT	DIY- Smart Experience (DiYSE) Projects- a introduction
S-7	SLO-1	IoT Security and Privacy	Data Versus Network Analytics	IoT Application transport methods- Definitions	Edge Analytics core functions	Requirements for Enabling DiY in Eco- awareness Applications
	SLO-2	IoT Data Analytics, Protocols	Data Analytics Versus Business Benefits	The Toolkit Approach for End-user Participation in the Internet of Things:	Distributed analytics systems	Technologies and Standards Relevant for DiY Eco-awareness
S-8	SLO-1	IoT Environmental challenges: excess waste disposal	Smart Services	Existing Toolkits	Network Analytics	Sensor-actuator Technologies and Middleware as a Basis for a DiY Service Creation Framework
	SLO-2	Legal Challenges for a Privacy Framework- an IoT perspective	Iot Data Management And Compute Stack: The Hierarchy Of Edge, Fog, And Cloud	I/O Boards	IoT physical servers and cloud offerings (Cloud computing for IoT)	Device Integration, Middleware Technologies
S-9	SLO-1	Privacy Enhancing Technologies for IoT	Fog Computing	HW Based Systems, Introduction to Open source boards (Arduino, Raspberry Pi and other variants)	Relevance of Cloud connectivity and IoT- Overview	Semantic Interoperability- a requirement for IoT DiY
	SLO-2	Case Studies: Domain specific IOT Applications	Edge Computing	SW Based Solutions	Logical design using Python, Useful IoT libraries	DiY Smart Experiences Service Framework-an Introduction

Learning Resources	1. ArshdeepBahga, Vijay Madisetti, "Internet of Things, A Hands -on Approach", 1st Edition 2015, University Press, ISBN: 978-81-7371-954-7 2. InternetofThings:LegalPerspectivesbyRolfH.Weber,RomanaWeber,Springer,2010 3. Uckelmann, D., Harrison, M., & Michahelles, F. (Eds.). Architecting the Internet of Things.doi:10.1007/978-3-642-19157-2 ,2011	4. IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things by Rob Barton, Gonzalo Salgueiro, David Hanes, Publisher: Cisco Press, Release Date: June 2017, ISBN: 9780134307091 (https://www.oreilly.com/library/view/iot-fundamentals-networking/9780134307091/)

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. Paventhan Arumugum, Director (R&D), ERNET India	Dr. S. Srinivasan, Professor and Head, Dept. of Computer Science & Engineering, Anna University, Madurai	Dr.Kayalvizhi Jayavel, SRMIST
Mr. Vinay Solanki, Head IoT, Lenovo (APAC & MEA)	Dr. R. Krishnamoorthy, Professor, Department of CSE and IT, BIT Campus, Anna University, Trichy	Dr. Sreekumar, SRMIST
Mr.Hariharan Ramalingam, Vertical Delivery Head, Wipro ltd	Dr.S.Chithra Selvaraj, Associate Professor, Department of IT, SSN College of Engineering	Mr.V.Haribaabu, SRMIST

Course Code	18CSE380T	Course Name	PERVASIVE 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		Computer Science and Engineering		Data Book / Codes/Standards	Nil

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning			Program Learning Outcomes (PLO)															
CLR-1 :	Understanding the basics of pervasive computing and its application	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-2 :	Gain knowledge on the voice enabling																		
CLR-3 :	Understand the fundamental elements of pervasive computing.																		
CLR-4 :	Learn the design process of Pervasive Computing Environments and its solutions																		
CLR-5 :	Familiarize with device connectivity & web applications concepts																		
CLR-6 :	Introduce the concepts of wearale computing and security in pervasive computing																		

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 :	Understand the fundamental elements of pervasive computing.	2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	Learn the design process of Pervasive Computing Environments and its solutions	2	75	80	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-3 :	Familiarize hardware, software and the aspects involved in pervasive computing	2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	Apply the knowledge for implementing security	2	80	75	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	Organize the functionalities and components of PDA in pervasive computing.	2	75	85	H	-	-	H	-	-	-	-	-	-	-	-	-	-	-
CLO-6 :	Describe the user interface issues in pervasive computing.	2	75	80	H	-	-	M	-	-	-	-	-	-	-	-	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	- INTRODUCTION	Device connectivity	WAP & VOICE TECHNOLOGY, WAP and Beyond: Introduction	Wearable Computing and Sensor Systems for Healthcare - Introduction	Security and Privacy in Pervasive Networks - Introduction
	SLO-2	Pervasive Computing: Past, Present and Future Pervasive computing	Protocols: wireless	Components of the WAP	The Health Body Area Network	Security Classics - Perimeter Security - Access Control
S-2	SLO-1	Pervasive Computing Market,	mobile phone technologies	architecture	Medical and Technological Requirements of Health Sensors	Hardening Pervasive Networks - Pervasive Computational Paradigms
	SLO-2	m-Business	mobile phone technologies	WAP infrastructure,	Wearable Sensors for Vital Signals Monitoring	Pervasive Hardware
S-3	SLO-1	Application examples: Retail,	mobile internet protocol	WAP security issues	Wearable Sensors for Activity Recognition	Pervasive Networking and Middleware
	SLO-2	Application examples: Airline check-in and booking,	mobile internet protocol	Wireless Markup Language	Sensors and Signals for Emotion Recognition	Pervasive Applications
S-4	SLO-1	Healthcare	Synchronization and replication protocol	WAP push	ntra-BAN Communications in Pervasive Healthcare Systems: Standards and Protocols - IEEE 802.15.4 and ZigBee	Pervasive Distributed Application
	SLO-2	Tracking, Car information system,	Synchronization and replication protocol	Products	Bluetooth	Logic Based Level Security
S-5	SLO-1	Sales Force Automation		i-Mode	Bluetooth Low Energy	Deterministic Access Models
	SLO-2	Email access via WAP and voice	distributed services	VoiceTechnology: Basics of Speech recognition,	Integrated and Additional Solutions for Health BAN Communications	Predictive Statistical Schemes

S-6	SLO-1	A Pervasive System for Volcano Monitoring	distributed message	VoiceTechnology: Basics of Speech recognition,	Introduction - Pervasiveness and Mobility in Computing and Communications	Privacy in Pervasive Networks - Problem Definition
	SLO-2	A Pervasive Computing Platform for Individualized Higher Education	transaction protocols	Voice Standards	Context Awareness	Challenges to Privacy Protection
S-7	SLO-1	Device Technology	Security	Voice Standards	Heterogeneity	Location Dependency
	SLO-2	Hardware,	Device Management		Wireless Technologies and Standards	Data Collection
S-8	SLO-1	Human machine interface	Web Application Concepts: WWW Architecture	Speech Applications,	Middleware	Internet Service Provider (ISP) Role
	SLO-2	Bio metrics,	Protocols	Speech Applications,	Future Trends: Beyond the Middleware	Data Ownership Private Systems
S-9	SLO-1	Operating systems	Transcoding	Speech and Pervasive Computing	Pervasive Computing in Extreme Areas; The Hiker's Personal Digital Assistant	Quality of Privacy (QoP)
	SLO-2	Java for pervasive devices	Client Authentication via Internet	Speech and Pervasive Computing	Pervasive Computing in Personal Health Systems; The MyHealthService Approach	Open Issues in Privacy of Systems 'Sharing' in Personal Networks

Learning Resources	1. JochenBurkhardt, Horst Henn, Stefan Hepper, Thomas Schaech & Klaus Rindtorff, "Pervasive Computing, Technology and Architecture of Mobile Internet Applications", Pearson Education,2012.ISBN-13: 978-0201722154 2. UweHansmann, L. Merk, M. Nicklous, T. Stober, U. Hansmann, "PervasiveComputing (Springer Professional Computing) ", 2003, Springer Verlag,ISBN:3540002189	3. S. Poslad, "Ubiquitous Computing: Smart Devices, Environments and Interactions," Wiley, 2009 4. Frank Adelstein, Sandeep KS Gupta, Golden Richard III, Loren Schwiebert, "Fundamentals of Mobile and Pervasive Computing", McGraw Hill edition, 2006. ISBN-13: 978-0071412377

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
Suganya Anbumani Director of Engineering, Wealth Management, Redi2 Technologies Greater Boston Area	1. Dr. J. Prakash, MIT, Chennai, prakaiit@rediffmail.com	1.Dr.V.Kavitha, SRMIST
Saranya A T Associate at Cognizant Chennai	2. 2.Dr. Latha Karthigaa, PhD , Innovation Research Assistant, The University of Auckland	2. Mr. Haribaabu V, SRMIST

Course Code	18CSE381T	Course Name	CRYPTOGRAPHY	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		Computer Science and Engineering		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 OSI security architecture and classical encryption techniques.																		
CLR-2 :	Acquire fundamental knowledge on the concepts of finite fields and number theory																		
CLR-3 :	Understand various block cipher and stream cipher models	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-4 :	Describe the principles of public key cryptosystems, hash functions and digital signature.																		
CLR-5 :	Gain a first-hand experience on encryption algorithms, encryption modes.																		

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																		
CLO-1 :	Implement the Classical Encryption Techniques.	2	80	85	H									H					
CLO-2 :	Comprehend fundamental concepts of finite field and number theory.	2	75	80	H														
CLO-3 :	Categorize block cipher modes of operation and comprehend digital signature functions	2	85	80	H														
CLO-4 :	Implement Public Key Cryptography and hash functions.	2	80	75	H							H							

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Introduction to Cryptography and Network Security	Groups, Rings, Fields	Block cipher principles-Introduction	Principles of Public-key Cryptosystems - Structure and key management	Message Authentication Codes
	SLO-2					
S-2	SLO-1	OSI Security Architecture	Modular arithmetic	Data Encryption Standard	Principles of Public-key Cryptosystems – Applications for Public-key Cryptosystems	Requirements for Message Authentication Codes
	SLO-2					
S-3	SLO-1	Introduction to Security attacks	Euclid's Algorithm	DES Example, Strength of DES	Requirements for Public-key Cryptosystems and Public – Key Cryptanalysis	Applications of Cryptographic Functions - Message Authentication
	SLO-2					Two Simple Hash Function
S-4	SLO-1	Security mechanisms	Polynomial Arithmetic	Block cipher Modes of operation – Multiple Encryption	RSA algorithm - Key management	Security Requirements for Cryptographic hash Functions
	SLO-2					
S-5	SLO-1	Symmetric cipher model	Finite Fields	Block cipher Modes of operation – Triple DES	RSA algorithm - Encryption and Decryption	Hash Algorithms - MD5
	SLO-2					
S-6	SLO-1	Substitution techniques: Caesar cipher	Prime Numbers, Testing for Primality	Electronic Code Book, Cipher Block Chaining Mode	Diffie Hellman key exchange – Algorithm, Key Exchange Protocols	Hash Algorithms - SHA
	SLO-2	Play fair Cipher		Cipher Feedback Mode, Output Feedback Mode and Counter Mode	Diffie Hellman key exchange – Man-in-the-Middle Attack	
S-7	SLO-1	Mono alphabetic cipher	Fermat's and Euler's Theorem	Advanced Encryption Standard – Structure and Transformation Functions	Elliptic curve: Arithmetic – Abelian Groups, Elliptic Curves over Real Numbers	Digital Signature Standard
	SLO-2	Poly alphabetic ciphers , Onetime pad		AES Key Expansion and AES Example		
S-8	SLO-1	Hill Cipher -Encryption	The Chinese remainder theorem	Blowfish	Elliptic Curves over Zp, Elliptic Curves over	Applications pertaining to Encryption

	SLO-2	Decryption			$GF(2^m)$	using different ciphers and modes
S-9	SLO-1	Transposition techniques, Steganography	Discrete Logarithms	RC5 algorithm	Elliptic Curve Cryptography	One-way hash algorithms.
	SLO-2					

Learning Resources	1. WilliamStallings,"CryptographyandNetworkSecurity",6th Edition, 2014,Pearson Education, ISBN:9789332518773. 2. AtulKahate,"CryptographyandNetworkSecurity",2nd Edition, 2009, McGraw Hil lEducation India Pvt Ltd,ISBN:100070151458.	3. WebTutorial: http://www.cis.syr.edu/~wedu/seed/cryptography.htmlas on 14/04/2016

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
1.Mohanraj N - PayPal	1. Dr. E.Sivasankar – Assistant Professor – NIT, Trichy	1.Dr.E.Sasikala, SRMIST
		2. Ms. S. Aruna, SRMIST
		3. Ms. G. Sujatha, SRMIST

Course Code	18CSE382T	Course Name	FORENSICS AND INCIDENT RESPONSE	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		Computer Science and Engineering		Data Book / Codes/Standards	Nil

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning			Program Learning Outcomes (PLO)															
CLR-1 :	Gain knowledge on the basics of procedures for identification, preservation of electronic evidence	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-2 :	Understand the purpose and usage of various forensic tools																		
CLR-3 :	Gain knowledge on how scientific evidence collection/extraction during investigation																		
CLR-4 :	Acquire knowledge on file systems and its innerworking																		
CLR-5 :	Understand the windows and linux investigation procedures																		
CLR-6 :	Introduce the report writingguidelines and principles																		

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 knowledge on basics of procedures for identification, preservation of electronic evidence	2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	Acquire the ability to identify the purpose and usage of various forensic tools	2	75	80	H	H	-	-	H	-	-	-	-	-	-	-	-	-	-
CLO-3 :	Understand how scientific evidence collection/extraction during investigation	2	85	80	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	Appreciate the concepts of file systems and its importance in forensic science.	2	80	75	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	Apply the knowledge of windows and Linux investigation procedures	2	75	85	H	-	-	H	-	-	-	-	-	-	-	-	-	-	-
CLO-6 :	Acquire the knowledge on forensic report writing guidelines and principles	2	80	85	H	-	-	-	-	H	-	-	-	-	-	-	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Introduction to Incident	Introduction to ACPO Principles	Introduction to File System Analysis	Introduction to Investigating Systems	Investigating Hacker Tools
	SLO-2	Goals of Incident Response	ACPO Principles of Computer Based Evidence	What is a File System?	Investigating Windows Systems	What are the goals of tool analysis?
S-2	SLO-1	Introduction to Incident Response Methodology (IRM)	Introduction to computer Storage Formats	Five Data Categories	Where Evidence resides on Windows Systems	How are files compiled?
	SLO-2	Steps in Incident Response Methodology	Understanding Storage Formats for Digital Evidence	FAT Concepts	Conducting a Windows Investigation I	Static Analysis of Hacker Tools I
S-3	SLO-1	IRM: Pre-incident preparation	Forensic Duplication	FAT Analysis	Conducting a Windows Investigation II	Static Analysis of Hacker Tools II
	SLO-2	IRM: Detection of incidents	Forensic Duplication tools	FAT - The Big Picture	File Auditing	Dynamic Analysis of Hacker Tools I
S-4	SLO-1	IRM: Initial Response	Forensic Duplicate creation of HDD	Introduction to NTFS	Theft of Information	Dynamic Analysis of Hacker Tools II
	SLO-2	IRM: Formulate a Response Strategy	Qualified Forensic Duplicate creation	Files in NTFS	Handling the departing employee	Evaluating Computer Forensics Tools
S-5	SLO-1	IRM: Investigate the Incident	Restored Image	MFT Concepts	Investigating Unix Systems	Types of Forensic Tools
	SLO-2	IRM: Reporting	Mirror Image	MFT Attribute Concepts	Overview of steps - Unix Investigation	Tasks performed by Forensic Tools
S-6	SLO-1	Creating response toolkit - Windows	Forensic Duplication Tool Requirements	Other MFT Attribute Concepts	Reviewing pertinent logs	Tool comparisons
	SLO-2	Volatile Data Collection - Windows	Creating a Forensic Duplicate of a Hard Drive	Indexes in NTFS	Performing keyword searches	Computer Forensics Software Tools
S-7	SLO-1	In-depth data collection - Windows	Evidence Handling	NTFS Analysis - File System Category	Reviewing relevant files	Computer Forensics Hardware Tools
	SLO-2	Storing collected data - Windows	Types of Evidence	NTFS Analysis - Content Category	Identifying unauthorized user	Validating and Testing Computer

					accounts/groups	Forensics Software
S-8	SLO-1	Creating response toolkit - Unix	Challenges in Evidence Handling	NTFS Analysis - Metadata Category	Identifying rogue processes	Introduction to Forensic Report Writing
	SLO-2	Volatile Data Collection - Unix	Overview of Evidence Handling Procedure.	NTFS Analysis - File Name Category	Checking for unauthorized access points	Understanding the Importance of Reports
S-9	SLO-1	In-depth data collection - Unix	Evidence Handling Procedure	NTFS Analysis - Application Category	Analyzing trust relationships	Guidelines for Writing Reports
	SLO-2	Storing collected data - Unix	Evidence Handling reports	NTFS - The Big Picture	Detecting loadable kernel modules	A Template for Computer Forensics Reports

Learning Resources	1. KevinMandia,ChrisProsise,"IncidentResponseandcomputerforensics",TataMcGrawHill,2006. 2. Bill Nelson,Amelia Philips and Christopher Steuart, "Guide to computer forensics and investigations", coursetechnology,CengageLearning;4thedition,ISBN:1-435-49883-6,2009.	3. EoghanCasey,"HandbookComputerCrimeInvestigation'sForensicToolsandTechnology",Academic Press, 1st Edition,2001. 4. Brian Carrier, "File System Forensic Analysis", Addison-Wesley Professional; 1st edition 2005, ISBN-13: 978-0321268174

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.Balan C, Scientist F, CDAC, cbalan@cdac.in	1.	1. Mr. A.R. Nagoor Meeran, SRMIST
2.	2.	2. Dr. C.N.S.Vinoth Kumar, SRMIST

Course Code	18CSE383T	Course Name	INFORMATION ASSURANCE AND SECURITY	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		Computer Science and Engineering		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 different ways the information systems may be compromised.																		
CLR-2 :	Learn to model the various types of threats.	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 Information Assurance planning strategies.																		
CLR-4 :	Acquire knowledge by analyzing software systems.																		
CLR-5 :	Understand and apply different countermeasures and protect information.																		
CLR-6 :	Perform vulnerability testing.																		

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLO-1 :	Acquire the basic knowledge about the Information Assurance.	2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	Design an appropriate Policies for the organization.	2	75	80	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-3 :	Deliver professional, ethical, legal, security and social issues and responsibilities in an effective manner.	2	85	80	H	-	-	-	-	-	-	M	-	-	-	-	-	-	-
CLO-4 :	.Develop risk management strategies for an enterprise.	2	80	75	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	Provide the understanding of different security mechanisms used in various areas of computing	2	75	85	H	-	-	H	-	-	-	-	-	-	-	-	-	-	-
CLO-6 :	Apply the current technical concepts and practices in the core information technologies.	2	80	85	H	-	-	-	-	-	-	-	M	-	-	-	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Information Assurance Basics	Information Security Planning	Information Assurance Process : Managing Information Assurance	Benefits of Incorporating Security Considerations	Information Assurance Detection and Recovery Processes
	SLO-2	The Need for Information Assurance	Information Security Governance	Information Security project management	System Development Life Cycle	Intrusion Detection and Prevention System(IDPS)
S-2	SLO-1	Key Information Security concepts	Policy, Standards and Practices	Technical aspects of implementing Information Security	Information Assurance in System Development Life Cycle	IDPS types
	SLO-2	Critical characteristics of Information	Policy Management, Information Security Blueprint	Non-Technical aspects of implementing Information Security	Information Assurance in the Service Acquisition Life Cycle	IDPS detection methods
S-3	SLO-1	MSR Model	Continuity Strategies	Structure of an Information Assurance	Physical and Environmental Security Controls	IDPS - Analysis
	SLO-2	Security in System lifecycle	Crisis Management	Organizational Maturity, Asset Management	Handling of Media	Log Management Tools: SIEM
S-4	SLO-1	NIST Approach to Securing SDLC	Information Asset Life Cycle, Plan,Do,Check,Act Model	APM Maturity model	Information Assurance Awareness, Training, and Education (AT and E), Purpose, Benefits	Honeypot/Honeynet
	SLO-2	Security Professionals and Organizations	Current Practices : Due Care and Due Diligence	Overview of Risk Management	AT and E : Design, Development	Scanning and Analysis tools
S-5	SLO-1	Communities of Interest	Specific Laws and Regulations	Risk Identificaion	AT and E : Assessment	Malware Detection

	SLO-2	Information Security: Is it an art or Science?	International Laws and Acts	Risk Assessment	Types of Learning Programs	Penetration Test
S-6	SLO-1	Information Assurance Concepts : Defense in Depth	Standards and Best Practices	Risk control	Employment Policies and Practices	Physical Controls
	SLO-2	Information Assurance in Cyber Security	Plans for Information Assurance Strategy	Quantitative vs Qualitative Risk management practices	Securty considerations for temporary employees, consultants and other workers	Special considerations for Physical security
S-7	SLO-1	CIA Triangle	Cryptology	Recommended risk control practices	Preventive Information Assurance Tools	Information Assurance Measurement Process
	SLO-2	The Need for Security	Cipher methods	Process , Secure design through threat modeling	Preventive Information Assurance controls	Metrics Program
S-8	SLO-1	Categories of Threats	Cryptographic algorithms	Importance of Policy	Positioning and staffing the Security function	Incident Handling Process
	SLO-2	Software Attacks types	Cryptographic tools	Information Assurance Policy	Credentias for Information Security Professionals	Continuity Strategies
S-9	SLO-1	Other vulnerabilities	Protocols for secure Communications	Policy Development Steps	Access control benefits	Computer Forensics
	SLO-2	Implications from Lack of Information Assurance	Approaches to implement Information Assurance	Certification, Accreditation, and Assurance	Access control Techniques, Administration	Examiner Prerequisites, Team Establishment

Learning Resources	1. MichaelE.WhitmanandHerbertJ.Mattord,"PrinciplesofInformationSecurity",5thedition,2015, Thomson Publications, ISBN1111899134. 2. Steven Hernandez, Corey Schou, "Information Assurance Handbook: Effective Computer Security and Risk Management Strategies" ,1st Edition, 2014, McGraw Hill Osborne Media ,ISBN:0071821651, ISBN : 9780071821650	3. William Stallings, " Cryptography and Network Security- Principles and Practice", 6 th Edition, 2013, Pearson, ISBN:9780136073734. 4. CoreySchou, Dan Shoemaker,"InformationAssurancefortheEnterprise",TataMcGraw -HillEdition,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
1. Mr.P.AnandaNatarajan,Senior Associate Consultant, Infosys, Chennai.	1. Dr.S.Anbuchelian, Assistant Professor(Sl.G), IT Department, Anna University, Chennai anbuchelian@annauniv.edu	1.Ms.C.Fancy ,SRMIST, fancyc@srmist.edu.in
2. Mr.SurenderPalanivel, GM, GGS Information Services Pvt. Ltd., Pune.		2. Dr.Vinothkumar,SRMIST vinothks1@srmist.edu.in

Course Code	18CSE384T	Course Name	SECURE SOFTWARE DEVELOPMENT LIFE CYCLE	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		Computer Science and Engineering		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 :	Identify project security risks & selecting risk management strategies.																		
CLR-2 :	Analyze software security standards, policies, and guidelines to articulate and elaborate requirements																		
CLR-3 :	Use automated tools and secure coding practices to analyze and test existing code and reduce vulnerabilities																		
CLR-4 :	Select and integrate established security design patterns and address threat assessments to mitigate common vulnerabilities and achieve the target design																		
CLR-5 :	Participate in team-based peer reviews to analyze the security development life cycle and mitigate risks and vulnerabilities																		

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 :	Explain terms used in secured software development and life cycle process	3	80	70	L	H	-	L	L	-	-	-	L	L	-	H	-	-	-
CLO-2 :	Incorporate requirementsinto secured software development process and testsoftware for security vulnerability	3	85	75	M	H	L	M	L	-	-	-	M	M	-	H	-	-	-
CLO-3 :	Identify vulnerable code in implemented software and describe attack consequences	3	75	70	M	H	M	H	L	-	-	-	M	L	-	H	-	-	-
CLO-4 :	Apply mitigation and implementation practices to construct attack resistant software	3	85	80	M	H	M	H	L	-	-	M	M	M	-	H	-	-	-
CLO-5 :	Apply secure design principles for developing attack resistant software	3	85	75	H	H	M	H	L	-	-	-	M	M	-	H	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Software Engineering- Process model	A Risk Management Framework	Introduction toArchitectural Risk Analysis	Code Review with a Tool	Software Penetration Testing
	SLO-2				Catching Implementation Bugs with a Tool)	
S-2	SLO-1	Agile development-Agile Process	The Five Stages of Activity	Common Themes among Security Risk Analysis Approaches	Approaches to Static Analysis	Software Penetration Testing—a Better Approach
	SLO-2	Extreme Programming				
S-3	SLO-1	Need to secure development life cycle	Understanding the Business Context	Traditional Risk Analysis Terminology	Modern Rules	Using Penetration Tests to Assess the Application Landscape
	SLO-2		Gathering the Artifacts			
S-4	SLO-1	Current Software Development Methods Fail to Produce Secure Software .	Identifying the Business and Technical Risks	Knowledge Requirement	Tools from Researchland	Risk-Based Security Testing
	SLO-2	Incentive to Review Code				
S-5	SLO-1	Understanding Security Bugs	Synthesizing and Ranking the Risks	The Necessity of a Forest-Level View	Commercial Tool Vendors	Abuse Cases
	SLO-2	Critical Mass		A Traditional Example of a Risk Calculation		
S-6	SLO-1	Proprietary Software Development Methods- CMMI, TSP, and PSP	Defining the Risk Mitigation Strategy	Modern Risk Analysis	Key Characteristics of a Tool	Software Security Meets Security Operations
	SLO-2					
S-7	SLO-1	SDL for Management	Carrying Out Fixes and Validating	Touchpoint Process: Architectural Risk Analysis	The Fortify Knowledge Base	Knowledge for Software Security
	SLO-2					
S-8	SLO-1	Managing the SDL	The Importance of Measurement	Limitations of Traditional Approaches	Touchpoint Process: Code Review	Establishing a Metrics Program
	SLO-2					

S-9	SLO-1	Case study: A Short History of the SDL at Microsoft	The Cigital Workbench	Getting Started with Risk Analysis	Use a Tool to Find Security Bugs	Continuous Improvement
	SLO-2					

Learning Resources	1. The Security Development Lifecycle: SDL: A Process for Developing Demonstrably More Secure Software (1st Edition) By Michael Howard,2017. 2. Software Security: Building Security In by Gary McGraw. Addison-Wesley.2006	3. Software Security Engineering: A Guide for Project Managers by Julia H. Allen, Sean Barnum, Robert J. Ellison, Gary McGraw, and Nancy Mead. Addison-Wesley,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
Mr.V.SelvaKumar,Assistant General Manager,Hexaware Technologies.	Dr.N.Prakash,Associate Professor,Department of Information technology,B.S.A Crescent Institute of Science and Technology.	1. Mr.Arivazhagan
		2. Dr. Naresh
		3. Mrs.B.Jothi, SRMIST

Course Code	18CSE385T	Course Name	SECURITY AUDIT AND RISK ASSESSMENT	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		CSE			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 security audit planning strategies																		
CLR-2 :	Gain knowledge about information risk																		
CLR-3 :	Discover knowledge in collecting data about organization																		
CLR-4 :	Acquire knowledge in various analysis on Information Risk Assessment																		
CLR-5 :	Introduce the System Risk analysis																		
CLR-6 :	Understand the organizational and system specific risk																		

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 knowledge on various secure auditing techniques	2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	Acquire the ability to identify knowledge in information risk	2	75	80	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-3 :	Understand the basic ideas about data collection workload	2	85	80	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	Appreciate the concepts of vulnerability catalogs and impact analysis scheme	2	80	75	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	Identify the knowledge in risk classification techniques	2	75	85	H	-	-	H	-	-	-	-	-	-	-	-	-	-	-
CLO-6 :	Acquire the knowledge on system specific risk	2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Need for Audit Planning	What is Risk?	Data Collection-Introduction	Compiling Observations from Organizational	System Risk Analysis
	SLO-2	Steps in Audit Planning	Going Deeper with Risk	The Sponsor	Risk Documents	Risk Classification
S-2	SLO-1	Audit Risk Assessment	Components of Risk	The Project Team	Preparation of Threat and Vulnerability Catalogs	Risk Rankings
	SLO-2	Performing Audit	Putting it Altogether	The size and Breadth of the Risk Assessment	Threat Catalog	Risk Prioritization and Treatment
S-3	SLO-1	Internal Controls	Information Security Risk	Scheduling and Deadlines	Vulnerability Catalogs	Review of Audit Findings
	SLO-2	Audit Evidence	Information Security Risk Assessment Overview	Assessor and Organization Experience	Threat Vulnerability Pairs	Review of Security Incidents
S-4	SLO-1	Audit Testing	Assess Information Security Risk	Work load	Overview of the System Risk Computation	Review of Security Exceptions
	SLO-2	Follow up activities	Risk assessment and security Program	Data Collection Mechanisms	Designing the Impact Analysis Scheme	System Specific Risk Treatment
S-5	SLO-1	Security Monitoring and Auditing	Information Security Management in a Nutshell	Collectors	Confidentiality, Integrity	Information Security Risk Assessment Reporting
	SLO-2	Assurance and Trust	Drivers, Laws and Regulations	Containers	Availability	Risk Analysis Executive Summary
S-6	SLO-1	Need for Assurance	Federal Information Security Management	Executive Interview	Preparing the Impact Score	Methodology
	SLO-2	Role of Requirements in Assurance	Gramm-Leach-Blile(GLBA)	Document Requests	Designing the Control analysis Scheme	Organizational
S-7	SLO-1	Audit Assurance in Software	Health Insurance Portability and	IT Asset Inventories	Designing the Likelihood Analysis Scheme	System Specific

		Development Phases	Accountability Act(HIPAA)			
	SLO-2	Building Secure and Trusted Systems	State Governments	Asset Scoping	Exposure	Results
S-8	SLO-1	Designing an Auditing System	ISO 27001	Business Impact Analysis and Other Assessments	Frequency	Organizational Analysis
	SLO-2	Auditing to detect Violations of a Security Policy	Drivers,Laws and Regulations	Critical Success Factor Analysis	Controls	System Specific
S-9	SLO-1	Auditing Mechanisms	Risk Assessment Framework	Profile & Control Survey	Likelihood	Risk Register
	SLO-2	Audit Browsing	Practical Approach	Consolidation	Final Risk Score	Post Mortem

Learning Resources	1. Mark Talabis, "Information Security Risk Assessment Toolkit: Practical Assessments through DataCollectionandDataAnalysis",Syngress;1Edition.ISBN:978-1-59749-735-0.Nov2012. 2. David L. Cannon, "CISA Certified Information Systems Auditor Study Guide", SYBEX Publication. ISBN:978-0-470-23152-4.	3. Thomas R.Peltier, "Information Security Risk Analysis", CRC Press, 2001

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.PrasannaKumar,InfosysPrasanna_kumar11@infosys.com	1.Dr.E.Sivashankar, NIT Trichy,sivasankar@nitt.edu	1.Dr.G.Usha,SRMIST, Dr.M.B.MukeshKrishnan,SRMIST
2.Mr.Mithun, Cognizant,Mithun.SS@cognizant.com	2.Dr.KunvarSingh,NITTrichy,kunwar@nitt.edu	2.Mrs G.K. Sandhia,SRMIST

Course Code	18CSE386T	Course Name	PENETRATION TESTING AND VULNERABILITY ASSESSMENT	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		Computer Science and Engineering	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 :	Gain knowledge on various security testing techniques and asses sensitiveness of assets.																					
CLR-2 :	Gain knowledge on weaknesses of various OS, network and applications.																					
CLR-3 :	identify how security controls can be improved to prevent hackers gaining access to operating systems and networked environments.		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-4 :	Acquire knowledge on methodologies and techniques of Hacking																					
CLR-5 :	To test and exploit systems using various tools.																					
CLR-6 :	Understand the impact of hacking in real time machines																					

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																					
CLO-1 :	Acquire the knowledge on identifying security vulnerabilities	2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	Acquire the ability to identify problems in network, OS and applications commonly exploited by hackers	2	75	80	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-3 :	Understand management of static and dynamic security controls in firewalls, IPS, IDS	2	85	80	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	Appreciate the concepts of hacking and gaining access to remote and local systems.	2	80	75	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	Apply the knowledge for creating better security controls.	2	75	85	H	-	-	H	-	-	-	-	-	-	-	-	-	-	-	-
CLO-6 :	Acquire the knowledge to prevent threats in targeted attacks and real time systems.	2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Introduction to penetration testing	Types of Scanning	Meterpreter Basics	Social engineering	DOS Attack
	SLO-2	Introduction to penetration testing -2	Black, White and Grey Scanning	Working with Meterpreter session	Electronic and Non Electronic Social Engineering	DDOS Attack
S-2	SLO-1	Understanding basic Ethical Hacking terminologies	Foot Printing Stages	Exploit Modules	SET- Social Engineering Toolkit	Web application Vulnerability
	SLO-2	Understanding basic Ethical Hacking terminologies -2	Foot Printing Stages-2	Payload Modules	Social Engineering Prevention Techniques	Security assessment of public Domains
S-3	SLO-1	Batch Programming Basics	DNS Information Gathering	Privilege Escalation	Buffer Over Flow Attack	Phishing and its Types
	SLO-2	Batch Programming Basics - 2	NS Lookup	Vertical and horizontal Privilege Escalation	Stack Based Buffer overflow	Cross Site Request Forgery
S-4	SLO-1	Taking control using batch programs	Network Information Gathering	Token Stealing	Heap Based buffer overflow	DOM Based XSS
	SLO-2	Taking control using batch programs-2	NMap	Active and Passive stealing	Deep packet inspection	Brup Suite
S-5	SLO-1	Open web Application Security Project(OWASP)	Scanning	Network Sniffing	SQL Injection –Introduction	Password Cracking
	SLO-2		Port, Network and OS	Active and passive sniffing	SQL Injection Types	John the Ripper
S-6	SLO-1	Stages of Ethical Hacking	Nmap Scripting	Creating Backdoors	Error Based SQL,	Dictionary Attack, Brute Force Attack
	SLO-2			Persistent and Non-Persistent	Union Based SQL	Rainbow Table Attack,
S-7	SLO-1	Vulnerability Research	Vulnerability Scanning	Key Loggers	Blind SQL	Shoulder Sniffing, Spidering

	SLO-2		*Nessus*	*Software and Hardware Key loggers*	*Boolean-based SQL injection, Time-based SQL injection*	*Offline Cracking*
S-8	SLO-1	*Impact of Hacking*	*'Who is' Information Gathering*	*ARP Poisoning*	*SQL Map,DVWA*	*Wifi Hacking*
	SLO-2		*Wireshark*	*Maltigo*	*SQL injection Counter Measures*	*Alrcrack*
S-9	SLO-1	*Introduction to Kali OS*	*Enumeration*	*Man In The Middle Attack*	*Steganography*	*Documentation and Reporting*
	SLO-2	*Installation and configuration*	*Active and Passive Enumeration*	*Port Forwarding*	*Steganography counter measures*	*Dradis Framework*

Learning Resources	1. *David Kennedy, Jim O'Gorman, Devon Kearns, and Mati Aharoni, METASPLOIT The Penetration Tester's Guide, No Starch Press,2011.* 2. *Wil Allsopp, Advanced Penetration Testing: Hacking theworlds most Secure Networks, 1st Edition, John Wiley & Sons,2017*	3. *Sean-Philip Oriyano, Penetration Testing Essentials, JohnWiley & Sons,2017.* 4. *Leebrotherston,AmandaBerlin,DefensiveSecurityhandbook,O'reilly,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
Mr. S Manigandan, prnc Cyber Researcher, Symantec Inc manigandan_s@symantec.com		1. Geogen George,SRMIST
		2. Ms. Poornima,SRMIST
		3. Mr.Selvakumaraswamy,SRMIST

Course Code	18CSE472T	Course Name	MALWARE 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	Computer Science and Engineering	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 static and dynamic 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 :	Gain knowledge about running malware in virtual environment.																				
CLR-3 :	Study about disassembly constructs and its structures.																				
CLR-4 :	Study about new processors and file types using the IDA SDK																				
CLR-5 :	Explore popular plug-ins that make writing IDA scripts easier, allow collaborative reverse engineering																				
CLR-6 :	Understand how to best approach the subject of Android malware threats and analysis.																				

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																				
CLO-1 :	Gain knowledge about the different forms of malware.	2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	Set up a safe virtual environment to analyze malware.	2	75	80	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-3 :	Navigate, comment, and modify disassembly.	2	85	80	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	Use code graphing to quickly make sense of cross references and function calls	2	80	75	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	Use IDA's built-in debugger to tackle hostile and obfuscated code.	2	75	85	H	-	-	H	-	-	-	-	-	-	-	-	-	-	-	-
CLO-6 :	Learn procedures for recognizing and analyzing Android malware threats quickly and effectively.	2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	The Goals of Malware Analysis	The Structure of a Virtual Machine	Disassembly Theory	Cross-References	Introduction to the Android Operating System and Threats
	SLO-2	Malware Analysis Techniques	Creating Your Malware Analysis Machine	The Why and how of Disassembly	Function Calls	Malware Threats, Hoaxes, and Taxonomy
S-2	SLO-1	Types of Malware	Using Your Malware Analysis Machine	Reversing and Disassembly Tools.	IDA Graphing	Open Source Tools
	SLO-2	General Rules for Malware Analysis	The Risks of Using VMware for Malware Analysis	Getting started with IDA.	Console Mode IDA	Collections
S-3	SLO-1	Antivirus Scanning	Record/Replay: Running Your Computer in Reverse	IDA Data Displays	IDA's Batch Mode	File Data, Metadata
	SLO-2	Hashing- Fingerprint for Malware	Sandboxes: The Quick-and-Dirty Approach	Disassembly Navigation.	Customizing IDA's	Creating a JAR File, VisualThreat Modeling
S-4	SLO-1	Finding Strings	Running Malware	Disassembly Manipulation.	Library Recognitions	Automation
	SLO-2	Packing Files	Monitoring with Process Monitor	Recognizing Data Structure Use	Augmenting Function Information	Processor Emulation
S-5	SLO-1	Detecting Packers with PEiD	Viewing Processes with Process Explorer	Creating IDA Structures	Augmenting Predefined Comments	Configuring Emulated Devices within AVD
	SLO-2	Portable Executable File Format	Comparing Registry Snapshots with Regshot	Using Structure Templates	The Infamous Patch Program Menu	Using the ADB Tool
S-6	SLO-1	Static, Runtime, and Dynamic Linking	Faking a Network	Importing New Structures	IDA Output Files and Patch Generation	Installing Samples to Devices and Emulators
	SLO-2	Exploring Dynamically Linked Functions with Dependency Walker	Packet Sniffing with Wireshark	Using Standard Structures	IDA Scripting	Application Storage and Data Locations

S-7	SLO-1	Imported and Exported Functions	Using INetSim	IDA TIL Files	IDA Software Development Kit	Devices View, LogCat View
	SLO-2	PotentialKeylogger.exe: An Unpacked Executable	Basic Dynamic Tools in Practice	C++ Reversing Primer- The this Pointer	The IDA Application Programming Interface	Application Tracing
S-8	SLO-1	Examining PE Files with PEview	Levels of Abstraction	Virtual Functions and Vtables	Writing a Plug-in, Plug-in User Interface Options	Build Your Own Sandbox
	SLO-2	Viewing the Resource Section with Resource Hacker	Reverse-Engineering	The Object Life Cycle	IDA Loader Modules	USB-cleaver, Torec
S-9	SLO-1	Using Other PE File Tools	The x86 Architecture	Name Mangling, Runtime Type Identification	Processor Module Architecture	Static and Dynamic Analysis of Uploaded Malware Samples.
	SLO-2	PE Header Summary	Recognizing C Code Construct in Assembly	Inheritance Relationships, C++ Reverse Engineering References	Real World Applications- Vulnerability Analysis.	Capabilities and Limitations of the Emulators.

Learning Resources	1. Michael Sikorski, Practical Malware Analysis – The Hands–On Guide to Dissecting Malicious Software, Kindle Edition, No Starch Press; 1 edition (1 February 2012), ISBN: 1593272901. 2. Chris Eagle, The IDA Pro Book, 2nd Edition, No Starch Press, 2011. ISBN-10: 1-59327- 289-8.	3. Ken Dunham, Android Malware and Analysis, Kindle Edition, Auerbach Publications.InternationalStandardBookNumber-13:978-1-4822-5220-0.

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. P.Santhosh, Information Security Risk Analyst, PricewaterhouseCoopers Pvt Ltd, Bangalore, Karnataka 560008. Email: santhoshshivam72@gmail.com	Dr.L.Kavisankar Associate Professor, Dept. Of CSE, Hindustan Institute of Science and Technology Email: lkavis@hindustanuniv.ac.in	1. Mr. V. Joseph Raymond, SRMIST
		2.Ms. Ida Seraphim, SRMIST

Course Code	18CSE474T	Course Name	CYBER LAW	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	Computer Science and Engineering	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:					Learning			Program Learning Outcomes (PLO)															
CLR-1 :	Understand the basics of cyber law and cyber security					1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-2 :	familiarize the issues those are specific to amendment rights																						
CLR-3 :	Become aware on copyright issues in software's																						
CLR-4 :	Understand the Cyber-crimes and Cyber Frauds																						
CLR-5 :	Understand the Legal Framework																						
CLR-6 :	understand ethical laws of computer for different countries																						

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 :	Gain in-depth knowledge on information on cyber security and issues specific to amendment rights	3	80	70	L	H	H	H	L	H	L	H	H	H	L	H	H	H	H
CLO-2 :	Apply the knowledge on copyright issues within software packages	3	85	75	L	H	H	H	L	H	L	H	H	H	L	H	H	H	H
CLO-3 :	Comprehend ethical laws of computer for various countries	3	75	70	L	H	H	H	L	H	L	H	H	H	L	H	H	H	H
CLO-4 :	Defines the Cyber-crimes and frauds	3	85	80	L	H	H	H	L	H	L	H	H	H	L	H	H	H	H
CLO-5 :	Apply the knowledge of Legal framework	3	85	75	L	H	H	H	L	H	L	H	H	H	L	H	H	H	H
CLO-6 :	Construct the secured environment	3	80	70	L	H	H	H	L	H	L	H	H	H	L	H	H	H	H

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Introduction	Overview Of The Information Technology Act, 2000	Cyber-crimes / Cyber Frauds	Cyber Crimes& Legal Framework	Cyber Security
	SLO-2	History of Internet and World Wide Web	Applicability of the Act	Definition of cyber crime	Cyber Crimes against Individuals, Institution and State	Network and website Security Risks
S-2	SLO-1	Need for cyber law	Scheme of the Act	First Cyber crime	Hacking	Hacking
	SLO-2	Cyber-crime on the rise	Important provisions of the Act		Digital Forgery	E-business Risk management issues
S-3	SLO-1	Important terms related to cyber law	Digital Signature under the IT Act, 2000	Types of cyber frauds	Cyber Stalking/Harassment	Firewall
	SLO-2		E-Governance		Cyber Pornography	Security framework
S-4	SLO-1	Cyber law in India	Attribution, Acknowledgement and Dispatch of Electronic Records	Cyber frauds in India	Identity Theft & Fraud	Cryptocurrency
	SLO-2		Certifying Authorities	Preventive measures	Cyber Terrorism	Blockchain –Technology Stack :Protocol, Currency
S-5	SLO-1	Need for cyber law in India	Controller of Certifying Authorities (CCA)	Cyber crimes	Cyber Defamation	Crowd Funding
	SLO-2		Security Guidelines for Certifying Authorities	Who commits cyber-crimes?	Right to Privacy and Data Protection on Internet	Bitcoin Prediction Markets
S-6	SLO-1	History of cyber law in India	Electronic Signature Certificates	Penalties and offences under the IT Act, 2000	Concept of privacy	Smart Property
	SLO-2		Duties of Subscribers		Self-regulation approach to privacy	Smart Contract

S-7	SLO-1	Information Technology Act, 2000	Penalties and Offences	Offences under other legislations	Ingredients to decide confidentiality of information	Decentralized Governance Services
	SLO-2				Intellectual Property Issues in Cyber Space	E Payments
S-8	SLO-1	Overview of other laws amended by the IT Act, 2000	Intermediaries	Investigation of cyber-crimes in India	Interface with Copyright Law	Digital Token based E payment systems
	SLO-2				Interface with Patent Law	E Wallet
S-9	SLO-1	National Policy on Information Technology 2012	rules issued under the IT Act, 2000	Regulatory Authorities	Trademarks &Domain Names Related issues	Online financial services in India
	SLO-2				Dispute Resolution in Cyberspace	Law to Protect online financial service fraud

Learning Resources	1. Justice Yatindra Singh,Cyber Laws, Universal Law Publishing Co, New Delhi, (2012). 2. Verma S, K, Mittal Raman,Legal Dimensions of Cyber Space, Indian Law Institute, New Delhi, (2004) 3. S. R. Bhansali, Information Technology Act, 2000, University Book House Pvt. Ltd., Jaipur (2003). 4. Blockchain, Blueprint for a new Economy , Melanie Swan, 2017 –O'Reilly	5. SudhirNaib, The Information Technology Act, 2005: A Handbook, OUP, New York, (2011) 6. Upadhyaya and A. Upadhyaya, Material Science and Engineering, Anshan Publications, 2007 7. Vasu Deva, Cyber Crimes and Law Enforcement, Commonwealth Publishers, New Delhi, (2003). 8. Essential CyberSecurity Science, Josiah Dykstra, 2017 –O'Reilly

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. Kesawan HCL Technologies	Dr. Surendran Rajendran AMA International University Bahrain	Dr.M.B Mukesh Krishnan, SRMIST
Mr.Celeian, Symantec		Mrs.R.Vidhya, SRMIST

Course Code	18CSE475T	Course Name	MOBILE AND WIRELESS SECURITY	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		CSE			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 mobile cellular networks and IEEE wireless networks																		
CLR-2 :	Learn the basic security fundamentals																		
CLR-3 :	understand the security issues in Wi-Fi.and Wi-Max																		
CLR-4 :	explore the security issues in Next generation mobile networks																		
CLR-5 :	understand the security issues and key management in ad-hoc networks.																		
CLR-6 :	study the hacking techniques in IEEE 802.11																		

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 :	understand the fundamentals of mobile cellular networks and IEEE wireless networks	2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	Identify various possibilities for security threats in wireless networks.	2	75	80	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-3 :	Handle the security threats in Wi-Fi networks.	2	85	80	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	Solve the security attacks in mobile IP networks	2	80	75	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	Prevent the attacks in ad-hoc networks.	2	75	85	H	-	-	H	-	-	-	-	-	-	-	-	-	-	-
CLO-6 :	Protect the 802.11 Networks from attacks.	2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Introduction to mobile cellular networks	Wi-Fi Security	Security in Next Generation Mobile Networks	Security in Ad Hoc Networks	Overview of Wireless security-Hacking
	SLO-2	Cellular network basic concepts	Attacks on wireless networks	SIP	Motivations and application fields	Scanning and Enumerating 802.11 Networks
S-2	SLO-1	IEEE wireless networks, WLAN: IEEE 802.11	IEEE 802.11 security mechanisms	VoIP security flaws	Routing protocols	Windows Sniffing/Injection Tools
	SLO-2	WMAN mobile: IEEE 802.20	WEP (Wired Equivalent Privacy) and Shortcomings	Making VoIP secure	Attacks to routing protocols	Attacking 802.11 Wireless Networks
S-3	SLO-1	Mobile Internet networks	Security in 802.1x	IP Multimedia Subsystem (IMS)	Security mechanisms - Basic protections and existing tools	Security Through Obscurity
	SLO-2	Security in the digital age	Authentication	IMS architecture and security	Key management architectures	Attacking WPA-Protected 802.11 Networks
S-4	SLO-1	Threats and risks to TeleCommunication systems	The 802.11i security architecture	4G security	Protections using asymmetric cryptography	Breaking Authentication: WPA-PSK
	SLO-2	From wireline vulnerabilities to vulnerabilities in wireless Communications	Radio security policies	Confidentiality	Protections using symmetric cryptography	Breaking Authentication: WPA Enterprise
S-5	SLO-1	Security services	Authentication in wireless networks	Security of IP-Based Mobile Networks	Protection against data modification	Attack 802.11 Wireless Clients
	SLO-2	Symmetric and asymmetric	Layer 3 security mechanisms	Vulnerabilities of Mobile IP networks	Protection against tunnel attacks	Attacking the Application Layer

		cryptography				
S-6	SLO-1	Hash functions	WiMAX Security	Discovery mechanisms and Authenticity of the mobile location	Key Management in Ad Hoc Networks	Dynamically Generating Rogue APs and Evil Servers with Karmetasploit
	SLO-2	Electronic signatures and MAC	Security evolution in WiMAX standards	Data protection (IP tunnels)	The threshold cryptography technique and Self-managed PKI	Direct Client Injection Techniques
S-7	SLO-1	Public Key Infrastructure (PKI) and electronic certificates	WiMAX low layers	IPv6 mobility mechanisms	Key agreement technique within MANETs and Cryptographic identifiers	Overview of Bluetooth Scanning and Reconnaissance
	SLO-2	Management of cryptographic keys	Security according to the IEEE-802.16e standard	Mobile IPv6 bootstrapping	The Resurrecting Duckling technique	Bluetooth Eavesdropping
S-8	SLO-1	Cryptographic protocols	Authentication with PKMv2-RSA, PKMv2-EAP	Mobility with Mobile IPv4	Group key management within ad hoc networks	Commercial Bluetooth Sniffing
	SLO-2	IPsec protocol suite	SA-TEK 3-way handshake	Protocol and security	Security services and challenges for group Communications within MANETs	Open-Source Bluetooth Sniffing
S-9	SLO-1	Authentication mechanisms	GTEK updating algorithm	Mobility with MOBIKE	Comparison metrics	ZigBee Security
	SLO-2	Access control-Firewalls	Algorithms associated with the TEKs	IP mobility with HIP	Approaches for Group key management	ZigBee Attacks

Learning Resources	1. Hakima Chaouchi, Maryline Laurent-Maknavicius, "Wireless and Mobile Network SecuritySecurity Basics,SecurityinOn-the-shelfandEmergingTechnologies",JohnWiley&SonsInc,2009. 2. JohnnyCache,JoshuaWright,VincentLiu,"HackingExposedWireless:WirelessSecuritySecrets& Solutions", Second Edition, McGraw-Hill,2010.	3. LeiChen,JiahuangJi,ZihongZhang,"WirelessNetworkSecurity:TheoriesandApplications",Higher Education Press,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 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

Course Code	18CSE476T	Course Name	DATABASE SECURITY	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		Computer Science and Engineering		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 :	Demonstrate understanding of Fundamentals of Security in database technology with its security architecture in modern computer systems in a typical enterprise.																							
CLR-2 :	Formulate a working definition of database security and administration and Identify contemporary practices of operating system security.																							
CLR-3 :	To identify risks and vulnerabilities in operating systems from a database perspective.																							
CLR-4 :	Demonstrate the knowledge and skills for administration of user, profiles, password policies, privileges and roles.																							
CLR-5 :	Manage database security Model on application level and Conduct database auditing for security and reliability																							
CLR-6 :	Implement typical security projects on enterprise systems.																							

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 :	Students are able to identify fundamentals of data , securityof data and security issues	3	85	75	M	H	L	H	L	-	-	-	H	H	M	H	-	-	-
CLO-2 :	Students are obtaining knowledge about architecture of data base security and Operating System Security	3	85	75	M	H	L	M	L	-	-	-	M	L	M	H	-	-	-
CLO-3 :	Develop and implement a security plan for an enterprise level database (password policies, auditing policies, user privileges, profile, and roles).	3	75	70	M	H	M	H	H	H	-	-	M	L	H	H	-	-	-
CLO-4 :	Students are able to design and implement access control rules to assign privileges and protect data in databases.	3	85	85	M	H	H	H	L	-	H	-	M	L	H	H	-	-	-
CLO-5 :	Identify some of the factors driving the need for Database security and classify particular examples of attacks	3	85	75	H	H	M	H	L	M	-	M	M	L	-	H	-	-	-
CLO-6 :	Students implement database auditing and Virtual Private Database to protect data in databases	3	80	85	H	H	H	H	H	-	-	-	H	H	M	H	-	-	-

	Duration (hour)		9		9		9		9		9
S-1	SLO-1	Importance of Data,Identity Theft	Installing a typical database product	Introduction-Authentication-Creating Users	Database Application Security Models: Introduction	Virtual Private Databases: Introduction-Overview
	SLO-2			SQL Server User	Types of Users	Implementation of VPD using Views
S-2	SLO-1	Levels of data security	Security architecture: Database Management Systems	Removing,Modifying Users-Default, Remote Users	Security Models	Application Context in Oracle
	SLO-2	Authorization in databases	Information Security Architecture			Implementing Oracle VPD
S-3	SLO-1	ACL Application Vulnerabilities	Database Security,Basics of Security in distributed databases	Database Links-Linked Servers	Application Types-Application Security Models	Viewing VPD Policies and Application contexts using Data Dictionary
	SLO-2		Asset Types and value-Security Methods			Policy Manager Implementing Row and Column level Security with SQL Server
S-4	SLO-1	Database security issues	Operating system security principles	Remote Servers-Practices for Administrators and Managers	Data Encryption.Excessive privileges, SQL Injections	Auditing Database Activities:
	SLO-2	Access to key fields,Access to surrogate information				
S-5	SLO-1	Problems with data extraction	Security Environment	Best Practices Profiles	Countermeasures of Malware, Countermeasures of Weak Audit Trail	Creating DLL Triggers with Oracle
	SLO-2	Access control in SQL		Password Policies		

S-6	SLO-1	Discretionary security in SQL,Schema level	Components	*Introduction*-Defining and Using Profiles	DB Vulnerabilities and Misconfiguration	Auditing Server Activity with SQL Server 2000
	SLO-2					
S-7	SLO-1	Authentication, Table level	Authentication Methods	Designing and Implementing Password Policies	Countermeasures of Denial of Service,Stolen Database Backups	Using Oracle Database Activities
	SLO-2		User Administration			
S-8	SLO-1	SQL system tables, Mandatory security in SQL	Password Policies	Granting and Revoking User Privileges	CONTROL METHODS: Access Control,Access control models for XML databases, Inference Policy	Security Project Case study-
	SLO-2		Vulnerabilities			
S-9	SLO-1	Data protection,	E-mail Security	Creating, Assigning and Revoking User Roles-Best Practices	User Identification,Authentication, Accountability,PasswordCrptography	Security and Auditing Project Case Study Data Protection and the IoT
	SLO-2					

Learning Resources	1. Alfred Basta ,Melissa Zgola and Dana Bullaboy "Database Security" 1st Edition Cingage ,2012 (Unit 1 toIII) 2. Michael Gertz and SushilJajodia (Editors) ,Handbook of Database Security: Applications and Trends , ISBN-10: 0387485325. Springer, 2007	3. Hassan A. Afyouni, "Database Security and Auditing", Third Edition, Cengage Learning,2009.(UNIT III to V) 4. http://aircconline.com/ijist/V6N2/6216ijist18.pdf (UnitIV)

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%	-	20%	-	30%	-
	Understand										
Level 2	Apply	40%	-	40%	-	40%	-	40%	10%	40%	-
	Analyze										
Level 3	Evaluate	20%	-	30%	-	30%	-	20%	10%	30%	-
	Create										
	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.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Mr.Prithivi R , Teradata DBA,T.C.S Company	Dr.N.P.Gopal,Professor,Department of Computer Applications , National Institute of Technology,Triuchy	1. Mrs.S.Amudha/SWE, SRMIST
Mr.JeroTerrence,Project Developer in Datawarehousing and DataMining,T.C.S Company	Dr.G.R.KanagaChidambaresan,Asso.Prof,VelTechUniveristy,Chennai	2. Dr. Madhavan/CSE, SRMIST
-	Dr.KannimuthuAsso.Prof,KarpagamCollege of Engineering,Coimbatore	3.Dr.MB.MukeshKrishnan/IT,SRMIST

Course Code	18CSE477T	Course Name	SECURITY GOVERNANCE, RISK AND COMPLIANCE	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		Computer Science and Engineering		Data Book / Codes/Standards	Nil

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning			Program Learning Outcomes (PLO)															
CLR-1 :	Analyze the expanding role of IT governance and its effect on organizations	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-2 :	Be aware of management issues in IT governance																		
CLR-3 :	Analyze the role of risk to an organization and ways to identify key risk factors																		
CLR-4 :	Evaluate various risks and appropriate actions																		
CLR-5 :	Develop naming conventions for the resources in a system																		
CLR-6 :	Create and justify several appropriate policies and procedures to manage resources in a system.																		

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 :	Having an overview of IT governance	3	80	70	M	H	H	H	H	M	M	M	M	M	H	H	H	H	H
CLO-2 :	Undergo an risk assessment	3	85	75	M	H	H	H	H	M	M	M	H	M	H	H	H	H	H
CLO-3 :	Describe legal and ethical considerations related to the handling and management of enterprise information assets.	3	75	70	M	H	H	H	H	M	M	M	H	M	H	H	H	H	H
CLO-4 :	Specify what constitutes admissible evidence in a legal proceeding and how to acquire and maintain this information.	3	85	80	M	H	H	H	H	M	M	M	H	M	H	H	H	H	H
CLO-5 :	Create a set of policies that implement a specified organizational objective.	3	85	75	M	H	H	H	H	M	M	M	H	M	H	H	H	H	H
CLO-6 :	Justify several appropriate policies and procedures to manage resources in a system.	3	80	70	M	H	H	H	H	M	M	M	H	M	H	H	H	H	H

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Introduction to IT Governance	overview of Industry Best Practice Standards	Security mindset	Trends	Creation of policies
	SLO-2					
S-2	SLO-1	IT Risk Management Life Cycle	Model and Guidelines covering some aspect of IT governance	Design principles	Auditing	Maintenance of policies
	SLO-2					
S-3	SLO-1	IT Risk framework	principles of Business/IT Alignment Excellence,	System/security life-cycle	Cost / benefit analysis	Prevention
	SLO-2					
S-4	SLO-1	IT Risk identification	principles of Program/Project Management Excellence	Security implementation mechanisms	Asset management	Avoidance
	SLO-2					
S-5	SLO-1	IT Risk Security Governance	principles of IT Service Management and Delivery Excellence	Information assurance analysis model	Standards	Incident response
	SLO-2					
S-6	SLO-1	IT Risk assessment	principles of Vendor Management	Disaster recovery	Enforcement	Domain integration
	SLO-2					
S-7	SLO-1	IT Risk evaluation	Outsourcing Excellence	Forensics	Legal issues	Social engineering
	SLO-2					
S-8	SLO-1	IT Risk response,	critical success factors	threats	Disaster recovery	Protocol attacks
	SLO-2			vulnerabilities		

S-9	SLO-1	IT Risk monitoring and reporting	Case Study	attacks	security related issues and incidents	Security awareness
	SLO-2			countermeasures		

Learning Resources	1. Iannarelli, J. G., & O'Shaughnessy, M. O. (2015). Information governance and security: Protecting and managing your company's proprietary information. Waltham, MA: Butterworth Heinemann, Elsevier. 2. van Wyk, K. R., Graff, M. G., Peters, D. S., & Burley, D. L. (2015). Enterprise software security: A confluence of disciplines. Upper Saddle River, NJ: Pearson Education.	3. Legal Issues in Information Security, Joanna Lyn Grama, 2015. Jones & Bartlett Learning, Second Edition, ISBN: 978-1-284-05474-3. 4. Ethics of Big Data, Kord Davis, 2012. O'Reilly Media, ISBN: 978-1449311797

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. Kesawan HCL Technologies	Dr. Surendran Rajendran AMA International University Bahrain	1. Dr.M.B Mukesh Krishnan, SRMIST
Mr.Celeian, Symantec		2. Ms. Ramaprabha.J,SRMIST
		3. Dr. G. Usha,SRMIST

Course Code	18CSE478T	Course Name	OPERATION SYSTEM SECURITY	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		Computer Science and Engineering	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 introduce students to a broad range of operating system security topics	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 :	To introduce students network and system security plans																		
CLR-3 :	To introduce students security design																		
CLR-4 :	To introduce students security threats and risks																		
CLR-5 :	To introduce students system and application security tools																		
CLR-6 :	To introduce students Network monitoring and audit logs and resolution of any security breach																		

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																		
CLO-1 :	Identify and assess current and anticipated security risks and vulnerabilities	3	80	70	H	H	M	M	M	L	L	L	H	M	L	H	H	H	H
CLO-2 :	Monitor, evaluate and test security conditions and environment	3	85	75	H	H	M	M	M	L	L	L	H	M	L	H	H	H	H
CLO-3 :	Develop an organizational security plan that provides for periodic reviews of security policies and procedures	3	75	70	H	H	M	M	M	L	L	L	H	M	L	H	H	H	H
CLO-4 :	Evaluate tools and technologies for use in protecting the network and individual network systems	3	85	80	H	H	M	M	M	L	L	L	H	M	L	H	H	H	H
CLO-5 :	Implement security plan and monitor solutions	3	85	75	H	H	M	M	M	L	L	L	H	M	L	H	H	H	H
CLO-6 :	Monitor and evaluate audit logs and set administrator alerts	3	80	70	H	H	M	M	M	L	L	L	H	M	L	H	H	H	H

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Secure operating systems	What is a secure OS?	Information Protection And Security	Kali Linux	Implementation of strong password
	SLO-2	Security goals				
S-2	SLO-1	Trust model	Nature of threats/attacks	Requirements	Installation and Configuration	Implementation of buffer overflow attack
	SLO-2			Computer System Assets		
S-3	SLO-1	Threat model	Parts of an OS	Design Principles	Information Gathering Tools	Creation of child process using fork() function
	SLO-2					
S-4	SLO-1	Access Control fundamentals: Lampson's access matrix	Processes & Threads	Protection of Memory	Vulnerability Analyses Tools	Executing programs with exec() functions
	SLO-2					
S-5	SLO-1	Mandatory protection systems	Secure handling of Processes & Threads, Concurrency	User-Oriented Access Control	Wireless Attacks	Communication among multiple processes
	SLO-2					
S-6	SLO-1	Reference monitor	Memory management	Data-Oriented Access Control	Website Penetration Testing	Automating simple jobs simple scripts
	SLO-2					
S-7	SLO-1	Secure operating system definition	Secure memory management	File Sharing	Exploitation Tools	Executing programs at periodic intervals using at and crontab
	SLO-2			Access Rights		

S-8	SLO-1	*Assessment criteria*	*Secure Communication and messaging*	*Simultaneous Access*	*Forensics Tools*	*Building own shell interpreter with limited features (mini project)*
	SLO-2			*Trusted Systems*		
S-9	SLO-1	*OS Security Assessment*	*Security perspective: end-user*	*Trojan Horse Defense*	*Social Engineering*	*Retrofitting security into operating systems*
	SLO-2		*Hardware/Architecture support for OS security*			

Learning Resources	1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, "Operating System Concepts", John Wiley & Sons ,Inc., 9th Edition, 2012 2. William Stallings, "Operating System: Internals and Design Principles", Prentice Hall, 7th Edition,2012 3. Tom Adelstein and Bill Lubanovic, "Linux System Administration", O'Reilly Media, Inc., 1st Edition, 2007	4. Trent Jaeger, "Operating Systems Security", Morgan & Claypool Publishers, 2008 5. Michael J.Palmer, "Guide to Operating Systems Security", Thomson/Course Technology, 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	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. Kesawan HCL Technologies	*Dr. Surendran Rajendran* *AMA International University Bahrain*	1. Dr.M.B Mukesh Krishnan, SRMIST
Mr.Celeian, Symantec		2. Mr. M.V. Ranjith Kumar,SRMIST
		3. Mrs. S. Aruna Sankaralingam, SRMIST

Course Code	18CSE361T	Course Name	WEB PROGRAMMING	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		Computer Science and Engineering	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 :	Web has become ubiquitous in nature																		
CLR-2 :	Organizations have integrated the Internet "seamlessly" into their information systems and the Web offers endless opportunity to do so.																		
CLR-3 :	This course provides the basic concepts and techniques used to design, develop, and deploy web applications satisfying the requirements in terms of flexibility, availability and scalability.	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

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																		
CLO-1 :	Understand different internet Technologies, web 2.0 and create a basic website using HTML and Cascading Style Sheets	1	80	70	H	H	H	H	H	M	L	M	H	M	M	H	H	H	M
CLO-2 :	Design a dynamic web page with validation using JavaScript objects and by applying different event handling mechanisms	1	85	75	H	H	H	H	H	M	L	M	H	M	M	H	H	H	M
CLO-3 :	Design a server side program using Servlets and JSP	1	75	70	H	H	H	H	H	M	L	M	H	M	M	H	H	H	M
CLO-4 :	Design a simple web page in PHP, and to present data in XML format.	2	85	80	H	H	H	H	H	M	L	M	H	M	M	H	H	H	M
CLO-5 :	Get overviews of java specific web services architecture and to enable rich client presentation using AJAX.	2	85	75	H	H	H	H	H	M	L	M	H	M	M	H	H	H	M

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Understanding Internet , Difference between websites and web server	An introduction to JavaScript	Java Servlet Architecture	An introduction to PHP	Introduction to Ajax
	SLO-2	Internet technologies Overview	Java Script Terminologies	Servlet Life Cycle	Using PHP, Variables, Program control	Ajax Client Server Architecture
S-2	SLO-1	Understanding websites and web servers:	Introduction to DOM Model	Form GET and POST actions	Built-in functions	Introduction to XMLhttpRequest Object
	SLO-2	Understanding the difference between internet and	DOM Model	Session Handling ,	Connecting to Database	XMLhttpRequest Object
S-3	SLO-1	Web 2.0: Basics, RIA Rich Internet Applications	Introduction to Objects	Understanding Cookies,	Using Cookies	Introduction to Call Back Methods
	SLO-2	collaborations tools	Built-in objects: Math Object	Installing and Configuring Apache Tomcat Web Server	Regular Expressions	Call Back Methods
S-4	SLO-1	HTML5.0 Introduction	Built-in objects: String Object	Introduction to JSP	Introduction to XML	Introduction to Web Services
	SLO-2	HTML5.0 Elements Headers ,Linking,Images,List	Date Object	Understanding Java Server Pages	Basic XML Concepts	Java web services Basics
S-5	SLO-1	HTML5.0 Elements Tables, Formatting,Frames	Boolean Object	Applications on JSP	Introduction to DTD	Introduction to SOAP
	SLO-2	CSS Introduction	Object Collections	Introduction to JSTL	Document Type Definition	Elements of SOAP
S-6	SLO-1	CSS Types	Regular Expressions	Understanding of JSTL	Introduction to XML	Introduction to WSDL

	SLO-2	CSS : Positioning,Text Flow and Box Model	Examples of Regular Expressions	JSP Standard Tag Library(JSTL)	XML Schema	Creating, Publishing a WSDL
S-7	SLO-1	XHTML Introduction	Exception Handling	Creating HTML forms by embedding JSP code	DOM and Presenting XML	Testing and Describing a Web services(WSDL)
	SLO-2	XHTML Elements:Headers ,Linking,Images,List	Validation	Creating HTML forms by embedding JSP code	XML Parsers	Consuming a web service
S-8	SLO-1	XHTML Elements:Tables, Formatting,Frames	Event Handling Concept	Creating HTML forms by embedding JSP code	XML Validation	Introduction to Database Driven web service from an application
	SLO-2	CSS 3 Introduction	Introduction to DHTML	Creating HTML forms by embedding JSP code	XSLTransformation	Database Driven web service from an application
S-9	SLO-1	CSS 3 Types	DHTML with JavaScript	Lab 6:Creating HTML forms by embedding JSP code	XSLT Transformation	Applications on Database Driven web service
	SLO-2	CSS 3: Positioning,Text Flow and Box Model		Creating HTML forms by embedding JSP code	News Feed (RSS and ATOM)	Applications on Database Driven web service

Learning Resources	1. Deitel, Deitel and Nieto, Internet and World Wide Web : How to Program, 5 thEdition, 2012, Prentice Hall,. ISBN-13:978-0-13-215100-9 2. Stephen Wynkoop, Running a perfect website, QUE, 2ndEdition,2001. ISBN 13: 9780789709448 3.Chris Bates, Web Programming : Building Intranet applications, 3rdEdition,2009, Wiley Publications,. ISBN 13:9780470017753.	3.Jeffrey C. Jackson, "Web Technologies A computer Science Perspective", 2011, Pearson, ISBN 9780133001976 4. https://www.W3Schools.com

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.R.Jebakumar

Course Code	18CSE362T	Course Name	INTEGRATIVE PROGRAMMING AND TECHNOLOGY	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		Computer Science and Engineering		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 concepts and features of Integrative programming																		
CLR-2 :	Gain knowledge on Java network programming and JDBC for integrating applications																		
CLR-3 :	Gain knowledge on Java component based technology for integrating reusable components across applications																		
CLR-4 :	Acquire knowledge on XML and JSON technology for data representation and exchange in integrating applications																		
CLR-5 :	Acquire knowledge in Java Messaging Service																		
CLR-6 :	Understand interoperability between programming languages																		

Column headers for Learning: Level of Thinking (Bloom), Expected Proficiency (%), Expected Attainment (%)

PLO headers: 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

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLO-1 :	Understand the basic ideas in Integrative coding	2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	Acquire the ability to code java socket programming and java application to integrate databases	2	75	80	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-3 :	Acquire the ability to develop Enterprise Java bean components and Java based Web services	2	85	80	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	Appreciate the concepts of ML and JSON techniques in data representation and exchange for integrating applications	2	80	75	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	Acquire the knowledge for developing JMS based enterprise application integration	2	75	85	H	-	-	H	-	-	-	-	-	-	-	-	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Programming paradigms an overview	Java network programming and RMI overview	Component Based technology overview	Data representation and exchange techniques in integrating applications overview	Interoperability between programming languages an overview
	SLO-2	Integrative programming an overview,	Java networking basics	Java beans concept and feature for reusability	Understanding XML and JSON for data representation and exchange	Understanding Java platform runtime environment and JVM
S-2	SLO-1	Integrative coding and its supporting Object Oriented concepts like inheritance, interface polymorphism .	Socket programming for TCP	Visual Java Beans components features and steps for creation	Understanding XML validation, Schema,	Understanding Java Native Interface(JNI) concepts in integrating native application code in java applications
	SLO-2	Object oriented design pattern for integrative coding overview..	Options and features for socket programming	Integrating visual beans to different applications	Understanding XML parsers DOM and SAX variant parsers.	Java tools for JNI programming
S-3	SLO-1	Creational design pattern, structural design pattern, Behavioral design pattern	UDP programming using Datagram	Enterprise Java platform overview	Understanding Integration of Enterprise applications with XML	Java libraries for JNI support
	SLO-2	Concept of Inversion of Control	options and features for UDP programming	Enterprise java bean components features and types	JSON encoding and decoding implementation	Understanding Usage of IDE for JNI programming
S-4	SLO-1	Application Architecture overview	Secure socket Communication	Session bean concepts and its types	Concept of Messaging Queue in integrating software systems to exchange information Asynchronously	Understanding concepts in JNI programming .Name mangling and function signatures DLL ,The JNIEnv argument
	SLO-2	Multi-tier architecture for integrating application packages like client side,	IP multicast and Multicast socket programming	Entity bean concepts and types	JMS and its role in integrating application in java enterprise platform	Understanding Accessing of Java Strings, Passing and using Java objects in native code

		middleware and databases				
S-5	SLO-1	Enterprise application architecture, overview	RMI and distributed applications	Implementing Enterprise application through integrating session and Entity beans	JMS features and benefits	Exception handling in JNI
	SLO-2	JEE platform and its features	Understanding stub and skeleton concept in RMI	Java web services an overview	JMS service providers	Threading concept in JNI
S-6	SLO-1	Understanding Design principles in Enterprise applications	RMI programming application steps	SOAP based web services .WSDL,SOAP message	Concept of Message queues	Python integration in java platform overview
	SLO-2	Enterprise application integration overview	RMI programming implementation	JAX-WS implementation for SOAP based webservices	Point to point messaging domain features	Jython programming concepts and features
S-7	SLO-1	Role of Design Patterns in Enterprise application integration,	Concepts in Java Database connectivity in integrating java applications with various databases	RESTful web services features	Application scenario for integrating applications through p2p messaging	Installation of Jython for developing applications to run in java platform.
	SLO-2	Designing distributed object interfaces	Understanding Types of data base connectivity Different drivers	JAX-RS implementation for Restful web services	Concept of publish/subscribe method of messaging	Jython programming basics
S-8	SLO-1	Front controller patterns	JDBC application program concepts and implementation	Integrating web services component to client application	Application scenario for integrating applications through publish/subscribe method based messaging	Accessing Java features and libraries of java in Jython code
	SLO-2	Facade patterns,	Java persistence API overview	Service discovery, UDDI	Message driven beans in Enterprise JavaBeans	Java swing based GUI development in Jython
S-9	SLO-1	Adapter patterns	Java Data Objects(JDO) concepts	Policy and security for web services	Features and environmental setup for implementing Message driven beans	Understanding Jython JDBC connectivity
	SLO-2	Concepts of DAO	Java persistence API frameworks overview	Comparison between SOAP and RESTful web services	Understanding and using JMS in Message driven beans	Integrating Jython code in Java application

Learning Resources	1. KogentLearningSolutionsInc,JAVA Serve rProgramming Java EE7 BlackBook , 5th ed., Weily India, 2016. 2. ElliotteRustyHarold,JavaNetworkprogramming,O'Reilly,2013	3. Cay S. Horstmann , D. R., Core Java Volume II - Advanced Features 10nd ed., John Wiley & Sons, 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
1. Mr. Venketasan Palavesam Delivery Head L &T		1.Mr. K. Navin, SRMIST
2. K.S.Kumar COO MindZen,India private Ltd		Mr S.Ramaraj and Dr. Parthiban

Course Code	18CSE364T	Course Name	SYSTEM ADMINISTRATION AND MAINTENANCE	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	
Course Offering Department		Computer Science and Engineering	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 factors that make Authentication/Authorization and stores of system Administration																		
CLR-2 :	Acquire a knowledge and understanding of the specific problems in the Enterprise Security, and be able to apply some of the techniques																		
CLR-3 :	Identify the specific challenges that inherent in the Budget and Desktop Deployment of system Administration that are able to apply some of the techniques that can be of use in comprehending and changing them																		
CLR-4 :	Evaluate and understand the specific problems inherent in the system maintenance and evolution of package- based operating system, and be able to apply techniques for designing change-resistant systems from pre- packaged code.																		
CLR-5 :	Analyze and apply system maintenance technical concepts that relate to UPS software administration																		

Column headers for Learning: Level of Thinking (Bloom), Expected Proficiency (%), Expected Attainment (%)

PLO headers: 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

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLO-1 :	Explain terms used in make Authentication/Authorization and stores of system Administration	3	80	70	H	H	H	H	H	-	-	-	H	H	-	H	-	-	-
CLO-2 :	Incorporate a knowledge and understanding of the specific problems Enterprise Security, and be able to apply some of the	3	85	75	M	H	H	M	H	-	-	-	M	H	-	H	-	-	-
CLO-3 :	Identify challenges that inherent in maintenance and evolution of package-based operating system, and be able to apply techniques	3	75	70	M	H	M	H	H	-	-	-	M	H	-	H	-	-	-
CLO-4 :	Apply techniques for designing change-resistant systems from pre-packaged code.	3	85	80	M	H	M	H	H	-	-	-	M	H	-	H	-	-	-
CLO-5 :	Apply system maintenance technical concepts that relate to UPS software administration	3	85	75	H	H	M	H	H	-	-	-	M	H	-	H	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Authentication/Authorization	Thin client support:	Issues relating to proposal construction and endorsement: New project development issues,	Customization of Operating System and maintenance of system:3 types of media to use when backing up your data and when each method is appropriate,	UPS: Identify the specifications of UPS,
	SLO-2					
S-2	SLO-1	Storage: Storage Area Networks	LTSP, Citrix	RFC construction, RFP Process,	How to create automated backups to ensure you always have a recent backup,	Switch-on and Switch-off procedure of UPS,
	SLO-2					
S-3	SLO-1	Network Attached Storage	Windows Terminal services,	Budgeting,	Learn how to manually backup data, How to make an exact copy of a hard drive	Measurement of Input/output voltage/current levels, battery charge level,
	SLO-2					
S-4	SLO-1	Storage Virtualization, Enterprise Backup and Restoration Issues	Sun Ray Services	Budgeting for new projects	Hardware Troubleshooting: The danger in not diagnosing problems first,	Identifying status of UPS from front panelindicators,
	SLO-2					
S-5	SLO-1	Enterprise Service Deployment: Clustering and fault tolerance,	Enterprise Security:	Desktop Deployment and Management, Alternative Desktops: SUS	Learn how to test your RAM ,	carryout routine maintenance of battery, battery terminals, loose contacts etc.,
	SLO-2					
S-6	SLO-1	Virtualization of services, Grids/On Demand/N1	Disaster Recovery	RIS,	check your hard drive for errors	Test UPS as per specification. Verification of back-up time.
	SLO-2					
S-7	SLO-1	Enterprise Applications: Enterprise Resource Planning,	Policies	Sun Java Desktop,	PC Cleaning: The best cleaning supplies to use,	Circuit tracing and fault finding practice
	SLO-2					

S-8	SLO-1	Customer Relationship Management,	Planning	Xandros	How to increase airflow and increase your computers lifespan	Servicing of UPS by simulating more likely faults and systematic approach to identify and rectify them
	SLO-2					
S-9	SLO-1	Office Automation	Procedures	Lindows	How to clean your computer	backup times its dependence on battery's load and its calculations
	SLO-2					

Learning Resources	1. Tittel, et al, A Guide to Microsoft Exchange Server 5.5, Course Technology	2. 2.Hughes and Thomas, Novell's Guide to NetWare 5 Networks, IDG 3. 3.Harvel et al, Unix and Windows 2000 Handbook, Prentice Hall

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. MrS.Selvakumara Samy., SRMIST

Course Code	18CSE365T	Course Name	FUNDAMENTALS OF VIRTUALIZATION	Course Category	E	Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil		Progressive Courses	Nil			
Course Offering Department		Computer Science and Engineering		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 about Computing Virtualization tools, applications and techniques	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-2 :	Understand CPU virtualization, memory virtualization																		
CLR-3 :	How to configure VM CPU and memory options																		
CLR-4 :	Understand storage and network virtualization																		
CLR-5 :	Acquire knowledge about virtualization security																		
CLR-6 :	Learn about many case studies																		

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 :	Able to define, distinguish Computing Virtualization tools, applications and techniques	3	80	70	L	H	-	H	L	-	-	-	L	L	-	H	-	-	-
CLO-2 :	Create a virtual environment and install VM with several guest operating systems	3	85	75	M	H	L	M	L	-	-	-	M	L	-	H	-	-	-
CLO-3 :	Able to configure virtual machine CPU and memory options	3	75	70	M	H	M	H	L	-	-	-	M	L	-	H	-	-	-
CLO-4 :	Able to configure VM storage and network options	3	85	80	M	H	M	H	L	-	-	-	M	L	-	H	-	-	-
CLO-5 :	Identify threats and able to security to virtualized environment	3	85	75	H	H	M	H	L	-	-	-	M	L	-	H	-	-	-
CLO-6 :	Investigate and discuss about case studies	3	80	70	L	H	-	H	L	-	-	-	L	L	-	H	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Overview Of Virtualization -Basics of Virtualization -	Creating a Virtual machine- Performing P2V Conversions	Managing Storage for a virtual machine-Understanding storage virtualization	Theory Network Device Virtualization -VLANs	Case study: Load balancing
	SLO-2	Virtualization Types – Desktop Virtualization	Loading your Environment	Configuring VM Storage options	VRF Instances- VFIs -Virtual Firewall Contexts Network Device Virtualization	Autonomic computing
S-2	SLO-1	Storage Virtualization – System-level Operating Virtualization – Application Virtualization-	Building a new Virtual machine	Tuning practices for VM storage	Fundamentals of Virtualization security-Virtualization architecture	Xen para virtualization
S-3	SLO-1	Virtualization Advantages	Managing CPUs for a virtual machine- Understanding CPU Virtualization	SCSI- Speaking SCSI- Using SCSI buses – Fiber Channel – Fiber Channel Cables – Fiber Channel Hardware Devices – iSCSI Architecture – Securing iSCSI	Threats to a virtualized environment	Any Simulation tool
S-4	SLO-2		Configuring VM CPU options	Server virtualization concepts	How security must adapt to virtualization	Webhosting
S-5	SLO-1	Understanding Hypervisors	Tuning practices for VM CPUs	Introduction to server virtualization, Types of server virtualization technologies	Securing hypervisors-Hypervisor configuration and security	KVM virtualization
S-6	SLO-2			Limitations of server virtualization		
S-7	SLO-1	Understanding Virtual Machines Assignment-Installing windows, Linux on a virtual machine	Managing Memory for a virtual Machine- Understanding memory virtualization, Configuring VM memory options	Managing Networking for a virtual machine- understanding network virtualization	Designing virtual networks for security-comparing virtual and physical networks	Microsoft Virtual Server

| S-8 | SLO-2 | | Tuning practices for VM memory | Configuring VM network options | Virtual network security considerations | Live migration |
| S-9 | | | | Tuning practices for Virtual networks | Configuring virtual switches for security | |

| Learning Resources | 1. William von Hagen, Professional Xen Virtualization, Wrox Publications, January, 2008
2. Virtualization Essentials by Matthew Portnoy ISBN: 978-1118176719 | 3. Virtualization Security: Protecting Virtualized Environments, Dave shackleford, sybex publications,2013
4. Kumar Reddy, Victor Moreno, Network virtualization, Cisco Press, July, 2006.
5. David Marshall, Wade A. Reynolds, Advanced Server Virtualization: VMware and Microsoft Platform in the Virtual Data Center, Auerbach Publications, 2006. |

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
	Ms.SS.Subashka, SRMIST, Ramapuram	1. Mrs. TYJ Naga Malleswari SRMIST
	Mr. B.S. Vidhyasagar, SRMIST, Vadapalani	2. Mrs Sasirekha Sankar, SRMIST
		3. Dr.MB.Mukesh krishnan SRMIST

Course Code	18CSE366T	Course Name	HUMAN COMPUTER INTERACTION	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	NA	Co-requisite Courses	NA	Progressive Courses	//Course code
Course Offering Department		Computer Science and Engineering	Data Book / Codes/Standards		NA

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 HCI																			
CLR-2 :	Learn the various design and software processes																			
CLR-3 :	Become familiar with different models of HCI and evaluation techniques																			
CLR-4 :	Learn web interface design																			
CLR-5 :	Learn mobile interface design																			

Learning column headers: Level of Thinking (Bloom), Expected Proficiency (%), Expected Attainment (%)

PLO column headers: 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

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	1	2	3	4	5	6	7	8	9	10	11	12	PSO-1	PSO-2	PSO-3
CLO-1 :	Explain why it is important to design interactive products that are usable	3	75	70				M											
CLO-2 :	Explain key terms used in interactive design	3	75	70				M											
CLO-3 :	Explain the need for different models and the importance of evaluation	3	65	60															M
CLO-4 :	Gain knowledge on web interface design	3	55	50				M	H					M					M
CLO-5 :	Attain knowledge on mobile interface design	3	55	50				M	H					M					M

Duration (hour)	9	9	9	9	9
S-1	Human: I/O Channels, Memory	Interactive design basics: Design process, Navigation design	Cognitive models: Introduction and GOMS	Designing web interfaces:	Mobile Interface design:
S-2	Thinking: Reasoning and Problem Solving, Emotion	Screen design and layout, Iteration and prototyping	Linguistic model	Introduction and Brainstorming session	Introduction and Brainstorming session
S-3	Individual differences, Psychology design of interactive systems	Software process: Software lifecycle, Usability engineering	Physical and device models	Drag and Drop,	Mobile Ecosystem: Platforms
S-4	Computer: Devices, Physical controls, sensors and special devices	Iterative design and prototyping, Design rationale	Organizational issues, Capturing requirements	Direct Selection	Application frameworks
S-5	Readability of text, Memory, Processing and networks	Design rules: Principles, Standards	Communication and collaboration models:	Contextual tools	Types of mobile applications: Widgets,
S-6	Interaction: Basics and Models	Guidelines, Golden rules	face-to-face and conversation	Overlays	Application, Games
S-7	Frameworks, Ergonomics, Interaction styles	Evaluation techniques: Goals, evaluation through expert analysis	Text based Communication and Group working	Inlays and Virtual pages	Mobile Information Architecture
S-8	WIMP interface elements, Interactivity	Evaluation through user participation	Task analysis: Introduction and Task decomposition comparison	Process flow	Mobile design: Elements and Tools
S-9	Paradigms: Interactive paradigms	Universal design: Principles, Multi-modal interaction User support: Requirements and Approaches	Knowledge based analysis	Case Study discussion	Case Study discussion

Learning Resources	1. Human Computer Interaction by Alan Dix, Janet Finlay, Gregory D.Abowd and Russell Beale – Third Edition - Pearson Education – 2004 2. Human Computer Interaction by K.Meena and R.Sivakumar – 2015 – Prentice Hall India 3. Designing the User Interface: Strategies for Effective Human Computer Interaction by Ben Shneiderman and Catherine Plaisant – Fifth Edition - 2009 – Pearson Addison Wesley	4. Designing Web Interfaces by Bill Scott and Theresa Neil – First Edition – O'Reilly Media Inc. – 2009 5. Mobile Design and Development by Brian Fling - First Edition – O'Reilly Media Inc. – 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 %	

CA – 3 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
	Dr.T.Nagarajan, Professor and Head,Dept. of IT, SSN college of Engineering.	1. Dr. M. Thenmozhi, SRMIST
		2. Dr.S Prabakaran, SRMIST
		3. Dr. Alice Nithya , SRMIST

Course Code	18CSE397T	Course Name	COMPUTATIONAL DATA 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		Computer Science and Engineering	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 underlying assumptions, verify them, and propose appropriate actions if some assumptions do not hold																		
CLR-2 :	Identify appropriate statistical learning methods for the given problem involving real data.																		
CLR-3 :	Evaluate performance of the chosen regression and classification techniques and compare them																		
CLR-4 :	Show, analytically or empirically, the optimal balance between precision within training data and prediction power.																		
CLR-5 :	Use training and testing data to evaluate performance of the chosen regression and classification techniques and compare them.																		
CLR-6 :	Illustrate results with appropriate plots and diagrams.																		

Column headers for Learning: Level of Thinking (Bloom), Expected Proficiency (%), Expected Attainment (%)

PLO headers: 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

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLO-1 :	Acquire the knowledge on methods, theory, mathematics and algorithms in data analysis	2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	Acquire the ability to To formulate and model mathematical and computational tasks	2	75	80	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-3 :	Understand the basic ideas about high-level data analysis, concepts and techniques	2	85	80	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	Acquire the ability identify other possible problems with messy data, such as multi-collinearity, understand their consequences, and propose solutions.	2	80	75	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	Apply the knowledge To build from scratch the basic components of a data analysis pipeline	2	75	85	H	-	-	H	-	-	-	-	-	-	-	-	-	-	-
CLO-6 :	To Show, analytically or empirically, the optimal balance between precision within training data and prediction power.	2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	General Introduction	Generative Algorithms: Multivariate Normal	Unsupervised Learning:	Regularization and Model Selection:	Decision Tree and Random Forest:
	SLO-2	Supervised Learning	Linear Discriminant Analysis	PCA	Cross Validation,	Entropy
S-2	SLO-1	Least Squares and Nearest Neighbors	Naive Bayes	Mixture Models	Hill Climbing	Building Tree Bagging features
	SLO-2	Statistical Models	Laplacian Smoothing	Bayesian Graphical Models	Bayesian Optimization	Bagging Samples
S-3	SLO-1	Discriminative Algorithms	Multiclass Classification	Power Method	Bayesian Regression	Random Forest Adaboost
	SLO-2	Supervised Learning Concept	K-NN	Oja's algorithm	Bayesian Logistic	Gradient Tree Boosting
S-4	SLO-1	Linear Regression	Multi-class Fisher Discriminant Analysis	EM Algorithm	Regression Forward and	Boosting and Regularization Paths
	SLO-2	The Gauss–Markov Theorem	Multinomial Regression	Variational Inference	Backward Regression	Learning Ensembles
S-5	SLO-1	Multiple Regression	Support Vector Machines and Kernel Methods	Matrix Factorization/Completion	Lasso	Proximity Plots
	SLO-2	Maximum Likelihood	Intuition, Geometric Margins,	Independent Component Analysis	elastic-net	Random Forests and Overfitting
S-6	SLO-1	Normal Equation	Optimal Margin Classifier	The Google PageRank Algorithm	Proximal Gradient	Neural Network: Concept
	SLO-2	Gradient Descent	Lagrangian Duality, Soft-margin,	Principal Components, Curves and Surfaces	Prox-SVRG	Deep Neural Network
S-7	SLO-1	Stochastic Gradient	Loss function, Stochastic Subgradient	Cluster Analysis	Coordinate Proximal Gradient	Backpropagation

			Method			
	SLO-2	SVRG	Kernel, SMO algorithm	Proximity Matrices	Pathwise Coordinate Descent	Convolutional Neural Network;
S-8	SLO-1	Linear Classification	Coordinate Gradient Descent	Dissimilarities Based on Attributes	Principal Components Regression	Bayesian Neural Nets
	SLO-2	Linear Discriminant Analysis	Kernel PCA, Kernel Logistic Regression	Object Dissimilarity	Incremental Forward Stage wise Regression	Bayes, Boosting and Bagging
S-9	SLO-1	Logistic Regression	Kernel Ridge Regression	Clustering Algorithms	The Dantzig Selector	Fitting Neural Networks
	SLO-2	Newton Method	Multiclass SVM	Combinatorial Algorithms	The Grouped Lasso	Issues in Training Neural Networks

Learning Resources	1. Hastie,Tibshirani and friedman,The Elements of Statistical Learning, Data Mining, Inference and Prediction, 2nd ed., Springer,2008. 2. Mohri, Rostamizadeh and Talwalker , Foundations of Machine Learning, The MIT Press Cambridge,Massachusetts London,England,2012	3. AndrewNg.CS229Lecturenotes:http://cs229.stanford.edu/notes/cs229-notes1.pdf

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.Jayaraj Chandrasekaran, UST Global,Chennai, jayaraj.chandrasekaran@ust-global.com	Dr.Devaki,Rajalakshmi Engineering College,Professor, Department of Computer Science and Engineering,	Mrs.S.Nagadevi
		Dr.G.Vadivu

Course Code	18CSE461T	Course Name	INTERNET SECURITY AND CYBER FORENSICS	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	18CSC302J	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department		Computer Science and Engineering	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 :	Study about various threats associated with security and information warfare		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 :	Study about email security and the Importance of Firewalls and their types																			
CLR-3 :	Impart an introduction to the need of computer forensics																			
CLR-4 :	Study the tools and tactics associated with cyber forensics																			
CLR-5 :	Analyze and validate computer forensics data																			
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																			
CLO-1 :	Have thorough knowledge about various threats associated with security and information warfare		2	85	80	L	H	-	L	L	-	-	-	L	L	-	H	-	-	-
CLO-2 :	Have in-depth knowledge about email security and understand the Importance of Firewalls and their types		2	85	75	M	H	-	M	L	-	-	-	M	L	-	H	-	-	-
CLO-3 :	Understand the need of computer forensics		2	80	75	M	H	M	H	L	-	-	H	M	M	-	H	-	-	-
CLO-4 :	Utilize the tools and tactics associated with cyber forensics		3	75	70	M	H	M	H	H	-	-	H	M	M	-	H	-	-	-
CLO-5 :	Analyze and validate computer forensics data and apply them for solving computer forensics issues		3	75	70	H	H	M	H	M	-	-	H	M	M	-	H	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	IPSec Protocol – Basics	PGP – Confidentiality and Authentication	Computer Forensics Fundamentals: Introduction to Computer Forensics, Use of Computer Forensics in Law Enforcement, Computer Forensics Assistance to Human Resources/Employment Proceedings	Processing Crime and Incident Scenes: Identifying Digital Evidence	Computer Forensics Analysis and Validation, Determining what data to collect and analyze
	SLO-2	IPSec Protocol - Documents	PGP – Compression and E-mail compatibility via Radix-64 conversion	Computer Forensics Services, Benefits of Professional Forensics Methodology, Steps Taken by Computer Forensics Specialists, Who Can Use Computer Forensic Evidence?	Collecting Evidence in Private-Sector Incident Scenes, Processing Law Enforcement Crime Scenes	Validating Forensics Data, Validating with Hexadecimal Editors, Validating with Computer Forensics Programs
S-2	SLO-1	IPSec Protocol – Security Associations	MIME	Types of Computer Forensics Technology: Types of Military Computer Forensic Technology	Preparing for a Search	Data Hiding Techniques - Hiding Partitions, Marking Bad Clusters, Bit-Shifting
	SLO-2	Hashed Message Authentication Code (HMAC)	S/MIME	Types of Law Enforcement: Computer Forensic Technology	Securing a Computer Incident or Crime Scene , Seizing Digital Evidence at the Scene	Using Steganography to Hide Data,
S-3	SLO-1	IP Authentication Header	Internet Firewalls for Trusted System: Roles of Firewalls	Types of Business Computer Forensic Technology	Storing Digital Evidence, Obtaining a Digital Hash	Examining Encrypted Files, Recovering Passwords
	SLO-2	IP ESP	Firewall related terminology	Specialized Forensics Techniques	Reviewing a Case	Performing Remote Acquisition, Remote Acquisitions with Runtime Software
S-4	SLO-1	Key Management Protocol for IPSec – OAKELY Key Determination Protocol	Types of Firewalls	Types of Computer Forensics Systems: Internet Security Systems, Intrusion Detection Systems, Firewall Security Systems	Working with Windows and DOS Systems	Network Forensics

	SLO-2	Key Management Protocol for IPSec – ISAKMP	Packet filters	Storage Area Network Security Systems, Network Disaster Recovery Systems, Public Key Infrastructure Systems	Understanding File Systems, Exploring Microsoft File Structures	Securing a Network
S-5	SLO-1	Transport layer Security : SSL and TLS	Circuit level gateways	Wireless Network Security Systems, Satellite Encryption Security Systems, Instant Messaging (IM) Security Systems , Net Privacy Systems	Examining NTFS Disks	Email Investigations – Exploring the Role of E-mail in Investigations, Exploring the Roles of the Client and Server in E-mail
	SLO-2	SSL Protocol	Application level gateways	Identity Management Security Systems, Identity Theft, Biometric Security Systems, Homeland Security Systems	Understanding Whole Disk Encryption	Investigating E-mail Crimes and Violations: Examining E-mail Messages, Viewing E-mail Headers, Examining E-mail Headers, Examining Additional E-mail Files
S-6	SLO-1	SSL Record Protocol	Firewall designs	Understanding Computer Investigation: Preparing a Computer Investigation, Taking a Systematic Approach	Understanding the Windows Registry	Tracing an E-mail Message,Using Network E-mail Logs
	SLO-2	SSL Change Cipher Spec Protocol	Screened Host Firewall (Single – Homed Bastion Host)	Procedures for Corporate High-Tech Investigations	Understanding Microsoft Startup Tasks, Understanding MS-DOS Startup Tasks, Understanding Virtual Machines	Understanding E-mail Servers - Examining UNIX E-mail Server Logs, Examining Microsoft E-mail Server Logs, Examining Novell GroupWise E-mail Logs, Using Specialized E-mail Forensics Tools
S-7	SLO-1	SSL Alert Protocol	Screened Host Firewall (Dual – Homed Bastion Host)	Understanding Data Recovery Workstations and Software	Current Computer Forensics Tools: Software/ Hardware Tool	Cell Phone and Mobile Devices Forensics
	SLO-2	SSL Handshake Protocol	Screened Subnet Firewall	Conducting an Investigation, Completing the Case	Evaluating Computer Forensics Tool Needs	Understanding Mobile Device Forensics
S-8	SLO-1	Cryptographic Computations – Computing the Master Secret	SET for E-Commerce Transactions: Business requirements for SET	Data Acquisition: Understanding Storage Formats for Digital Evidence, Determining the Best Acquisition Method, Contingency Planning for Image Acquisitions, Using Acquisition Tools	Types of Computer Forensics Tools, Tasks Performed by Computer Forensics Tools	Mobile Phone Basics, Inside Mobile Devices
	SLO-2	Cryptographic Computations – Converting the Master Secret into Cryptographic Parameters	SET System Participants	Validating Data Acquisitions, Performing RAID Data Acquisitions	Computer Forensics Software Tools, Command-Line Forensics Tools, UNIX/Linux Forensics Tools, Other GUI Forensics Tools	Inside PDAs
S-9	SLO-1	TLS Protocol	SET Cryptographic Operation Principles, Dual Signature, Authentication and Message Integrity	Using Remote Network Acquisition Tools	Computer Forensics Hardware Tools, Forensic Workstations, Using a Write-Blocker, Recommendations for a Forensic Workstation	Understanding Acquisition Procedures for Cell Phones and Mobile Devices
	SLO-2	Cryptographic Computations for TLS	SET Payment Processing	Using Other Forensics Acquisition Tools	Validating and Testing Forensics Software, Using National Institute of Standards and Technology (NIST) Tools, Using Validation Protocols	Mobile Forensics Equipment

| Learning Resources | 1. Man Young Rhee, "Internet Security: Cryptographic Principles, Algorithms and Protocols", Wiley Publications, 2003
2. Christopher Steuart, Bill Nelson, Amelia Phillips, "Guide Computer Forensics and Investigations", Cengage Learning, India, Fourth Edition, 2013. | 2. John R.Vacca, "Computer Forensics: Computer Crime Scene Investigation", Charles RiverMedia, 2002.
3. Richard E.Smith, "Internet Cryptography", Pearson Education, 3rd Edition, 2008.
4. Marjie T.Britz, "Computer Forensics and Cyber Crime: An Introduction", Pearson Education, 3rd Edition, 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
	1. Dr.L.Kavisankar, Associate Professor, Department of Computer Science and Engineering, Hindustan Institute of Technology and Science, Chennai, India	1. Mr. S.Saminathan, SRMIST
		2. Dr.M.B.Mukesh Krishnan, SRMIST

Course Code	18CSE462T	Course Name	DATA CENTRE ADMINISTRATION AND MANAGEMENT	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		Computer Science and Engineering		Data Book / Codes/Standards		Nil			

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1 :	Critically discuss data center networking technologies
CLR-2 :	Evaluate key concepts in data center design
CLR-3 :	Concepts related to data center maintenance
CLR-4 :	Design, build and configure a data centers
CLR-5 :	Expose to implementing the various system management practices

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom) 1	Expected Proficiency (%) 2	Expected Attainment (%) 3	Engineering Knowledge 1	Problem Analysis 2	Design & Development 3	Analysis, Design, Research 4	Modern Tool Usage 5	Society & Culture 6	Environment & Sustainability 7	Ethics 8	Individual & Team Work 9	Communication 10	Project Mgt. & Finance 11	Life Long Learning 12	PSO – 1 13	PSO – 2 14	PSO – 3 15
CLO-1 :	Manage Server Systems and Data Centres Infrastructure Management	1	90	85	L	-	-	M	-	-	-	-	-	-	-	H	L	-	-
CLO-2 :	Utilize the Storage, Bandwidth, Efficiency of systems and other resources for Data centre.	3	85	80	M	M	H	H	H	-	-	-	-	-	-	H	M	H	-
CLO-3 :	Monitoring the Networks and Resources. .	3	85	80	M	H	H	H	H	-	-	-	-	-	-	H	M	H	-
CLO-4 :	Planning for Flexible resource allocation	3	80	75	M	H	H	H	H	-	-	-	-	-	-	H	H	H	-
CLO-5 :	Administer the data centers	3	80	75	H	H	H	H	H	H	-	M	-	-	-	H	M	H	H

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Data center Architecture	Data Center design	Data Center Maintenance	Data Center HVAC	System Management Best Practices
	SLO-2					
S-2	SLO-1	Data center Requirements	Characteristics of an Outstanding Design	Network Operations Center, Network Monitoring	Reasons for Strict Environmental Requirements	Server Cluster Best Practices
	SLO-2					
S-3	SLO-1	Data center prerequisites	Characteristics of an Outstanding Design	Datacenter physical security	Need for Energy-Efficient HVAC Systems	Data Storage Best Practices
	SLO-2					
S-4-5	SLO-1	Physical Area for Equipment and Unoccupied Space	Guidelines for Planning a Data Center	Data center Logical security	Air-Conditioning Systems	Network Management Best Practices
	SLO-2					
S-6	SLO-1	Required power to run all the devices	Data Center structures	Data center Cleaning	Air Circulation in a Data Center	Security Guidelines Internet security
	SLO-2					
S-7	SLO-1	Required cooling and HVAC Required weight	Raised Floor Design and Deployment	Floor Surface Cleaning	Placement of Hardware Racks	Best Practices for System Administration
	SLO-2				Bottom-to-Top Cooled Racks	
S-8	SLO-1	Budget Constraints	Design and Plan against Vandalism	Subfloor and Above-Ceiling Plenum Cleaning	Top-to-Bottom Cooled Racks	Device Naming, Naming Practices
	SLO-2				Front-to-Front Cooled Racks	
S-9	SLO-1	Selecting a Geographic Location Safety from Natural hazards	Data center design case study	Equipment Cleaning	Front-to-Back Cooled Racks	Load balancing, Terminology, Advantages &Types of load balancing
	SLO-2					

| Learning Resources | 1. Mouricio Arregoces, "Data Centre Fundamentals", Cisco Press ,2003
2. Administering Data Centers: Servers, Storage and Voice over IP, Kailash Jayaswal.
3. Kevin Corbin, Ron Fuller, David Jansen, "NX-OS and Cisco Nexus Switching: Next-Generation Data Center Architectures" Cisco Press; 1 edition [ISBN: 9781587058929], 2010.
4. SilvanoGai, TommiSalli, Roger Andersson, "Cisco Unified Computing System" Cisco Press; 1 edition, [ISBN: 9781587141935], 2010. | 5. Nash Darukhanawalla, Patrice Bellagamba, "Interconnecting Data Centers Using VPLS" Cisco Press; 1 edition, [ISBN: 9781587059926], 2009.
6. Robert W. Kembel, Roger Cummings (Introduction), "The Fibre Channel Consultant" Northwest Learning Assoc; 3rd edition, [ISBN: 0931836840], 1998.
7. Robert W Kembal"Fiber Channel Switched Fabric" Northwest Learning Associates, inc. [ISBN: 0931836719], 2009.
8. John L. Hufferd, "ISCSI", Addison-Wesley Boston [ISBN: 978- 0201784190], 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
Dr.M.S.Sricharan/Wipro Technologies		Dr. B.Amutha, Professor and Head, Department of CSE, SRM IST
		Dr. G.Vadivu, Professor and Head, Department of IT, SRM IST

Course Code	18CSE463T	Course Name	IT SERVICE MANAGEMENT AND OPERATIONS	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	Computer Science and Engineering	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 develop an awareness of the opportunities that information technology can have for enhancing service firms' competitiveness.																		
CLR-2 :	To appreciate the organizational significance of managing the IT service encounter to achieve internal and external customer satisfaction.																		
CLR-3 :	To understand new service development from both a product and process perspective.																		
CLR-4 :	To gain an appreciation of the complexities associated with implementing change during IT services.																		
CLR-5 :	to understand how an integrated ITSM framework																		
CLR-6 :	To Understand practical implementation of Information Technology Service Management																		

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 :	Illustrate the basic concepts of Service Science, Management, and Engineering	3	80	70	L	H	L	H	L	L	M	L	L	L	M	L	L	L	L
CLO-2 :	Examine the principle of IT service processes	3	85	75	L	H	L	H	L	L	M	L	L	L	M	L	L	L	L
CLO-3 :	Skills for planning, estimating, and resourcing for IT services	3	75	70	L	H	L	H	L	L	M	L	L	L	M	L	L	L	L
CLO-4 :	Manage the scope changes and the organizational changes in IT services	3	85	80	L	H	L	H	L	L	M	L	L	L	M	L	L	L	L
CLO-5 :	Ability to identify IT services as a means to provide functionality and value to customers in the context of specific case studies	3	85	75	L	H	L	H	L	L	M	L	L	L	M	L	L	L	L
CLO-6 :	Ability to understand the needs and targets of the different stakeholders (service providers, customers, suppliers/partners) in the services value chain.	3	80	70	L	H	L	H	L	L	M	L	L	L	M	L	L	L	L

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Introduction	IT Project/Service Management	Communication Management	Service management concepts and frameworks	Planning and delivery processes
	SLO-2	Overview of Service Science, Management, Engineering				
S-2	SLO-1	IT Infrastructure	Planning	Team Building in IT Services	Services and service management	Service reporting
	SLO-2					
S-3	SLO-1	RFID Applications	Estimating	IT service project in a start-up company	Customer-facing services	Service availability and continuity management
	SLO-2					
S-4	SLO-1	Data Storage Management	Resourcing	Smaller IT service organization	Resource-facing services	Capacity management
	SLO-2					
S-5	SLO-1	IT Service Strategy	IT Project/Service Change	Soft Skills in IT Service Management	The service lifecycle. Processes. Functions. Roles	Information security management
	SLO-2					
S-6	SLO-1	Approach, and Practice	Quality	Presentation skills	Service strategy	Customer relationship management

	SLO-2					
S-7	SLO-1	IT Infrastructure Library	Issue	Negotiation skills	Service portfolio	Supplier relationship management.
	SLO-2					
S-8	SLO-1	e-Business Case Study	Risk Management	Job interview skills	Service catalog management	Service management tools
	SLO-2					
S-9	SLO-1	IT service report of IBM e-business at Ford Motor	Evaluate issue, and mitigate risk in IT service management	IBM perspectives of IT Service Management	Service level agreements.	Tool assessment framework
	SLO-2				Operational level agreements	Analysis of specific ITSM tools

Learning Resources	1. Service Management, Fourth Edition, J.A. Fitzsimmons and M.J. Fitzsimmons, McGraw Hill. 2. Services Marketing, Valerie Zeithaml, Mary Jo Bitner, and Dwayne Gremler, McGraw-Hill. 3. Introduction to Operations Research, Hillier and Lieberman	4. Service modeling, Principles and Applications. Vilho Råisånen, Wiley 5. Understanding Service Business, S.E. Sampson, Wiley.

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. Kesawan HCL Technologies	Dr. Surendran Rajendran AMA International University Bahrain	1. Dr.M.B Mukesh Krishnan, SRMIST
Mr.Celeian, Symantec		2. Mr.C.Santhanakrishnan, SRMIST
		3. Mr. G. Senthil Kumar , SRMIST

Course Code	18CSE464T	Course Name	COMPUTER GRAPHICS AND GAME PROGRAMMING	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	Computer Science and Engineering	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 fundamental concepts of generating basic output primitives	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-2 :	Know the basics of transformations and curves and surface representations																		
CLR-3 :	Know the various visible surface detection methods and various color models																		
CLR-4 :	Learn the interfaces of Unity and its installation procedure																		
CLR-5 :	Know the various objects in Unity to develop games																		

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 :	Have a very good understanding of generating various output primitives	2	80	85	-	-	H	-	-	-	-	-	-	-	-	-	-	M	-
CLO-2 :	Posses the ability to represent various curves and surfaces	2	75	80	-	-	-	-	-	-	-	-	-	-	-	-	-	M	-
CLO-3 :	Have a clear understanding of various visible surface detection algorithms and color models	2	85	80	-	-	-	-	-	-	-	-	-	-	-	-	-	M	-
CLO-4 :	Apply the knowledge to install and explore the interfaces of Unity	2	80	75	-	-	H	-	H	-	-	-	H	-	-	-	-	-	-
CLO-5 :	Possess the ability to design and implement games using Unity	2	75	85	-	-	H	-	H	-	-	-	H	-	-	-	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Graphics systems Overview and IO devices	Basic Three-Dimensional Concepts	Classification of visible surface detection Algorithms	Introduction to Unity Installation and its interface	Concept of collisions
	SLO-2					
S-2	SLO-1	Applications of Computer Graphics	Clipping operations-Point, Line and Polygon	Back-face detection, Depth buffer method and A-buffer method	Game objects, 2D&3D and its transformation	Introduction to Prefabs
	SLO-2					
S-3	SLO-1	Line drawing algorithms	Curve, Text and Exterior Clipping	Scan line method, Depth sorting method, BSP and Area sub division method	Fundamentals of models, materials and shaders	Handling sprites and adding UI to the game
	SLO-2					
S-4	SLO-1	Circle drawing algorithms	Polygon Clipping algorithms	Octree, Ray casting method and curved surfaces	How to sculpt terrain	Basics of particle systems
	SLO-2					
S-5	SLO-1	Ellipse drawing algorithms	Plane equations and meshes	Basic models of illumination	Adding environments	Basics of animation
	SLO-2					
S-6	SLO-1	Filled area primitives	Curved line& surfaces	Halftone and ditheringtechniques	Using lights	Designing a complex game
	SLO-2					
S-7	SLO-1	Basics of Geometric transformations	Quadratic surfaces and Blobby objects	Properties of Light, RGB Color Model	Using cameras	Basics of audio in Unity
	SLO-2					
S-8	SLO-1	Reflection and shearing -2D	Fractals	YIQ, and CMY color model	Designing a basic game	Basics of audio in Unity

	SLO-2					
S-9	SLO-1	2D viewing and window to viewport	Bezier and B-Spline curves and surfaces	HSV and HLScolor model, Color selection	Introduction to scripting	Requirements for mobile game development
	SLO-2					

Learning Resources	1. Donald Hearn & M.PaulineBaker,"Computer Graphics C Version", 2nd Edition, Pearson Education, 2010, ISBN 978-93-325-3587-9 2. John F.Hughes, Andries VanDam, Morgan McGuire, David F.Sklar, James D.Foley, Steven K.Feiner, KurtAkeley, "Computer Graphics: Principles and Practice",3rd Edition, Addison-Wesley Professional, 2013, ISBN-13: 0785342399523 3. Mike Geig, "Unity 2018 Game Development in 24 Hours, Sams Teach Yourself " 3rd Edition, Pearson Education, 2018, ISBN-13:978-0134998138, ISBN-10:0134998138	4. Joseph Hocking, "Unity in Action: Multiplatform game development in C#", 2nd Edition, Manning Publications Company, ISBN: 9781617294969 5. Dr. Edward Lavieri, "Getting Started with Unity 2018 - Third Edition: A Beginner's Guide to 2D and 3D game development with Unity ", Packt Publishing Ltd., 2018, ISBN-10: 1788830105, ISBN-13: 978-1788830102.

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
Valiyullasha, Bugtreat Technologies, UK, coe@bugtreat.com	C.M.T.Karthigeyan, Assistant Professor, Government College of Engineering, Bargur, email: c.m.t.karthikeyan@gcebargur.ac.in	P.Rajasekar, Assistant Professor, Department of Information Technology, Faculty of E&T,&SRMIST, email: rajasekp@srmist.edu.in

Course Code	18CSE465T	Course Name	COMPUTATIONAL MEDIA	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		Computer Science and Engineering		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 fundamental concepts of analog and digital data																			
CLR-2 :	Know the basics of bitmap, DCT and color models																			
CLR-3 :	Learn the various tools for digital image processing																			
CLR-4 :	Know the basics of digital audio representation																			
CLR-5 :	Understand the concepts of video and its compression methods																			

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 :	Have a very good understanding of analog and digital data	2	80	85	-	-	H	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	Have a clear understanding of bitmap, DCT and color models	2	75	80	-	-	H	-	-	-	-	-	-	-	-	-	-	M	-
CLO-3 :	Possess the ability to handle various tools for digital image processing	2	85	80	-	-	H	-	-	-	-	-	-	-	-	-	-	M	-
CLO-4 :	Apply the knowledge to represent digital audio	2	80	75	-	-	H	-	H	-	-	-	H	-	-	-	-	M	-
CLO-5 :	Possess the ability to compress the video	2	75	85	-	-	H	-	H	-	-	-	H	-	-	-	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Introduction	Bitmaps- Frequency in digital images	Tools for digital image processing	Introduction of digital audio representation	Tools for digital audio processing
	SLO-2					
S-2	SLO-1	Analog to digital conversion	Discrete Cosine Transform	Digital image file types	Audio waveforms	Dynamics processing- Audio restoration
	SLO-2					
S-3	SLO-1	Data storage	Aliasing	Indexed colors - Dithering	Pulse code modulation & audio digitization	Digital audio filters and related processing
	SLO-2					
S-4	SLO-1	Data Communication	Color models	Channels, layers and masks	Sampling rate and aliasing	Pulse code modulation & audio digitization
	SLO-2					
S-5	SLO-1	Data Communication	Color models	Blending modes	quantization and quantization error	Designing and implementing your own file
	SLO-2					
S-6	SLO-1	Compression methods	Color models	Pixel point processing	Frequency analysis	Digital audio compression
	SLO-2					
S-7	SLO-1	Compression methods	Vector graphics	Spatial filtering	Frequency analysis	Fundamental concepts in video
	SLO-2					
S-8	SLO-1	Standards and standardization organizations	Vector graphics	Resampling and interpolation	Statistical analysis of an audio file	Basic video compression
	SLO-2					
S-9	SLO-1	Mathematical modeling tools for the study of digital media	Algorithmic art and procedural modeling	Digital image compression	MIDI	MPEG 1 and 2
	SLO-2					

Learning Resources	1. Jennifer Burg, "The Science of Digital Media", Pearson Education, ISBN: 978-01324335802 2. Ze-Nian Li and Mark.s.Drew, "Fundamentals of Multimedia", Pearson Education International, ISBN 0-13-127256-X	3. Fred Halsall, "Multimedia Communications: Applications, Networks, Protocols and Standards", Pearson Education India, 2002, ISBN-10: 8131709949 and ISBN-13: 978-8131709948

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
Valiyullasha, Bugtreat Technologies, UK, coe@bugtreat.com	C.M.T.Karthigeyan, Assistant Professor, Government College of Engineering, Bargur, email: c.m.t.karthikeyan@gcebargur.ac.in	P.Rajasekar, Assistant Professor, Department of Information Technology, Faculty of E&T,&SRMIST, email: rajasekp@srmist.edu.in

Course Code	18CSE345T	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		CSE			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 Data and Knowledge Management and use of Devices in IoT Technology.																		
CLR-2 :	Understand State of the Art – IoT Architecture.																		
CLR-3 :	To Understand the Architectural Overview of IoT																		
CLR-4 :	Understand the IoT Reference Architecture and RealWorld Design Constraints																		
CLR-5 :	To Understand the various IoT Protocols (Datalink, Network, Transport, Session, Service)																		
CLR-6 :	Understand and apply IoT protocols appropriately																		

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 :	Interpret the vision of IoT architecture from a global context.	2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	Implement state of the art architecture in IoT.	2	75	80	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-3 :	Compare and Contrast the use of Devices, Gateways and Data Management in IoT.	2	85	80	H	M	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	Implement using the available resources and demonstrate quick to deployment protocols wherever applicable	2	80	75	H	H	H	M	-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	Apply the protocols and Techniques towards integration in relevant areas of IoT Product development	2	75	85	H	M	H	M	H	-	-	-	M	-	-	H	-	-	-
CLO-6 :	Choose appropriate protocols for various layers (Datalink, Network, Transport, Session, Service)	2	80	85	H	M	H	H	H	-	-	-	H	-	-	H	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	M2M and IoT- Relevance and Transition	Data Management- Introduction	Introduction to RFID	Transport Layer Protocols - Introduction	Service Layer Protocols- Introduction
	SLO-2	Building an architecture	Managing M2M data: Data generation,	Introduction to NFC	TCP	oneM2M
S-2	SLO-1	Main design principles and needed capabilities	Data acquisition, Data validation	WSN(Large topic),	MPTCP	ETSI M2M
	SLO-2	IoT architecture outline	Data storage, Data processing	Narrow band IoT (NbIOT)	UDP	OMA
S-3	SLO-1	M2M and IoT Technology Fundamentals	Data remanence, Data analysis	WiFi	DCCP	BBF
	SLO-2	Devi ces and Gateways-Introduction	Data management,	PLC Communication Protocols: A comparison	SCT	Understanding Security and Interoperability
S-4	SLO-1	Basic Devices	Business processes in IoT	Popular radio protocols and its security drawbacks	TLS	Modes of attack: DoS, Getting Access, Guess, Man in Middle, Sniff, Post Scan
	SLO-2	Gateways	Everything as a Service (XaaS)	802.15.4 in depth	DTLS	Modes of attack: Web Crawl, Search Features and Wild Cards, Breaking Cipher
S-5	SLO-1	Advanced devices	M2M and IoT Analytics	Network Layer Protocols- Introduction	Session Layer-HTTP	Tools for achieving Security: VPN, X.509, Authentication,
	SLO-2	Need for networking	Knowledge Management	IPv4	CoAP	Tools for achieving Security: User names and Passwords, Message Brokers,
S-6	SLO-1	State of the art-ETSI M2M	Data Link Layer Protocols: PHY/MAC Layer:3GPP MTC	IPv6	Implementation demo of CoAP	Tools for achieving Security: Provisioning servers, Centralization versus decentralization,

	SLO					
	SLO-2	IoT Reference model-IoT Domain model	IEEE 802.11	6LoWPAN in depth	MQTT	The need for interoperability:
S-7	SLO-1	Information model	IEEE 802.15	6TiSCH	Implementation demo of MQTT	Combining Security and Interoperability
	SLO-2	Functional model	Wireless HART	ND	MQTT-SN	Need for Security in IoT Protocols – Introduction
S-8	SLO-1	Communication model	Z-Wave	DHCP	Implementation demo of MQTT-SN	Security in IoT Protocols :MAC 802.15.4
	SLO-2	Safety, privacy, trust, security model	Bluetooth, Bluetooth Low Energy	ICMP	XMPP	Security in IoT Protocols :6LoWPAN,
S-9	SLO-1	Introduction to Protocols- Physical, Data Link	Zigbee, Zigbee Smart Energy	RPL	AMQP	Security in IoT Protocols :RPL
	SLO-2	Introduction to Protocols- Network, Transport, Application	DASH7	CORPL, CARP	Introduction to Contiki- Practical demo	Security in IoT Protocols: Application Layer

Learning Resources	1. Uckelmann, D., Harrison, M., & Michahelles, F. (Eds.). Architecting the Internet of Things.doi:10.1007/978-3-642-19157-2 , 2011 2. IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things by Rob Barton, Gonzalo Salgueiro, David Hanes, Publisher: Cisco Press, Release Date: June 2017, ISBN: 9780134307091 (https://www.oreilly.com/library/view/iot-fundamentals-networking/9780134307091/) 3. 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	4. Peter Waher, "Learning Internet of Things", PACKT publishing, BIRMINGHAM – MUMBAI 5. Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", ISBN: 978-1-118- 47347-4, Willy Publications

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. Vinay Solanki, Head IoT, Lenovo (APAC & MEA)	Dr.Zayaraj, Professor / CSE, PEC, Pondicherry	Dr. S.Babu, SRMIST
Dr. Paventhan Arumugum, Director (R&D), ERNET India	Dr.Vijalakshmi Associate Professor / CSE, PEC, Pondicherry	Dr.Kayalvizhi Jayavel, SRMIST
Shiv Kumar Ganesh, Full Stack Developer, Altimetrik	Dr.P.Yogesh, Professor/IT, Anna University, Chennai.	Mr.V.Haribaabu, SRMIST

Course Code	18CSE346T	Course Name	NETWORK PROGRAMMING	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	18CSC302J	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department		Computer Science and Engineering	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 learn different socket function and implement client server applications using sockets																		
CLR-2 :	To conduct experiments to know how different internet protocols like TCPIP works																		
CLR-3 :	To analyze various application program like TELNET, DNS, DHCP	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-4 :	Build different application like Routing, Load balancing & Security																		
CLR-5 :	To apply protocols get adapted to emerging technologies																		

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 :	Become familiar with elementary socket functions	3	80	70	L	H	-	H	L	-	-	-	-	L	L	-	H	-	-	-
CLO-2 :	Design and implement client –server applications using Sockets	3	85	75	M	H	L	M	L	-	-	-	-	M	L	-	H	-	-	-
CLO-3 :	Learn about functions that convert between names and numeric values and protocols	3	75	70	M	H	M	H	L	-	-	-	-	M	L	-	H	-	-	-
CLO-4 :	Analyze network programs	3	85	80	M	H	M	H	L	-	-	-	-	M	L	-	H	-	-	-
CLO-5 :	Build network applications	3	85	75	H	H	M	H	L	-	-	-	-	M	L	-	H	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Introduction	Socket function	Get sock opt function	DNS	Internet Protocol
	SLO-2	simple daytime client	connect function	set sock opt function	resolvers and name servers	
S-2	SLO-1	protocol independence	bind function	IPV4	gethostbyname function	IPV4
	SLO-2	Error handling	listen function	ICMP	gethostbyaddr function	
S-3	SLO-1	simple daytime server	accept function	TCP socket options	getservbyname	IPV6 interoperability
	SLO-2	Roadmap to client/server.	Fork function		getservbyport function	
S 4-5	SLO-1	Overview of TCP/IP protocol- TCP connection establishment and termination	exec function	UDP Echo server and client	tcp_connect function-	Daemon processes
	SLO-2					
S-6	SLO-1	TCP state transition diagram – Time-wait state	concurrent servers	recvfrom function	tcp_listen function	Daemon processes and the inetdsuperserver
	SLO-2	SCTP association establishment and termination	close function-getsockname and getpeername	send to function	udp_client	
S-7	SLO-1	TCP port numbers and concurrent servers	TCP Echo server, TCP Echo client	Connect function with UDP	udp_connect	Advanced I/O functions
	SLO-2	Buffer size and limitations	normal startup and termination		udp_server function	
S 8-9	SLO-1	standard internet services	POSIX signal handling, Wait and Waitpid functions	dg_cli function	BOOTP	Advanced I/O functions
	SLO-2	protocol usage by common,Internet applications	Termination of server process, Crashing and rebooting of server host	lack of flow control with UDP	DHCP	

Learning Resources	1. W.Richard Stevens, Bill Fenner, Andrew M. Rudoff " Unix Network programming " 3rd edition, Volume – 1, Pearson Education , 2015 R.F.Gilberg, B.A.Forouzan, Data Structures, 2nd ed., Thomson India, 2005 2. Douglas.E.Comer " Internetworking with TCP/IP " principles, protocols and architecture, 6th Edition , Volume 1, Pearson Education,2013	3. Behrouz A.Forouzan , " TCP/IP protocol suite", 4th edition, Mc Graw Hill education private limited,2010 4. Wendell Odom , " IP networking ", 1st edition, Pearson Education 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.Viswanadham, Teken BIM Technologies Pvt. Ltd, 9962514477, Viswanathan_alladi@yahoo.com	Dr. Latha, Prof & Head, CSE dept, SAIRAM engg college,latha.cse@sairam.edu.in, 8754502224	1. MrsT.Manoranjitham, SRMIST
		2. Mr. Godwin , SRMIST
		3. Ms. Vinoth, SRMIST

Course Code	18CSE445T	Course Name	INTERNET OF THINGS SECURITY	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	
Course Offering Department		Computer Science and Engineering		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, various attacks and importance of Security aspects in IoT																		
CLR-2 :	Understand the techniques, protocols and some idea on security towards Gaming models																		
CLR-3 :	Understand the relevance of Blockchain, its techniques towards IoT																		
CLR-4 :	Understand the operations of Bitcoin blockchain, crypto-currency as application of blockchain technology																		
CLR-5 :	Understand the essential components of IoT																		
CLR-6 :	Understand security and privacy challenges of IoT																		

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 :	Incorporate the best practices learnt to identify the attacks and mitigate the same	3	80	70	L	H	M	H	M	-	-	-	M	L	-	H	-	-	-
CLO-2 :	Adopt the right security techniques and protocols during the design of IoT products	3	85	75	L	H	M	H	M	-	-	-	M	L	-	H	-	-	-
CLO-3 :	Apply the skills learnt towards gaming designs	3	75	70	L	H	M	H	M	-	-	-	M	L	-	H	-	-	-
CLO-4 :	Assimilate and apply the skills learnt on cipers and blockchains when appropriate	3	85	80	L	H	M	H	M	-	-	-	M	L	-	H	-	-	-
CLO-5 :	Describe the essential components of IoT	3	85	75	L	H	M	H	M	-	-	-	M	L	-	H	-	-	-
CLO-6 :	Find appropriate security / privacy solutions for IoT	3	80	70	L	H	M	H	M	-	-	-	M	L	-	H	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Fundamentals of IoT and Security and its need	Prevent Unauthorized Access to Sensor Data	Block ciphers	Introduction to Blockchain	Introduction of IoT devices
	SLO-2	IoT Security Requirements	,M2M Security,	Message integrity	Modeling faults and adversaries	Difference among IoT devices, computers, and embedded devices.
S-2	SLO-1	IoT and cyber-physical systems	RFIDSecurity,	Authenticated encryption	Byzantine Generals problem	sensors and actuators in IoT
	SLO-2	IoT security (vulnerabilities, attacks, and countermeasures),	Cyber Physical Object Security, ,	Hash functions	Consensus algorithms and their scalability problems	Accelerometer, photoresistor, buttons
S-3	SLO-1	Security engineering for IoT development	Hardware Security,	Merkle trees and Elliptic curves	digital signatures, verifiable random functions, Zero-knowledge systems	motor, LED, vibrator,
	SLO-2	IoT security lifecycle	Front-end System Privacy Protection, Management,Secure IoT Databases	Public-key crypto (PKI),	blockchain, the challenges, and solutions,	analog signal vs. digital signal
S-4	SLO-1	Data Privacy	Networking Function Security	Trees signature algorithms	proof of work, Proof of stake,	Networking in IoT
	SLO-2	Device/User Authentication in IoT	IoT Networking Protocols,	Crypto-currencies,	alternatives to Bitcoin consensus, Bitcoin scripting language and their use	Real-time communication
S-5	SLO-1	Introduction to Authentication Techniques	SecureIoT Lower Layers,	Bitcoin P2P network,	Ethereum and Smart Contracts,	Bandwidth efficiency
	SLO-2	Data Trustworthiness in IoT	SecureIoT Higher Layers,	Distributed consensus, , ,	Smart Contract Languages and verification	data analytics in IoT - simple data

					challenges	analyzing methods
S-6	SLO-1	Human IoT Trust Relationship	Secure Communication	Incentives and proof-of-work	comparing Bitcoin scripting vs. Ethereum Smart Contracts	IoT architecture, component and technology
	SLO-2	Trust and Reputation Systems	Links in IoTs,Back-end Security - Secure Resource	Mining, scripts and smart contracts	Hyperledger fabric	Case study: discussion on specific IoT applications and their design considerations
S-7	SLO-1	Trust Negotiation	Game Theory Foundation	Wallets: hot and cold storage ,anonymity, altcoins	Mechanisms in permissioned blockchain	cybersecurity overview in IoT
	SLO-2	IoT Privacy Preservation Issues	Mixed-strategy, ,	Credential management for connected devices: Security credential management system (SCMS),	Pseudo-anonymity vs. anonymity	General cybersecurity concepts in IoT
S-8	SLO-1	Attack Models - Attacks to Sensors in IoTs,	Nash equilibrium	VehicleBased Security System (VBSS),	Zcash and Zk-SNARKS for anonymity preservation	security threats in IoT
	SLO-2	Attacks to RFIDs in IoTs,	Repeated games	PKI design, Certification provisioning	Attacks on Blockchains	data privacy in IoT
S-9	SLO-1	Attacks to Network Functions in IoTs,	Bayesian games	Pseudonyms (privacy-by design),	Sybil attacks, selfish mining	device/User authentication in IoT
	SLO-2	Attacks to Back-end Systems and security in Front end Systems	Coalitional games.	Misbehavior detection and Revocation,	51% attacks	data trustworthiness problem in IoT

Learning Resources	1. B.RusellandD.VanDuren,"PracticalInternetofThingsSecurity,"PacktPublishing,2016. 2. FeiHU,"SecurityandPrivacyinInternetofThings(IoTs):Models,Algorithms,and Implementations", CRCPress,2016 3. Narayanan et al., "Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction," Princeton University Press,2016. 4. A.Antonopoulos,"MasteringBitcoin:UnlockingDigitalCryptocurrencies,"O'Reilly,2014	5. T. Alpcan and T. Basar, "Network Security: A Decision and Game-theoretic Approach," Cambridge University Press,2011. 6. SecurityandtheIoTecosystem,KPMGInternational,2015 7. InternetofThings:IoTGovernance,PrivacyandSecurityIssues"byEuropeanResearchCluster 8. Ollie Whitehouse, "Security of Things: An Implementers' Guide to Cyber-Security forInternet of Things Devices and Beyond", NCC Group,2014 9. JoshThompson,'Blockchain:TheBlockchainforBeginnings,GuildtoBlockchainTechnologyand BlockchainProgramming',CreateSpaceIndependentPublishingPlatform,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.A.Amuthan, Associate Dean, Dept. of CSE, Pondicherry Engg. College, Pondicherry	Dr.M.Murali Dr.Kayalvizhi Jayavel Mr. H.Karthikeyan

Course Code	18CSE446T	Course Name	ADVANCED DATABASE 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		Computer Science and Engineering		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 :	Familiarize with the various query processing, join and optimization techniques																		
CLR-2 :	Improve their ability to choose the appropriate techniques for any parallel and distributed database systems																		
CLR-3 :	Familiarize with the various object based databases techniques																		
CLR-4 :	Familiarize with the various Motivation, Structure, Storage, Application and Evaluation of XML Queries																		
CLR-5 :	Expose to the concepts of Performance Tuning, Temporal, Spatial, Multimedia and Mobile data bases																		
CLR-6 :	Expose to the latest Spatial and Geographic data, R Trees and Multimedia databases																		

Columns for Learning: Level of Thinking (Bloom), Expected Proficiency (%), Expected Attainment (%)

Columns for PLO: 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

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLO-1 :	Acquire the knowledge on query processing, join and optimization on a database	2	80	85	H	H	L	M	L	-	-	-	M	M	M	-	-	-	-
CLO-2 :	Acquire the ability to identify & design a parralel and distributed database	2	75	80	H	H	L	M	L	-	-	-	M	M	M	-	-	-	-
CLO-3 :	Understand the basic ideas about various object based databases	2	85	80	H	M	L	M	L	-	-	-	M	M	M	-	-	-	-
CLO-4 :	Apply the knowledge of XML on various applications	2	80	75	H	H	L	M	L	-	-	-	M	M	M	-	-	-	-
CLO-5 :	Appreciate the concepts of Performance Tuning, Temporal, Spatial, Multimedia and Mobile data bases	2	75	85	H	M	L	M	L	-	-	-	M	M	M	-	-	-	-
CLO-6 :	Appreciate the concepts of latest Spatial and Geographic data, R Trees and Multimedia databases	2	80	85	H	M	-	M	L	-	-	-	M	M	M	-	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Overview of query processing	Introduction to Parallel Databases	Overview of object based databases	Introduction to XML	Performance Tuning
	SLO-2	Measures of query cost	I/O parallelism	Complex data types		Improving set orientation
S-2	SLO-1	Selection Operation	Interquery Parallelis	Structured types in SQL	Motivation	Tuning of bulk loads and updates
	SLO-2	Sorting	Intraquery Parallelism	Inheritance in SQL		Location of bottlenecks
S-3	SLO-1	Join Operation-Nested loop join	Intraoperation Parallelism	Table inheritance	Structure of XML data	Tunable parameters
	SLO-2	Merge join and Hash join	Interoperation Parallelism			Tuning of hardware
S-4	SLO-1	Projection, set operation, Outer join and Aggregation	Query Optimization	Array and multiset Types in SQL	XML document scheme	Tuning of the schema and Indices
	SLO-2	Evaluation of Expressions	Design of Parallel Systems			Tuning of Physical design
S-5	SLO-1	Overview of query optimization	Homogeneous and heterogeneous database	Object –identity and reference Types in SQL	Querying and transformation	Tuning of concurrent transactions
	SLO-2	Transformation of relational expressions - Equivalence Rules	Distributed data Storage			Introduction to Temporal, Spatial, Multimedia and Mobile data bases
S-6	SLO-1	Join Ordering	Distributed transactions	Implementing O-R features	Application program interface to XML	Performance benchmarks
	SLO-2	Enumeration of Equivalent Expression	Commit protocols			Time in databases
S-7	SLO-1	Estimating statistics of expression results Cataloq Information	Concurrency control in distributed databases	Persistent programming languages – Persistence of objects	Storage of XML data	Spatial and Geographic data
	SLO-2	Selection Size and Join size Estimation	Distributed query processing	Object identity and pointers		Representation of Geographic data

S-8	SLO-1	*Size Estimation for other Operation,Estimation of Number of Distinct Values*	*Availability*	*Persistent C++ systems*	*XML applications.*	*Spatial Queries*
	SLO-2	*Choice of evaluation plans-Cost based join order Selection*		*Persistent Java systems*		*Indexing of Spatial Data*
S-9	SLO-1	*Cost based optimization with equivalence rules*	*Heterogeneous distributed databases.*	*Object-relational mapping*	*Evaluation of XML Queries*	*R Trees*
	SLO-2	*Heuristics in optimization, Optimizing Nested Sub queries*		*Object-oriented versus object-relational.*		*Multimedia databases*

Learning Resources	1. Abraham Silberscatz, Henry F Korth, S Sudarshan, "Database System Concepts", McGraw Hill Education –2013 2. RaghuRamakrisgnan,"DatabaseManagementSystems",-McGrawHillEducation-2014	3. Elmasri Navathe, Somayajulu, Gupta, "Fundamentals of Database Systems, Pearson Education, 4th Edition, 2006 4. CJDate,AKannan,SSwamynathan,"AnIntroductiontoDatabaseSystems",PearsonEducation,8th Edition, 2006

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. Dr.Mariappan Vaithilingam, Engineering Leader Amazon, dr.v.m@ieee.org		*1. Mr. Elizer, SRMIST*
2. Mr. Badinath, SDET, Amzon, sbadhrinath@gmail.com		*2. Mrs. Sasi Rekha Sankar, SRMIST*
		3. Ms. Hemavathy, SRMIST

Course Code	18CSE447T	Course Name	EDGE 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		Computer Science and Engineering		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 concepts of IoT																			
CLR-2 :	Understand the IoT and M2M Communication																			
CLR-3 :	Understand the protocols and standards of IoT																			
CLR-4 :	Understand the Fog computing Architecture and its components																			
CLR-5 :	Understand the integration of Fog and Cloud Computing																			
CLR-6 :	Understand the concepts of IoT																			

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 :	Apply concepts of IoT	3	80	70	H	L	H	M	H	H	H	H	H	H	M	H	H	H	H
CLO-2 :	Apply the M2M protocol in IoT.	3	85	75	H	L	H	M	H	H	H	H	H	H	M	H	H	H	H
CLO-3 :	Equip themselves familiar with Fog computing in IoT	3	75	70	H	L	H	M	H	H	H	H	H	H	M	H	H	H	H
CLO-4 :	Familiarize with IoT standard and protocols	3	85	80	H	L	H	M	H	H	H	H	H	H	M	H	H	H	H
CLO-5 :	Acquaint with Fog and Cloud computing in IoT	3	85	75	H	L	H	M	H	H	H	H	H	H	M	H	H	H	H
CLO-6 :	Apply concepts of IoT	3	80	70	H	L	H	M	H	H	H	H	H	H	M	H	H	H	H

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Introduction to IoT	IoT Architecture	Fog Computational Model	BIG DATA	Case Study-1: Edge analytics in Irrigation System
	SLO-2	Technologies in IoT	Data Acquisition, Data Aggregation and Data Analysis	Fog Simulators	Data Types in Big data	Machine Learning in Edge for automation in Irrigation system
S-2	SLO-1	IoT Applications- Smart Home, Wearable, Connected Cars, Industrial IoT	IoT Protocols- COAP, MQTT	iFogSim	Characteristics of BIG DATA	Case study 2: Edge analytics for Water Quality Monitoring
	SLO-2	Smart Cities, Agriculture, Smart Retail, smart Grid, Healthcare	XMPP, AMQP, Low power Lossy Network routing	FogTorch	Benefits of Big Data	Machine Learning in Edge for automation in water quality monitoring
S-3	SLO-1	Challenges in IoT- Delivering Value to Customers, Hardware Compatibility Issues, Data Connectivity Issues	Communication Methods- Bluetooth, Zigbee Z-wave, 6LowPAN	Cisco IoX and Fog Application	Big Data Application-	Case Study 3: IoT- Edge system for Hydroponics system
	SLO-2	Incorrect Data Capture Capabilities, Analytic Challenges, Data Security challenges,	Wireless Fidelity	Contiki/Cooja	Layered Big Data Architecture- Data Ingestion, Data collection, Data Processing Layer	Deep Learning in Edge for automation in hydroponics system
S 4-5	SLO-1	Introduction to Edge Computing	4G	NS3	Data storage, Data Query and Visualization Layer	Case Study 4: IoT-Edge for Smart Energy Management
	SLO-2					
S-6,7	SLO-1	Need for Edge Computing- Improved Performance , Compliance, Data Privacy, And Data Security	Sigfox, NeUL	Software Defined Multi-Tier Fog Architecture	Big Data Implementation- Hortonworks, Cloudera, MAP R	Case Study 5: IoT- Edge for water demand forecasting

	SLO-2	Reduced Operational Cost	LoRaWAN	PVFOg simulator	Apache Projects for Big Data	Demand forecasting at Edge
S-8,9	SLO-1	Challenges in Edge/Fog Computing	5G	System Model analysis	Edge Computing for Big Data	

Learning Resources

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7. M. Mukherjee et al., (2017), "Security and Privacy in Fog Computing: Challenges," IEEE Access, 5, pp. 19293–19304.
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10. Hesham El-Sayed et al., (2017), "Edge of Things: The Big Picture on the Integration of Edge, IoT and the Cloud in a Distributed Computing Environment," IEEE Access, 6, pp. 1706–1717
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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.Madan Lakshmanan	Dr.Subra Ganesan	Dr.S.Suresh
Senior Scientist	Professor, Department of Electrical and Computer Engineering	Dr.J. Sujithra
CEERI, CSIR, Chennai (R&D Industry)	Oakalnd University, USA	

Course Code	18CSE448T	Course Name	ENERGY MANAGEMENT FOR INTERNET OF THINGS DEVICES	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		Computer Science and Engineering		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 rudiments of energy conservation and IoT		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 the knowledge on various energy conservation schemes in IoT																			
CLR-3 :	Utilize the conventional and optimization algorithms for conserving energy in IoT devices																			
CLR-4 :	Understand the various techniques of green IoT and impact of conventional techniques of IoT																			
CLR-5 :	Gain the knowledge on existing energy efficient architecture for energy conservation and harvesting																			
CLR-6 :	Gain the knowledge on low energy Bluetooth devices and its importance																			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																			
CLO-1 :	Acquire the knowledge on IoT and energy conservation approaches in IoT		2	80	85	H	M	M	M	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	Identify and choose appropriate energy conservation component for real world problems		2	75	80	H	M	M	-	-	-	-	-	-	-	-	-	-	-	-
CLO-3 :	Design and develop energy conservation algorithms for improving the lifetime of IoT devices		2	85	80	H	H	H	H	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	Compare and contrast of various green IoT techniques and able to design green IoT for real world problems		2	80	75	H	M	H	H	-	-	-	-	-	-	-	M	-	-	-
CLO-5 :	Design and develop energy efficient architecture for real world problems		2	75	85	H	H	H	H	-	-	-	-	-	-	-	M	-	-	-
CLO-6 :	Design and develop energy efficient architecture for real world problems using low energy Bluetooth devices		2	80	85	H	M	M	M	-	-	-	-	-	-	-	-	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Introduction to IoT	Energy conservation schemes	Static energy efficient algorithms	Green IoT an Overview	Designing energy efficient IoT based Intelligent Transport System
	SLO-2	Architecture of IoT	Sleep/wakeup scheme	Exact allocation algorithm	Smart Homes, Smart Cities	Intelligent Transport System
S-2	SLO-1	Components of IoT	Data driven scheme	Best Fit Heuristic Algorithm	Energy Efficient smart health care	Motivations for IoT in Transportation
	SLO-2	Applications of IoT	Mobility based scheme	Dynamic energy efficient algorithms	Importance of Green IOT	Communication Technology and Related Power Issues
S-3	SLO-1	Challenges in IOT	Load balancing	Hardware Level Solution	Taxonomy of green IoT techniques	Information Extraction and Underlying Power Issues
	SLO-2	Energy Management in IoT	Working of load balancing	Dynamic Voltage Frequency Scaling (DVFS)	Various Approaches to Achieve Green IoT	Energy Efficiency Challenges and Corresponding Solutions, Further Challenges and Opportunities
S-4	SLO-1	Energy harvesting	Hardware based load balancing	Software Level Solution	software based green IoT techniques	Capacity Estimation of Electric Vehicle Aggregator for Ancillary Services
	SLO-2	Block diagram of energy harvesting	Software Based Load Balancing	First Fit Decreasing algorithm (FFD)	Hardware based green IoT techniques	Development of Electric Vehicles
S-5	SLO-1	Various ambient energies	Compare hardware and software based load balancing techniques	Modified Best Fit Decreasing algorithm (MBFD)	Policy based techniques	Motivation for Vehicle to Everything (V2X) and V2G Technology
	SLO-2	Energy harvesting schemes	Load balancing algorithms	Genetic Algorithm (GA)	Awareness based Approach - Toward Green IoT, Energy Awareness	Electric Vehicles and Solar Power Plants in Smart Grid Environment

S-6	SLO-1	Harvesting modules		Particle Swarm Optimization (PSO)	IoT Based Smart Metering	Potential of EV to Grid Connection, Capacity Estimation of Aggregator
	SLO-2	Rectenna Model	Static Algorithms, Dynamic Algorithms	Ant Colony Optimization (ACO)	Communication Technology Creating Awareness About Green Information, PromotingRecycling	Battery Management System, Grid Connection and Performance Testing of V2G
S-7	SLO-1	Sensing antenna	Issues of energy conservation in IoT	Simulated Annealing (SA)	Habitual Based Techniques	Weather monitoring using Bluetooth Low Energy (BLE) in warehouses
	SLO-2	DC-DC Converter		Cat Swarm Optimization(CSO)	Comparative analysis of different green IoT approaches	BLE Introduction
S-8	SLO-1	Wireless energy harvesting	Basic model of smart home system	Hybrid Genetic Algorithm and Cat Swarm Optimization (HGACSO)	Case study: impact of smart phones on the environment in present and future trends	BLE importance
	SLO-2	Near Field Communication, Inductive coupling	Energy Conservation in Smart Home and IoT	Hybrid Genetic Algorithm, Particle Swarm Optimization and Simulated annealing(HGAPSOSA)	Reduce the environmental impact life cycle assesment of smatphones, smart phone emission and selling rate	
S-9	SLO-1	Paradigmatic view of energy efficient IoT	Automation and Sensors in Smart Home	Comparison of dynamic energy efficient algorithms	Promoting the Usage of Sensor Cloud: a step toward green IoT.	Design weather monitoring using BLE
	SLO-2	Pragmatic energy efficient IoT system architecture	Case study: energy conservation component for smart home.	Compare and contrast static and dynamic energy efficient algorithms	Creating Awareness Through Prototyping: A Green IoT-Based Smart	

Learning Resources	1. ."EnergyConservationforIoTDevicesConcepts,ParadigmsandSolutions",MamtaMittal,Sudeep Tanwar,BasantAgarwal,LalitMohanGoyal,StudiesinSystems,DecisionandControl 206,2019. 2. "IOTprojectswithBluetoothLowEnergy-Harnessthepowerofconnectedthings",Madhur	3. 1Green IoT: An Investigation on Energy Saving Practices for 2020 and Beyond, Rushan Arshad, Saman Zahoor, Munam Ali Shah , Abdul Wahid, and Hongnian Yu, special section on future networks: architectures,protocols,andapplications,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
1.Mr.Anantha Velavan , Principal Validation Engineer, Micro chip	Dr. Divya Udayan J, PhD(S.Korea)| MIEEE	MACM	MIDF, Associate Professor, VIT University, Vellore	Dr.T.Sujithra,SRMIST
2.Mr.GaneshSKandha, Senior Applications Engineer, Micro chip	Dr.Masoodhu Banu, Professor/Head of Bio Medical, Veltech University,	Dr.Kayalvizhi Jayavel, SRMIST
		Mrs.Anitha,SRMIST

Course Code	18CSE367T	Course Name	REQUIREMENTS ENGINEERING	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		Computer Science and Engineering		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 :	Identify the sources, collect, organize and classify the requirements																		
CLR-2 :	Improve their ability to choose the appropriate Elicitation Techniques for any systems																		
CLR-3 :	Familiarize with the various requirements documentation and validation techniques																		
CLR-4 :	Familiarize with the various requirements quality drivers, Traceability models and requirements change control techniques																		
CLR-5 :	Expose to the Conflits, Escalation model , Settlements and Analytics of Cost Benefit analysis																		
CLR-6 :	Expose to the latest requirements engineering tools																		

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 knowledge on identifying the Source, organising and classifying requirements	2	80	85	H	H	L	M	-	L	L	M	H	H	M	L	-	-	-
CLO-2 :	Acquire the ability to identify and Apply the appropriate Elicitation Techniques for any systems	2	75	80	H	H	H	L	-	L	-	L	H	H	H	L	-	-	-
CLO-3 :	Understand the basic ideas about various requirements documentation and validation techniques	2	85	80	H	L	L	L	M	-	-	M	M	M	M	-	-	-	-
CLO-4 :	Apply the knowledge on various requirements quality drivers, Traceability models and requirements change control techniques for any system	2	80	75	H	H	L	M	H	M	-	M	M	L	L	M	-	-	-
CLO-5 :	Appreciate the concepts of Conflict, Escalation model , Settlements and Analytics of Cost Benefit analysis	2	75	85	H	H	-	H	H-	-	-	M	L	M	M	-	-	-	-
CLO-6 :	Appreciate the concepts of latest requirements engineering tools	2	70	70	H	L	L	M	H	-	L	L	L	L	M	M	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Introduction to Requirements and Requirements Engineering	Requirement Inception	Introduction to Requirement Document, Structure of Document	Business drivers of Quality-components of Integrated Quality approach	Conflict types
	SLO-2	Requirements Types	sources of requirements			
S-2	SLO-1	Classification of Requirements	Introduction to requirement Elicitation	Vision, Scope and Elicitation notes	Quality improvement techniques, Requirements Quality Assurance	Mastering and using detection of the 5conflicts types on the basis of indication in project
	SLO-2	Requirements Gathering relevant to Software Life Cycle Models				
S-3	SLO-1	Stakeholders in the requirements process	Classical Elicitation Techniques-Interview, Questionnaire, Social analysis	Requirement Specification techniques	PDCA Cycle	Glasl's conflicts escalation model
	SLO-2					
S-4	SLO-1	Requirements Engineering Process Framework, Requirements Engineering Maturity Model	Modern Elicitation Techniques-Brainstorming,	Introduction to requirement validation-Classical Requirement Validation techniques-Inspection, Simple Check	Introduction to Requirement Management-Requirement Identification-Requirements traceability	Conflicts Settlement techniques
	SLO-2	Generic Process for requirements Engineering				

S-5	SLO-1	Levels of Requirements Engineering	Modern Elicitation Techniques-Prototyping, Use Centered Design,	. Introduction to requirement validation-Classical Requirement Validation techniques-Desk Check, Walkthrough	Requirement Tracebility models, Traceability Matrix- Traceability List & Tree	Conflicts Settlement techniques
	SLO-2	System Model for Requirements Engineering				
S-6	SLO-1	Representation of Requirements-Data Flow, ER Diagram	Modern Elicitation Techniques-Walkthrough, Use case Joint Application Development	Format review	Introduction to RequirementTraceability-Requirement traceability methods	Analytic Methods – Mastering and using Consider All Facts (CAF)
	SLO-2	View Point Controlled Requirements				
S-7	SLO-1	Structured Analysis and Design Technique, Viewpoint Oriented Requirements Definition	Requirement reuse	Prototype & Enactments, Functional test Design		Analytic Methods – Plus –Minus-Intresting(PMI)
	SLO-2					
S-8	SLO-1	0bject Oriented Methods of Requirements Engineering	Feature Oriented Domain Analysis	Development of User manual	Advance Traceability	Analytic Methods – Cost Benefit Analysis
	SLO-2					
S-9	SLO-1	Case Study : For the given application identify the stakeholders, gather and classify the requirements according to the types	Case Study: For the given application apply various techniques and Elicitation the requirements	Case study. For the given application validate and document the specifications	Requirement Change Control	Case study : Requirement Engineering Tools
	SLO-2					

Learning Resources	1. ElizabethHull,KenJackson,JeremyDick,RequirementsEngineering,Springer,2013 2. RalphR.Young,"TheRequirmentsENgineeringHandbook",2004	3. AxelvanLamsweerde,"RequirementsEngineering:FromSystemGoalstoUMLModelstoSoftware Specifications" , Wiley,2014 4. KarlWiegers,JoyBeatty,SoftwareRequirements(DeveloperBestPractices),(3rdEdition),MicrosoftPress, 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 %	

CA – 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 Vaithilingam, Engineering Leader Amazon, dr.v.m@ieee.org		1. Mrs. Sasi Rekha Sankar, SRMIST
2. Mr. Badinath, SDET, Amzon, sbadhrinath@gmail.com		2. Mrs. Geetha.G, SRMIST
		3 Dr. S.Thenmalar, SRMIST

Course Code	18CSE368T	Course Name	SOFTWARE ARCHITECTURE AND 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		Computer Science and Engineering	Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:		Learning			Program Learning Outcomes (PLO)														
CLR-1 :	Classify the essential elements of software architecture		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-2 :	Understand the issues related to architecting a large-scale software system																			
CLR-3 :	Understand different software architectures views and styles																			
CLR-4 :	Able to use the four-views approach for developing and documenting a software architectures																			
CLR-5 :	Understand the implications of different design patterns																			
CLR-6 :	working as part of a team, develop, analyze and critique an architecture of a software system																			

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 :	Describe different approaches to design software application	3	80	75	H	H	-	-	L	-	-	-	-	L	-	H	-	-	-
CLO-2 :	Analyze specifications and identify appropriate design strategies.	3	85	80	M	H	H	H	-	-	-	-	M	M	M	H	-	-	-
CLO-3 :	Develop an appropriate design for a given set of requirements	3	75	75	M	H	H	H	-	-	-	-	-	M	M	H	-	-	-
CLO-4 :	Identify applicable design patterns for the solution	3	85	80	H	H	H	H	-	-	-	-	-	L	L	H	-	-	-
CLO-5 :	Abstract and document reusable design patterns	3	80	70	M	H	H	-	L	-	-	-	M	M	M	H	-	-	-
CLO-6 :	Evaluate a given design against the specifications	3	80	70	M	H	-	-	-	-	-	-	M	M	M	H	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Software Architecture –Software Design	Software Architectural Patterns & Styles	Evaluating a Software Architecture	Introduction to Design Process	Introduction to Design Pattern
	SLO-2	Importance and Need of Software Architecture	Types of Architectural Styles	Why- When -Who evaluate Architecture	Design Strategy	Component of Design Pattern - Types
S-2	SLO-1	4 +1 View Model	Layered pattern	What Qualities Can We Evaluate an Architecture?	Describing the design process the D-Matrix	Creational Design Patten - Abstract Factory Pattern
	SLO-2	Activities in Software Architecture	Merits and Demerits of Layered Pattern		Views associated with D-matrix	Factory Method
S-3	SLO-1	Fundamental design issues	Pipe-Filter pattern	Outputs of an Architecture Evaluation	Design by top-down decomposition	Singleton Pattern
	SLO-2		Merits and Demerits of Pipe and Filter			Structural design Pattern - Types
S-4	SLO-1	Understanding quality attributes -	Shared Data Pattern	Evaluating the Architecture - ATAM	Design by composition	Adaptor pattern
	SLO-2	Six parts of Quality Scenario	Merits and Demerits of Shared Data Pattern	Participants and Outputs of ATAM		Decorator Pattern
S-5	SLO-1	Design for quality attributes - Availability (General Scenario, Tactics)	Client Server pattern	Phases of ATAM	Function-oriented design	Proxy Pattern
	SLO-2		Merits and Demerits of Client Server	CASE Study for ATAM		Behavioral Design Pattern - Types
S-6	SLO-1	Design for quality attributes - Modifiability (General Scenario,	Blackboard Architectural Pattern	Evaluating the Architecture - CBAM	Object-oriented design	Observer Pattern

		Tactics)				Strategy Pattern
	SLO-2		Merits and Demerits	Decision-Making Context		Strategy Pattern
S-7	SLO-1	Design for quality attributes - Security (General Scenario, Tactics)	Flight Simulation: A Case Study in an Architecture for Integrability	Basis for the CBAM - Case Study	Aspect Oriented Design	Iterator pattern
	SLO-2		Relationship to the Architecture Business Cycle			Introduction to ADL
S-8	SLO-1	Design for quality attributes - Usability (General Scenario, Tactics)	Requirements and Qualities related to flight simulation	Evaluating Software Architecture - SAAM	Design Metrics - Need for Metrics	Components of ADL- Example
	SLO-2			SAAM Evaluation Process	WMC -DIT	
S-9	SLO-1	Design for quality attributes - Testability (General Scenario, Tactics)	Architectural Solution for flight simulation	Evaluating Software Architecture - ARID	NOC - CBC	Future Directions in Architecture
	SLO-2			ARID Evaluation Process	RFC- LCOM	

Learning Resources	1. Len Bass, Paul Clements, & Rick Kazman. Software Architecture in Practice (Third Edition). Addison- Wesley,2013 2. Humberto Cervantes, Rick Kazman ,Designing Software Architectures: A Practical Approach. Pearson Education,2016 3. CarlosOtero,"SoftwareEngineeringDesign:TheoryandPractice",CRCPress,2012	4. Paul Clements , Rick Kazman , Mark Klein, Evaluating Software Architectures: Methods and Case Studies. Addison Wesley; 1 edition (22 October2001) 5. Jason McC. Smith, "Elemental design Patterns",. Addison Wesley,2012 6. VasudevaVarma,SoftwareArchitecture:ACaseBasedApproach.PearsonEducation,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
		Mr.C.Arun, SRMIST

Course Code	18CSE369T	Course Name	SOFTWARE MODELING AND 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		Computer Science and Engineering		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 :	Select a suitable modeling method according to problem area and assignment, and can justify their choice.																		
CLR-2 :	Formulate models of a system to describe the system on different levels of abstraction and from different viewpoints.																		
CLR-3 :	Identify the Formal models used in software development																		
CLR-4 :	Define model checking concepts using tools																		
CLR-5 :	Model the software system and analyze its characteristics and correctness.	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

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																		
CLO-1 :	Implement the appropriate modeling method for the given problem	2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	Explain the system abstraction in different levels	2	75	80	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-3 :	Apply the Formal models in the software development	2	85	80	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	Apply tools to check model checking properties of a system	2	80	75	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	Analyze the characteristics and correctness of software system	2	75	85	H	-	-	H	-	-	-	-	-	-	-	-	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Introduction to software modelling	Representing domain concepts by conceptual objects	Modeling system agents, Characterizing agents.	Correctness of Object Oriented Programs Design by Contract, The Class Invariant	Introduction to Kripke Structures
S-2	SLO-1	Modeling principles	Entities, Association, Attributes	Representing agent models,Refinement of abstract agents	Example - correctness of stack application	Modeling System Design as Kripke Structure
S-3	SLO-1	Goal features as model annotations,Goal refinement	Built–in associations for structuring object models	Building Agent models	A real–time temporal logic for specifying model annotations	Exercise on Kripke Modelling, Recap to Kripke Structures
S-4	SLO-1	Representing conflicts among goals,Connecting the goal model with other system views.	Class Diagrams, Heuristic rules for building object models	Modelling system operations, Characterizing system operations	Specifying goals in the goal model.	Exercises on system modeling using kripke structures, Introduction to LTL
S-5	SLO-1	Modelling alternative options, Goal diagrams as AND/OR graphs.	Object or Attribute Entity, association, agent or event?	Goal Operationalization, Goals, agents, objects and operations	Specifying descriptive properties in the object model	Properties of a system, Liveness and Safety properties , Exercise on specifying properties as LTL formula
S-6	SLO-1	Documenting goal refinements and assignments with annotations	Attribute of a linked object or of the linking association Specialization and generalizing concepts Avoiding common pitfalls	Representing object models, Building operation models	Specifying operationalization's in the operation model	Introduction to NuSMV tool, Model Checking using NuSMV,Introduction to SPIN CHECKER tool
S-7	SLO-1	Building goal models: Heuristic rules and reusable patterns	Aggregation or association? Avoiding common pitfalls	Modelling System behaviour, Modelling instance behaviours	Checking goal refinements deriving goal operations	Model Checking using SPIN checker tool
S-8	SLO-1	Goal obstruction by obstacles	Specialization and generalizing concepts Avoiding common pitfalls	Modelling class behaviours	Generating obstacles for risk analysis Generating anti goals for security analysis	System Property as first order logic formula Proof of correctness using theorem prover

| S-9 | SLO-1 | Modelling obstacles, Obstacle ananlysis for a more robust goal model | Case Study | Building behaviour models | Formal conflict analysis. Synthesizing behaviour models for animation and model checking. | Introduction Isabelle tool, Theorem proving using Isabelle |

| Learning Resources | 1. AxelvanLamsweerde"RequirementsEngineering:FromSystemGoalstoUMLModelstoSoftware Specifications"ISBN:978-0-470-01270-3February9,2009Wiley
 2. http://www.bowdoin.edu/~allen/courses/cs260/readings/ch12.pdf | 3. Gerard J. Holzmann, "The SPIN Model Checker: Primer and Reference Manual" ISBN-13: 978-0321773715 , AT&T Bell Labs Murray Hill New Jersey ©2004 | Addison-Wesley Professional |

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 T Vijayalakshmi Priyadharsini, Senior Manager, Cognizant Technology Solutions, Chennai	1. Dr.Kumudha Padmanaban, Associate Professor, Coimbatore Institute of Technology, kumudha@cit.edu.in	1. Mr Ramraj S, SRMIST
	2. Dr M Sangeetha, Coimbatore Institute of Technology, citcsesangi@gmail.com	2. Ms A NithyaKalyani, SRMIST

Course Code	18CSE370T	Course Name	DESIGN PATTERNS	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		Computer Science and Engineering	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 :	Conceive the importance of reuse of solution for common problems in software development.																		
CLR-2 :	Identify the appropriate patterns for design problems.																		
CLR-3 :	Implement the various design pattern solution for appropriate scenarios																		
CLR-4 :	Refactoring the badly designed program properly using patterns.																		

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 :	To create software designs that are scalable and easily maintainable	2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	Use creational design patterns in software design for class instantiation	2	75	80	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-3 :	Use structural design patterns for better class and object composition	2	85	80	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	Use behavioral patterns for better organization and Communication between the objects	2	80	75	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Basics of UML Class Diagram, Interaction Diagram	Strategy pattern- Intent, Motivation, Applicability, Structure, Participants, collaborations, consequences Strategy pattern- Implementation and sample code	Abstract factory- Intent, Motivation, Applicability, Structure, Participants, collaborations, consequences Abstract factory- Implementation and sample code	Adapter- Intent, Motivation, Applicability, Structure, Participants, collaborations, consequences Adapter- Implementation and sample code	What to Expect from Design Patterns The Pattern Community An Invitation
	SLO-2					
S-2	SLO-1	Object design, Reuse Concepts, Solution Objects Inheritance & Design Patterns	Mediator - Intent, Motivation, Applicability, Structure, Participants, collaborations, consequences Mediator- Implementation and sample code	Singleton pattern- Intent, Motivation, Applicability, Structure, Participants, collaborations, consequences Singleton pattern Implementation and sample code	Bridge- Intent, Motivation, Applicability, Structure, Participants, collaborations, consequences Bridge- Implementation and sample code	A Parting Thought A Case Study : Designing a Document Editor : Design Problems, Document Structure
	SLO-2					
S-3	SLO-1	Principle and Strategies Open/Closed principle Designing from context, Encapusulating Variation	Template Method- Intent, Motivation, Applicability, Structure, Participants, collaborations, consequences Template Method- Implementation	Factory method pattern- Intent, Motivation, Applicability, Structure, Participants, collaborations, consequences Factory method pattern Implementation	Decorator, Facade- Intent, Motivation, Applicability, Participants, collaborations, consequences Structure Decorator, Facade- Implementation	A Case Study : Designing a Document Editor : Design Problems, Document Structure Formatting, Embellishing the User Interface
	SLO-2					
S-4	SLO-1	Abstract classes and Interfaces Design patterns and Architecture	Template Method- sample code Case study: Identify which pattern is applicable for the given case study and justify	Factory method pattern sample code Case study: Identify which pattern is applicable for the given case study and justify	Decorator, Facade- Sample Code Case study: Identify which pattern is applicable for the given case study and justify	Supporting Multiple Look-and-Feel Standards Supporting Multiple Window Systems
	SLO-2					
S-5	SLO-1	Gand of Four Patterns Basics of UML	Case study: Identify which pattern is applicable for the given case study and justifyStrategy pattern- Intent, Motivation, Applicability, Structure, Participants, collaborations, consequences	Case study: Identify which pattern is applicable for the given case study and justify Abstract factory- Intent, Motivation, Applicability, Structure, Participants, collaborations, consequences	Case study: Identify which pattern is applicable for the given case study and justify Adapter- Intent, Motivation, Applicability, Structure, Participants, collaborations, consequences	User Operations Spelling Checking and Hyphenation What to Expect from Design Patterns
	SLO-2					

S-6	SLO-1	Class Diagram, Interaction Diagram Object design, Reuse Concepts, Solution Objects	Strategy pattern- Implementation and sample code Mediator - Intent, Motivation, Applicability, Structure, Participants, collaborations, consequences	Abstract factory- Implementation and sample code Singleton pattern- Intent, Motivation, Applicability, Structure, Participants, collaborations, consequences	Adapter- Implementation and sample code Bridge- Intent, Motivation, Applicability, Structure, Participants, collaborations, consequences	The Pattern Community An Invitation A Parting Thought
	SLO-2					
S-7	SLO-1	Inheritance & Design Patterns Principle and Strategies Open/Closed principle	Mediator- Implementation and sample code Template Method- Intent, Motivation, Applicability, Structure, Participants, collaborations, consequences	Singleton pattern Implementation and sample code Factory method pattern- Intent, Motivation, Applicability, Structure, Participants, collaborations, consequences	Bridge- Implementation and sample code Decorator, Facade- Intent, Motivation, Applicability, Participants, collaborations, consequences Structure	A Case Study : Designing a Document Editor : Design Problems, Document Structure A Case Study : Designing a Document Editor : Design Problems, Document Structure
	SLO-2					
S-8	SLO-1	Designing from context, Encapusulating Variation Abstract classes and Interfaces	Template Method- Implementation Template Method- sample code	Factory method pattern Implementation Factory method pattern sample code	Decorator, Facade- Implementation Decorator, Facade- Sample Code	Formatting, Embellishing the User Interface Supporting Multiple Look-and-Feel Standards
	SLO-2					
S-9	SLO-1	Design patterns and Architecture	Case study: Identify which pattern is applicable for the given case study and justify	Case study: Identify which pattern is applicable for the given case study and justify	Case study: Identify which pattern is applicable for the given case study and justify	Supporting Multiple Window Systems
	SLO-2					

Learning Resources	1. Bruegge,BerndandAllenH.Dutoit."Object-OrientedSoftwareEngineering:UsingUML,Patternsand Java",Pearson: Prentice Hall Publishers2004 2. ErichGamma,RichardHelm,"DesignPatterns:Elementsofreusablesoftware development", Pearson Education,2005	3. Alan Shalloway, James R Trott "Design pattern explained", Pearson Education,2005. 4. EricFreeman,ElisabethRobson,BertBates,andKathySierra,"HeadFirstDesignPatterns", O'reilly Publications,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	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 T Vijayalakshmi Priyadharsini, Senior Manager, Cognizant Technology Solutions, Chennai	1. Dr.Kumudha Padmanaban, Associate Professor, Coimbatore Institute of Technology, kumudha@cit.edu.in	1. Dr S Sridar SRMIST
	2. Dr M Sangeetha, Coimbatore Institute of Technology, citcsesangi@gmail.com	2. Ramraj S SRMIST

Course Code	18CSE371T	Course Name	USER INTERFACE 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		Computer Science and Engineering	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 concepts of design; Utilize by learing various color models																		
CLR-2 :	Gain knowledge on the basics of various law in UX																		
CLR-3 :	Construct the task for requirement gathering																		
CLR-4 :	Gain knowledge on how to Design for various domains or applications																		
CLR-5 :	Introducetools for designing various applications																		
CLR-6 :	Utilisedifferent types of design for real-time programming 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 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 various color models for design	2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	Create the design as per the design law	2	75	80	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-3 :	Construct the task for requirement gathering	2	85	80	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	Create wire frames and prototypes	2	80	75	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	Create the usability constraints and accebility	2	75	85	H	-	-	H	-	-	-	-	-	-	-	-	-	-	-
CLO-6 :	Construct real-time applications using real-time programming applications	2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	What is typography-type properties, baseline, cap height	Laws of UX designing	Introduction to Interaction Design	Culture in usability	Importance of case studies and guidelines
	SLO-2	X-height, ascenders	Hicks law	Task analysis	Universal usability	Tracking APP Introduction
S-2	SLO-1	Descenders and weight	example of hicks law with an application	Data collection for gathering user	Inclusive interaction	Tracking APP Design guidelines
	SLO-2	Type classification-Serif	Jakob's law	Data for task requirements	Importance of accessibility	Tracking APP demo
S-3	SLO-1	sans serif fonts	example of jakob's law with an application	Requirements gathering	principles of accessibility	Designing UI
	SLO-2	monospace	Fitts's Law	Eliciting Qualitative data	Universal design	Redesigning Gmail and making it flash
S-4	SLO-1	handwriting and Display	example of Fitts's law with an application	analyzing qualitative data	Accessibility design	Design principles
	SLO-2	Readability, letter spacing	Ockham's Razor	Qualitative metrics	Font weight, color	Redesigning Gmail and making it flash Demo
S-5	SLO-1	line height with an example	example of Ockham's law with an application	User narratives	Contrast, Screen readers	Introduction of how to Design a new UX concept to reduce driver distraction
	SLO-2	Paragraph spacing, power of alignment	Pareto Principle	Scenario implementation and its challenges	Alt text using a tool	Designing concepts of Driver distraction
S-6	SLO-1	Leading and Kerning	example of Pareto principle with an application	Wireframes	Introduction to Multifaceted Users	Demo
	SLO-2	Fundamentals of color	Weber's law	Example on wireframes	Designing for Multifaceted Users	Importance of User data in UX designing
S-7	SLO-1	Color Models Introduction	example of Weber's law with an application	Prototypes	Design guidelines	Approach to design without user data
	SLO-2	RGB, CMYK	Tesler's law	Implementation of Prototypes	Guidelines for helping adults	Designing concept

S-8	SLO-1	Color harmony: monochromatic, analogous	example of Tesler's law with an application	UX design for mobile application	Application example	Implementation problems without data
	SLO-2	Complementary, triadic, double-complementary	Law of proximity	Application design example	Virtual third eye simulator introduction	Dynamic webpages
S-9	SLO-1	Meaning of colors	example of proximity	Responsive Design	Web accessibility guide	Demo
	SLO-2	The power of Contrast	Law of similarity and human eye	Adaptive design and difference with Responsive design	Virtual third eye simulator web accessibility	Perform UI Case study

Learning Resources	1. Jeff Johnson, Kate Finn- "Designing user Interfaces for an aging population towards Universal design- Morgan Kauffman publishers – Elseiver-2017 2. ElvisCanziba-"Hands-onUXDesignforDevelopers"–PacktBirminiham,mumbai-2018	3. AndrewRogerson-"UserExperienceDesign"–Smashinmedia2012-Freiburg,Germany 4. BarbaraBallard,"Designingthemobileuserexperience"Wileypublicatoins2007 5. https://uxdesign.cc/tagged/case-study

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 %	

 # CA – 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.S.Karthick, SRMIST
		2.Mrs.Akilandeswari, SRMIST

Course Code	18CSE372T	Course Name	VISUAL PROGRAMMING		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		CSE		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 :	Gain knowledge about basics of C# and .NET framework																		
CLR-2 :	Utilize object-oriented aspects of C# to develop applications																		
CLR-3 :	Utilize forms, menus etc. to design Windows applications																		
CLR-4 :	Utilize ActiveX Data Objects to create Database applications																		
CLR-5 :	Utilize web forms to develop Web based applications																		

Column headers (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

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	L	P	A	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLO-1 :	Understand the basics of C# and .NET framework	2	80	85	-	-	-	-	H	-	-	-	-	-	-	-	-	-	-
CLO-2 :	Develop applications using object-oriented aspects of C#	2	75	80	H	-	M	-	H	-	-	-	-	-	H	-	-	-	-
CLO-3 :	Design Windows applications	2	85	80	H	-	M	M	H	L	L	-	H	-	-	H	-	-	-
CLO-4 :	Create Database applications using ActiveX Data Objects	2	80	75	H	H	M	-	H	L	L	-	H	-	-	H	-	-	-
CLO-5 :	Develop Web based applications	2	75	85	H	-	M	M	H	L	L	M	H	M	L	H	M	H	H

Duration (hour)		10	10	9	8	8
S-1	SLO-1	Introducing C# - Understanding .NET Framework	Class – Objects	Building Windows Application	Accessing data with ADO.NET: DataSet	Programming Web Application with Web Forms
	SLO-2					
S-2	SLO-1	Overview of C# - Literals – Variables Data Types – Operators – Constants - Expressions	Constructors – Types of Constructors	Examples: Windows Applications	Accessing data with ADO.NET: Typed Dataset	Introduction to ASP.NET,
	SLO-2					
S-3	SLO-1	Program Control Statements: Branching	Inheritance and its types	Creating Window Forms with Events and Controls	Data Adapter	Working with XML and .NET
	SLO-2					
S-4	SLO-1	Program Control Statements: Looping	Examples - Inheritance	Examples: Window Forms with Events and Controls	Updating Database using Stored Procedures	Creating Virtual Directory and Web Application
	SLO-2					
S-5	SLO-1	Casting - Methods	Indexers and Properties	Menu and Toolbar	SQL Server with ADO.NET	Session Management
	SLO-2					
S-6	SLO-1	Arrays: Array Class	Polymorphism – Operator Overloading	Delegates - Inheriting Window Forms	Handling Exceptions	Web Services – web.config
	SLO-2					
S-7	SLO-1	Array List	Polymorphism – Method Overloading	SDI Application	Validating Controls	Web Services – Passing Datasets and Returning Datasets from Web Services
	SLO-2					
S-8	SLO-1	String	Interfaces, Abstract Class	MDI Application	Windows Application Configuration	Transaction Handling, Exception Handling – Returning Exceptions from SQL Server
	SLO-2					
S-9	SLO-1	String Builder	Event Handling	Dialog Box: Modal and Modeless		
	SLO-2					
S-10	SLO-1	Structures - Enumerations	Errors and Exception Handling			
	SLO-2					

Learning Resources	1. Herbert Schildt, "The Complete Reference: C# 4.0", Tata McGraw Hill, 2012.	3. Christian Nagel et al. "Professional C# 2012 with .NET 4.5", Wiley India, 2012.
	2. Andrew Troelsen, Philip Japikse, "C# 6.0 and the .NET 4.6 Framework", Seventh Edition, Apress, 2015	4. Andrew Troelsen, Philip Japikse , "Pro C# 7 with .NET and .NET Core", Eigth Edition, Apress, 2017
		5. Stephen C. Perry, "Core C# and .NET", Prentice Hall, 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 %	

CA – 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. Prakas, Associate Consultant, Virtusa, Chennai	1.	1. Dr. M.S. Abirami, SRMIST
2. Mr. S. Padmanabhan, Associate Vice President, Intellect, Chennai	2.	2, Ms. Nagadevi SRMIST 3. Mr. K. Navin

Course Code	18CSE373T	Course Name	PROGRAMMING IN JAVASCRIPT	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		CSE			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 scripting language basics for web development	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 :	Develop familiarity with the JavaScript language – Arrays, Objects, Functions																		
CLR-3 :	Understand concepts like HTML, CSS , DOM,																		
CLR-4 :	Acquire knowledge of jQuery , DOM events etc.																		
CLR-5 :	Apply in AJAX and learn the usage of Closures																		

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																		
CLO-1 :	Learn the basics of Scripting language	2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	Ability to use Javascript in applications	2	75	80	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-3 :	Ability to apply HTML, CSS and DOM	2	85	80	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	Ability to Apply jQuery concepts in applications	2	80	75	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	Understand the AJAX environment and Closure concept	2	75	85	H	-	-	H	-	-	-	-	-	-	-	-	-	-	-

Duration (hour)		9	9	9	9	
S-1	SLO-1	Learn concept of Scripting languages	Arrays. Array insertion and deletion	HTML and CSS and	jQuery , Overview of jQuery	AJAX.
	SLO-2	Compiled vs interpreter a comparison	. Array length	The Document Object Model , Tags	Examples	Asynchronous Communication
S-2	SLO-1	Understand Web development basics	Sparse arrays	Document structure.	Cross-browser compatibility	Callback functions.
	SLO-2	Acquire basic knowledge on Server side programming	Multidimensional arrays	Elements. Text, forms, images,blocks and frames.	The $ function object	The get and post formats.
S-3	SLO-1	Understand concept of dynamic interactive web pages.	Objects as unordered maps. Object creation,	Selectors	Element selectors.	Same-origin policy.
	SLO-2	Overview of JavaScript , Brief history	modification and lookup syntax. Nested objects. Object methods.	Cascading and inheritence	Tree traversal.	Cross-origin requests with JSONP
S-4	SLO-1	Common use-cases. Runtime environments, Overview of language features.	The delete keyword.	Text and color tyles.	Node creation, insertion, modification and deletion.	AJAX polling.
	SLO-2	Running JavaScriptDebugging JavaScript in the browser. The console and REPL in the browser and at the command line	The for... in statement, and the hasOwnProperty method.	The box model.	Getting and setting attributes,	Context Object method invocation as method passing
S-5	SLO-1	Values and literals. Primitive types. Numbers. Integer and floating point as a single type Rounding errors.	The global window object. Object references	Layout.	styles and class.	The this variable as an implicit parameter variable.
	SLO-2	. Special floating point numbers.	Aliasing. Pass-by-reference-copy	The DOM as an document API. Browser	Wrapping and unwrapping DOM raw	Problems with methods in event handlers

			semantics.	information	objects.	and callbacks
S-6	SLO-1	The Math library. Strings. Immutability of strings.	Functions :Function declaration and invocation syntax.	The setTimer and setTimeout		Usage of call and apply
	SLO-2	+ and [] operatorsCommon string utilities	Anonymous functions.	Element lookup	The chaining pattern	Binding context.
S-7	SLO-1	Booleans. Ternary operator.	Functions as data.	Tree traversal.	Event handling.	The new keyword.
	SLO-2	Regular expressions. Truth-y and False-y values. null and undefined.	The arguments object.	Attribute getting and setting	bind and unbind.	Closures Lexical scope. Inner functions
S-8	SLO-1	Dynamic typing. Weak typing. The typeof operator.	Variadic functions. Optional parameters.	Creating and deleting nodes.	Keyboard and mouse events.	Closure scope. Examining closure scope in the debugger
	SLO-2	The === and !== operators.	Named parameters. Function overloading.	Events.	Event delegation and bubbling.	Functors.
S-9	SLO-1	Control statements.	Duck typing.	Case studies	Animation.	Simulation of private object properties.
	SLO-2	Examples	Examples	Case Studies	Examples	Simulation of namespaces.

Learning Resources	1. Don Gosselin , JavaScript Fifth Edition, Thomson Learning., Web Technology Series 2. Nicholas C Zakas, Professional JavaScript for Web Developers , Wrox Professional Guide, 2012	3. Laura Lemay, Rafe Colburn, Jennifer Kyrnin, "Mastering HTML, CSS & Javascript", Web Publishing, 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 %	

CA – 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.	1. Prof.S.S.Sridhar, SRMIST

Course Code	18CSE374T	Course Name	SOFTWARE ENGINEERING TOOLS	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	CSE			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 software engineering process and the tools used to support this process to deliver the quality software product																		
CLR-2 :	Know the process, tools and methods used for software requirements modeling and the designing process																		
CLR-3 :	Study the various software development approaches, tools and to install and use some software development tools																		
CLR-4 :	Know about different web application development technologies and tools used to support the quick development process																		
CLR-5 :	Understand the software testing process used in the industry and various test related tools used for the different task in the testing																		
CLR-6 :	Study the functionalities of different testing tools used in the software maintenance and engineering process																		

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 :	Use automated tools to develop the quality software product in by following engineering process	2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	Design the specification of software using various techniques and tools	2	75	80	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-3 :	Create application using latest tools, code generators and IDEs	2	85	80	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	Apply the various web technologies and tools to develop the web application	2	80	75	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	Know the various testing tools and apply it during the software testing process	2	75	85	H	-	-	H	-	-	-	-	-	-	-	-	-	-	-
CLO-6 :	Use the tools for process management and to gain the knowledge of various tools used for different task in maintenance activities	2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Introduction to Software Engineering Process	Software Construction Tools	Web Application Development Tools	Software Testing Process	Software Engineering Process Tools
	SLO-2	Need of Tools in the Software Engineering Process	Program editors	Tools for Front End Developers	Software Testing Tools	Process modeling tools
S-2	SLO-1	Requirement Engineering Process	Compilers	TypeScript	Need for Automated Testing Tools	Process management tools
	SLO-2	Software Requirements Tools	Compiler types	Installing TypeScript	Taxonomy of Testing Tools	Integrated CASE environments
S-3	SLO-1	Requirements modeling tools	code generators	AngularJS	Functional/Regression Testing Tools	Process-centered software engineering environments
	SLO-2	Traceability tools	Tools for JAVA code generator	AngularJS Architecture and Features	Performance Testing Tools	Software Configuration Management Tools
S-4	SLO-1	Desirable Features of Requirement Management Tools	Comparison of code generation tools	Tools for Back End Developers	Testing Management Tools	Defect, enhancement, issue and problem tracking tools
	SLO-2	Some Requirement Management Tools Available	Interpreters	PHP	Source Code Testing Tools	Version management tools

S-5	SLO-1	Tools Description	Difference between Compiler and Interpreters	Ruby on Rails	How to Select a Testing Tool?	Software Engineering Management Tools
	SLO-2	Software Design Process	Debuggers	Laravel	Test execution frameworks	Project planning and tracking tools
S-6	SLO-1	Steps in Software Design	Integrated Development Environment	Overview of Content Management System (CMS)	Re-engineering tools	Risk management tools
	SLO-2	Software Modeling Languages	Comparison of IDE	WordPress	WinRunner	Infrastructure Support Tools
S-7	SLO-1	Unified Modeling Language	ATOM Tool	WordPress - Features	Overview of WinRunner	Interpersonal Communication tools
	SLO-2	Behavior Trees	Features of ATOM Tool	WordPress – Installation	LoadRunne - Overview	Information retrieval tools
S-8	SLO-1	C-K theory	Installing Atom	Joomla - Overview	QTP - Overview	System administration and support tools
	SLO-2	IDEF, Object-Role Modeling	NetBeans	Joomla – Features	Junit - Overview	Miscellaneous Tool Issues
S-9	SLO-1	Petri nets	Features of NetBeans	Joomla – Installation	Testing Java Code using Junit	Tool integration techniques
	SLO-2	Software Design Tools	Cloud Based Development tools	Drupal – Overview and Architecture	Examples	Tool evaluation

Learning Resources	1. RogerSPressman,"SoftwareEngineering–APractitioner'sApproach",7thedition,TataMcGrawHill Education,2014. 2. IanSomerville"SoftwareEngineering",9thedition,PearsonEducation,2010.https://atom.io/	4. SwapnaKishoreandRajeshNaik,"SoftwareRequirementsandEstimation",TataMcGrawHill,2003 5. K.V.K.K.Prasad,"SoftwareTestingTools",DreamtechPress,2010 https://www.w3schools.com https://www.joomla.org/

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 %	

CA – 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. R.Tamilanban, Senior Software Engineer, Altimetrik India Pvt. Ltd.	1.	1. S.KALIRAJ, SRMIST
2.	2.	2. R.ANITA, SRMIST

Course Code	18CSE466T	Course Name	SOFTWARE VERIFICATION AND VALIDATION	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	Computer Science and Engineering	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1 :	Provide an understanding of concepts and techniques for testing software
CLR-2 :	Prepare test plan based on the requirement document ,design test plans and document test plans
CLR-3 :	Design test cases suitable for a software development in various domains
CLR-4 :	Validate and document test cases, assuring software component or system satisfies its requirements and meets stakeholder expectations
CLR-5 :	Use of automation testing tools

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 :	Identify, design different types of test cases for software development in any domain	2	80	85	H	H	H	H	H	M	M	H	H	H	M	H	H	H	H
CLO-2 :	Design, develop, implement, validate and document test plans at various levels	3	80	80	H	H	H	H	M	M	M	H	H	H	M	H	H	H	H
CLO-3 :	Develop Test cases for a given Software/System Specification	2	90	85	H	H	H	H	M	-	M	H	H	M	M	H	H	H	H
CLO-4 :	Validate Test Cases with the Requirement Specifications	2	80	80	H	H	H	M	M	-	M	H	H	H	M	H	H	H	H
CLO-5 :	Use various automation tools to implement test cases	3	75	80	H	M	H	H	H	M	M	H	H	M	H	H	H	H	H

Duration (hour)		8	10	8	9	10
S-1	SLO-1	Fundamentals of Testing: Necessity of Testing-Case Studies on "Impact of Software bugs"	Test Case Design Strategies: Introduction to basic design strategies	The need for levels of testing, Unit Testing: Planning, Test Harness	Test Management: Choice of Standards	Software Test Automation: Skills and Scope Design
	SLO-2	Objectives of Testing, Basics Definitions		Running the tests Recording Results	Infrastructure Management, Test People Management	
S-2	SLO-1	Testing Principles-Illustrations	White Box Strategies - Peer Reviews, Inspections, Walkthrough	Integration Testing: Goals, Design and Plan	Test Plan Components	Architecture for Automation
	SLO-2		Comparative Analysis		Test Plan Attachments	
S-3	SLO-1	Fundamental Test Process, The tester's role in a software development organization	Static Analysis Tools: Coding Standards, Code Metrics, Code Structure	System Testing goals, Types of System Testing: Functional Testing	Locating Test Items, Managing Issues	Requirements for a test tool, Process Model for Automation, Selecting the test tool
	SLO-2	Test planning	Activity: Static Analysis of a source code	Performance Testing, Stress Testing	Addressing Perception, Taking team together	
S-4	SLO-1	Establishing Test Policy, Structured approach to testing Test Factors	Coverage and Control Flow Graphs	Configuration Testing	Documentation uses	Demonstration of a Functional Testing Tool
	SLO-2	Eleven Step software testing process	Activity: Calculate Complexity for a given source code	Security Testing	Documentation Types	
S-5	SLO-1	Origin of Defects, Defect Repository and Test Design	Paths Code Complexity	Recovery Testing, Reliability Testing	Test Analysis report Documentation,	Demonstration of a Web Testing Tool

	SLO-2	Developer/Tester support of developing a defect repository	Activity: Calculate Path Code Complexity for a given source code	Usability Testing	Analyze reports and Problem tracking,	
S-6	SLO-1	Defect Examples, Case Studies – "Identify the defect"	Evaluating test adequacy criteria, Case Studies- "Applying the suitable White Box Strategy"	Regression Testing	Controlling and Monitoring Test Progress	Démonstration of an Unit Testing Tool
	SLO-2			Alpha, Beta and Acceptance Testing	Test Metrics and measurements: Role, need and types	
S-7	SLO-1	Defect Analysis and Prevention Strategies	Black Box Testing Strategies: Requirements Based Testing, Random Testing	Role of use cases in testing	Project Metrics with Practice	Demonstration of an Defect Tracking Tool
	SLO-2			Applying Testing Skills: Compatibility testing, Internationalization testing		
S-8	SLO-1	Developing adhoc test cases for a case study	Black Box Testing Strategies: Boundary Value Analysis, Equivalence Class Partitioning,	Testing Documentation plan	Progress Metrics with Practice	Demonstration of an Test Management Tool
	SLO-2		Activity: Designing test cases for the given requirement specification using Boundary value analysis and Equivalence Class Partitioning	Recording test cases, Reporting and Measurement of Success		
S-9	SLO-1		Black Box Testing Strategies: Cause Effect graphing		Productivity Metrics with Practice	Challenges in Automation
	SLO-2		Activity: Designing test cases for the given requirement specification using cause effect graphing and developing decision tables			
S-10	SLO1 SLO2		Evaluating test adequacy criteria, Case Studies- "Applying the suitable Black Box Strategy"			The Future: Software Quality Assurance

Learning Resources	1. Srinivasan Desikan and Gopalaswamy Ramesh, "Software Testing – Principles and Practices", Pearson Education, 2006 2. Ron Patton, "Software Testing", Second Edition, Sams Publishing, Pearson Education, 2007.	3. Ilene Burnstein, "Practical Software Testing", Springer International Edition, 2003. 4. Aditya P. Mathur, "Foundations of Software Testing _ Fundamental Algorithms and Techniques", Dorling Kindersley (India) Pvt. Ltd., Pearson Education, 2008 5. RenuRajani, Pradeep Oak, "Software Testing-Effective Methods, Tools and Techniques", Tata McGraw Hill 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
1. Mr. ShrikantSatyanarayan, Technical Manager LDRA Technology PVT LTD	1. Dr. N. Bhalaji, Associate Professor, SSN Institutions	1. Mrs. Anupama.C.G, SRMIST
2. Mr. Girish Raghavan, Senior DMTS Manager, Wipro Technologies		2. Mr. Selvin Paul Peter, SRMIST

Course Code	18CSE467T	Course Name	SOFTWARE QUALITY ASSURANCE	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	CSE		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1 :	Understand the importance of software quality
CLR-2 :	Gain knowledge about the components of software quality assurance system
CLR-3 :	Gain knowledge on conducting reviews walk through and inspection
CLR-4 :	Understand the importance of SCM, procedures, policies in SQA
CLR-5 :	Recognize the significance of human components
CLR-6 :	Gain Knowledge on measurements and standards

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

Course Learning Outcomes (CLO): At the end of this course, learners will be able to:	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLO-1 : Acquire the knowledge on software quality	2	80	85		-	-	-	-	-	-	-	-	-	M	-	H	-	-
CLO-2 : Acquire the ability to identify the dimension of a software project	2	75	80	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-3 : Apply different quality component in different phase of life cycle	2	85	80	H	H	-	-	-	-	-	-	-	-	-	-	-	H	H
CLO-4 : Follow procedures, processes, policies and work instructions in software development	2	80	75	-	-	-	-	-	-	M	H	-	-	-	-	-	-	-
CLO-5 : Manage risks and handle human components effectively	2	75	85	H	-	-	H	-	M	-	-	-	H	-	-	-	-	-
CLO-6 : Apply different measurements and follow standards	2	80	85		-	H	-	H	-	-	-	H	-	-	H	-	-	-

Duration (hour)	9	9	9	9	9
S-1 SLO-1	Introduction to software Quality	Software Quality Assurance System Architecture	Check lists	Introduction to Risk management	Importance of Measurement
S-1 SLO-2	Defining software quality and software quality Assurance	Components of Software Quality Assurance System	Verification and validation	Risk management according to the standards and models	Measurement according to ISO 9001
S-2 SLO-1	Software error, defects and failures	Contract Review process and its stages Contract Review objectives	Verification and validation	Risk management according to the standards and models	The practical software and systems measurement method
S-2 SLO-2	Software error, defects and failures	Implementation of Contract Review, Contract review for internal projects	Basics of Software Configuration Management , Benefits of Good configuration Management	Risk management according to the standards and models	The practical software and systems measurement method
S-3 SLO-1	Cost of quality	Development plan	Activity: Test the functionalities of the given project using any functional testing toot	Roles, Measurements	Measurement According to the CMMI Model
S-3 SLO-2	Cost of quality	Quality Plan	Activity: Test the functionalities of the given project using any functional testing toot	Human factors and risk management	Measurement According to the CMMI Model
S-4 SLO-1	Quality culture	Reviews,Personal review and desk check review	SCM Activities, Baselines	Introduction to supplier management, Supplier requirements	Survey as a measurement tool
S-4 SLO-2	Five dimensions of a software project	Walk through	Software Repository and its branches,	Agreement Processes, Supplier	Survey as a measurement tool

				Configuration Control	agreement management according to the CMMI	
S-5	SLO-1	Software Engineering code of Ethics	Review standards and Models	Configuration Status Accounting	Managing suppliers	Implementing a measurement program
	SLO-2	Software Engineering code of Ethics	Review standards and Models	Software Configuration Audit, Implementing SCM in very small entities with ISO/IEC29110	Software Acquisition life cycle	Standards, cost of quality and business models
S-6	SLO-1	Software quality models- McCall	Inspection	Policies	Software Contract Types	ISO 9000 family
	SLO-2	Software quality models- McCall	Project Launch reviews and project assessments	Process	Software Contract Reviews	IEEE 730 standard for SQA processes
S-7	SLO-1	Software quality models -IEEE 1061	Agile Meetings	Procedures and work instructions	Case Study: Prepare Contract Review Document for a project	IEEE 730 standard for SQA processes
	SLO-2	Software quality models -EEE 1061	Measures	Organizational standards	Case Study: Prepare Contract Review Document for a project	Process Maturity models of the SEI
S-8	SLO-1	Software quality models -ISO-25000 set of standards	Selecting the type of review,Tools	Graphical representation of process and procedures	Staff Training and Certification	Software Quality Assurance Plan
	SLO-2	Software quality models -ISO-25000 set of standards	Audits, Types, Audits according to the IEEE 1028 standard	Graphical representation of process and procedures	Staff Training and Certifications	Software Quality Assurance Plan
S-9	SLO-1	Case Study: Analyzing quality factors involved in a project	Case Study: Prepare a development plan for a project.	Preventive and corrective actions	Management and its Role in Quality Assurance	Case study: Prepare a Software Quality Assurance Plan for –interested project
	SLO-2	Case Study: Analyzing quality factors involved in a project.	Case Study: Prepare a development plan for a project	Document control	Management and its Role in Quality Assurance	Case study: Prepare a Software Quality Assurance Plan for –interested project

Learning Resources	1. Claude Y.Laporte, Alain April, Software quality Assurance, First edition , IEEE computer Society and Wiley,2018. 2. DanielGalin,"SoftwareQualityAssurancefromtheorytoimplementation",Pearson,2016	3. G.GordonSchulmeyer, "Hand book of Software Quality Assurance", 4th edition, ARTECH HOUSE INC,2008 4. Allen Gilles, "Software quality: Theory and management" - International Thomson - Computer 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	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. Benet Zacharias, Senior Consultant, Wipro Consulting Services, Chennai	1. Dr. A. Amuthan, Professor, Dept. of CSE, Pondicherry Engg. College, Pondicherry.	1. Dr. T.S.Shiny Angel, Assistant Professor, SRMIST
		2. Dr. A. Jeyasekar, Associate Professor, SRMIST

Course Code	18CSE468T	Course Name	SOFTWARE MEASUREMENTS AND METRICS	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	18CSE466T	Co-requisite Courses	Nil	Progressive Courses	NIL
Course Offering Department		Computer Science and Engineering		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 :	Familiarize with different metrics used in different process levels																		
CLR-2 :	Apply metrics knowledge to measure Engineering problems.																		
CLR-3 :	Improve their ability in making decisions via continuous practice like assessment and usage of metrics.																		
CLR-4 :	Design, implement and change metrics based on industry practice																		

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 :	Understand and measure the software features	3			L	H	-	H	L	-	-	-	L	L	-	H	-	-	-
CLO-2 :	Understand the need of software quality	3			M	M	L	M	L	-	-	-	M	L	-	H	-	-	-
CLO-3 :	Will be able to understand the software development tools	3			M	M	M	H	L	-	-	-	M	L	-	H	-	-	-
CLO-4 :	Evalaute the stages of process improvement and its necessities in Development Life Cycle	3			M	H	M	H	L	-	-	M	M	L	-	H	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Software Sizing Metrics	Complexity Metrics and Models	Customer Satisfaction Surveys: Methods of survey data collection	Software Quality - Five steps to software quality control	Conducting In-Process Quality Assessments
	SLO-2	Fundamentals in Measurement		Sampling Methods	Product Quality Metrics with practice	The Preparation Phase
S-2	SLO-1	Basic Measures	Lines of Code	Analyzig Satisfaction with practise	In-Process Quality Metrics	The Evaluation Phase
	SLO-2	Reliability and Validity	Halstead's Software Science			The Summarization Phase
S-3	SLO-1	Measurement Errors	Cyclomatic Complexity	Satisfaction with Company terms	Metrics for Software Maintenance	Recommendations and Risk Mitigation
	SLO-2	Assessing Reliability	Syntactic Constructs			Conducting Software Project Assessments
S-4	SLO-1	Evolution in software Metrics	Structure Metrics	Metrics for Object-Oriented Projects with tools	Ishikawa's Seven Basic Tools with practice	Audit and Assessment
	SLO-2					Software Process Maturity Assessment and Software Project Assessment
S-5	SLO-1	Functional Size Measurements	Case Study for the usage of complexity metrics with tools	Concepts and Constructs	Defect removal Effectiveness	Software Process Assessment Cycle
	SLO-2			Design and Complexity Metrics		Measures and metrics of industry leaders
S-6	SLO-1	Cost of counting function point metrics	Testing Metrics :Test Progress S Curve	Lorenz Metrics and Rules of Thumb	The Rayleigh Model	Measures and metrics of industry leaders
	SLO-2					
S-7	SLO-1	Software measures and metrics not based on function points	Testing Defect Arrivals Over Time	CK OO Metrics Suite	Reliability Growth Models - Jelinski-Moranda Model	Measures,Metrics,Innovation
	SLO-2		Product Size Over Time			Measurements,Metrics and outsource Litigation
S-8	SLO-1	Future Technical Developments in Functional Metrics	CPU Utilization	Productivity Metrics	Goel-Okumoto Model	Measurements,Metrics and outsource and Behavioral changes
	SLO-2		Effort/Outcome Model			Software Process Improvement

						Sequences
S-9	SLO-1	*Case Study to Measure software size*	*Case Study to apply Testing metrics*	*Case Study for the usage of Object*	*Musa-Okumoto Model*	*Measuring Process Maturity*
	SLO-2	*using various size Metrics*		*oriented metrics with tools*		*Measuring Proess Capability*

Learning Resources	1. Stephen H. Kan, "Metrics and Models in Software Quality Engineering", Addison Wesley,Second Edition,2017. 2. CaperJones,"AppliedSoftwareMeasurement:GlobalAnalysisofProductivityandQuality",Third Edition, McGraw Hill Companies,2008	3. MarkLorenz,JeffKidd,"Object-OrientedSoftwareMetrics",PrenticeHall,2000 4. NareshChauhan,"SoftwareTestingPrinciplesandPractices",OxfordUniversityPress,2010. 5. RavindranathPandianC,"SoftwareMetricsAGuidetoplanning,Analysis,andApplication",Auerbach,First Indian Reprint,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
1. Bijoymon Soman Sr. Test Analyst UST Global,Philadelphia,PA, USA	1.Dr.Arun kumar M N, FISAT, Kerala, amrakmar.mn11@gmail.com	1. Mrs.B.Jothi, SRMIST
		2.Ms Aswathy, SRMIST

Course Code	18CSE469T	Course Name	SOFTWARE PROCESS AND AGILE PRACTICES	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	Computer Science and Engineering	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 basic concepts of Software process and Agile manifesto	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-2 :	Comprehend various Agile principles																		
CLR-3 :	Gain knowledge on Agile Methodologies																		
CLR-4 :	Acquire Knowledge on Agile project management and Environment																		
CLR-5 :	Understand the concepts of Test driven development and Feature driven development																		
CLR-6 :	Understand the Agile approach to Quality assurance																		

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 knowledge of best practices involved in Software process	2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	Acquire the ability to identify the agile principles for software development	2	75	80	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-3 :	Understand work products, roles and practices of Scrum, XP, UP and EVO	2	85	80	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	Apply the knowledge of Agile methodologies in various projects	2	80	75	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	Apply the knowledge of Agile project management and practices	2	75	85	H	-	-	H	-	-	-	-	-	-	-	-	-	-	-
CLO-6 :	Acquire the knowledge of Agile quality assurance	2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	The nature of Software	Agile And Its Significance	Agile methodology	Agile Project management	Agile Quality assurance
	SLO-2	Defining Software	Agile Story	Extreme Programming: Method Overview	Multi-team and multi-site development	Feature Driven Development
S-2	SLO-1	The Software Process	Evolutionary delivery, Scrum Demo	Life cycle phases	Pipelining activities across Iterations	Feature Driven Development roles
	SLO-2	Software Engineering practice	Planning game, Sprint back log, adaptive planning and retrospective	Work products	Rolling Wave adaptive and predictive planning	Feature Driven Development process
S-3	SLO-1	Agile Development	Agile Motivation	Roles and practices	Benefits of rolling wave adaptive planning	Class Ownership
	SLO-2	Agility and the cost of change	Challenges With The Waterfall	Core practices	Agile requirements	Reporting
S-4	SLO-1	Agile Process	Research Evidence	Process mixtures	Agile modeling	Test Driven Development (TDD)
	SLO-2	Agile Manifesto & Principles	Scrum: Method Overview	Strengths of XP	Defining and keeping the vision	Test Driven Development roles
S-5	SLO-1	Software is new product development	Life cycle phases	Unified process: Method Overview	Evolutionary Requirements workshop	TDD benefits
	SLO-2	Predictable vs. Inventive Projects	Work products	Work products	Gathering requirements	TDD Limitations
S-6	SLO-1	Iterative and Evolutionary methods	Roles and practices	Roles and practices	Tracking requirement across iterations, Direct user involvement	Agile approach to Quality Assurance
	SLO-2	Risk driven and client driven planning	Core practices	Core practices	Brainstorming and Brain writing	Unscheduled and Scheduled project reviews
S-7	SLO-1	Time boxed Iterative development	Values of Scrum meeting	EVO: Method Overview	Mind maps, Team rotation writing	Status meeting
	SLO-2	Evolutionary and Adaptive development	Other practices and values	Life cycle phases	Agile environment	Automated unit tests and Acceptance tests
S-8	SLO-1	Adaptive Development	Common mistakes and	Work products	Continuous Integration	Exploratory Testing

			misunderstandings			
	SLO-2	Incremental Delivery, Evolutionary delivery	Sample projects	Roles and practices	Project Wiki webs, Case tools	Code review and code metrics
S-9	SLO-1	Specific Iterative methods	Process mixtures	Core practices	Caves and common rooms	Continuous Integration
	SLO-2	Evolutionary methods	Strengths and Weakness of Scrum	Process mixtures	Reverse engineering	Informative Workspaces

Learning Resources	1. Bruce R. Maxim Roger S. Pressman, "Software Engineering: A Practitioner's Approach", McGraw Hill Education; Eighth edition,2019 2. CraigLarman,"AgileandIterativeDevelopment–AManager'sGuide",PearsonEducation–2010	3. ElisabethHendricksonQualityTreeSoftwareInc,"AgileTesting"2008 4. Chetankumar Patel, Muthu Ramachandran, Story Card Maturity Model (SMM): A Process ImprovementFrameworkforAgileRequirementsEngineeringPractices,JournalofSoftware, Academy Publishers, Vol 4, No 5 (2009), 422-435, Jul2009.

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.Harihara prasath venkatraman ,Agile Coach,Renault Nissan Technology & Business Centre India , Hariharaprasath.Venkataraman@rntbci.com	Dr.N.Prakash ,Associate professor , B.S.A. Crescent Institute of Science and Technology	Mr.G.Senthil Kumar, Asst.prof (S.G),SRMIST
	Dr.K.Kumar,Associate professor,Vellore Institute of technology	Mr.Gouthaman, Asst.Prof., SRMIST

Course Code	18CSE470T	Course Name	SOTWARE SECURITY	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		Computer Science and Engineering	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 need for Software Security and the threats to software security																		
CLR-2 :	Incorporate security principles to software development lifecycle																		
CLR-3 :	Understand Secure software architecture design and coding																		
CLR-4 :	Gain basic knowledge on web security principles																		
CLR-5 :	Learn risk management and mitigation of risk in software development																		
CLR-6 :	Learn testing types and strategies for secure software																		

Column headers for 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

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Bloom	Prof %	Attain %	Eng. Know.	Prob. Anal.	Des & Dev	Anal. Des. Res.	Modern Tool	Soc. & Cult.	Env. & Sust.	Ethics	Ind. & Team	Comm.	Proj. Mgt.	Life Long	PSO-1	PSO-2	PSO-3
CLO-1 :	Identify security threats and issues in software	2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	Gather security related requirements during requirement elicitation	2	75	80	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-3 :	Design software by incorporating security principles	2	85	80	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	Understand the issues in web and database security	2	80	75	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	Apply risk management strategies and risk mitigation strategies in software development	2	75	85	H	-	-	H	-	-	-	-	-	-	-	-	-	-	-
CLO-6 :	Apply testing strategies for secure software development	2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Introduction to software Security	Secure software architecture and design	Browser Security Principles	Risk Management Framework	Software security testing
	SLO-2	Software assurance and software security	Software security practices for architecture and design	Defining the same-origin policy	Five stages of activity	Contrasting software testing and software security testing
S-2	SLO-1	Threats to Software security	Software security knowledge for architecture and design	Client-side vs. server-side	Applying the RMF	Functional testing
	SLO-2	Sources of Software Insecurity	Software characterization	Exceptions to the same origin policy	Understanding the business context	Risk-based testing
S-3	SLO-1	Benefits of detecting software security defects early	Threat analysis	Cross-site scripting	Gathering the artifacts, conducting project research	Penetration Testing
	SLO-2	Managing Secure software development	Architectural vulnerability assessment	Reflected, POST-based reflected, stored and local XSS	Identifying the business and technical risk	Security testing consideration throughout the SDLC
S-4	SLO-1	Risk Management framework for Software security	Risk likelihood determination	XSS defense	Developing risk questionnaires, interviewing the target project team	Unit testing
	SLO-2	Software security practices in the development lifecycle	Risk Impact Determination	Cross-site request forgery	Analyzing the research and interview data	Testing Libraries
S-5	SLO-1	Properties of secure software	Risk Mitigation Planning	CSRF defense	Uncovering technical risks	Testing Executable files
	SLO-2	Influencing security properties of software	Security principles	Prevent XSS	Analyzing software artifacts	Integration testing
S-6	SLO-1	Building a security assurance case	Security guidelines and attack patterns	SQL Injection	Synthesizing and ranking the risk	System Testing
	SLO-2	Incorporating assurance cases into SDLC	Secure coding and testing	SQL Injection effects	Reviewing the risk data	Security Failures

S-7	SLO-1	Importance of requirements engineering	Code analysis	Blind SQL Injection	Conducting the business and technical peer review	Categories of Errors
	SLO-2	Security Requirements Engineering	common software code vulnerabilities	Setting Database Permissions	Defining the risk mitigation strategy	Attacker Behaviour
S-8	SLO-1	The SQUARE Process model	Source code review	Stored Procedure Security	The importance of measurement	Functional and attacker perspectives for Security Analysis
	SLO-2	SQUARE sample outputs	Coding practices	SQL Injection in stored procedures	Measurement and metrics in the RMF	Identity Management and Software development
S-9	SLO-1	Requirements elicitation	Sources of additional information on secure coding	Insecure direct object references	The Cigital Workbench	System Complexity drivers and security
	SLO-2	Requirements prioritization	Best practices for secure coding	Pre and post authorization checks	Risk Management is a framework for Software security	Deep Technical Problem Complexity

Learning Resources	1. GaryMcGraw,SoftwareSecurity–AGuideforProjectManagers,Addison-Wesley Professional, 2008, ISBN-13:978-0321509178	2. JamesM.Helfrich,SecurityforSoftwareEngineers,CRCPress,TaylorandFrancisGroup2019 3. JamesRansome,Anmol Misra, Core Software Security, CRC Press,Taylorand Francis Group 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 %	

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Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1.Mr.PrasannaKumar,InfosysPrasanna_kumar11@infosys.com	1.Dr.Ema,Anna University Chennai,umaramesh@auist.net	1.Dr.G.Usha,SRMIST
2.Mr.Mithun, Cognizant,Mithun.SS@cognizant.com	2.Dr.KunvarSingh,NITTrichy,kunwar@nitt.edu	2.Dr.Usha Krithikka,SRMIST

Course Code	18CSE471T	Course Name	SOFTWARE MAINTENANCE AND ADMINISTRATION	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	
Course Offering Department	Computer Science and Engineering	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 factors that make change of existing systems both technically challenging and risky, and the processes required to control change.	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
CLR-2 :	Acquire a knowledge and understanding of the specific problems inherent in the reengineering and evolution of legacy software systems, and be able to apply some of the techniques that can be of use in comprehending and changing them																			
CLR-3 :	Identify the specific challenges that inherent in the reengineering and evolution of data-intensive systems that are able to apply some of the techniques that can be of use in comprehending and changing them																			
CLR-4 :	Evaluate and understand the specific problems inherent in the reengineering and evolution of package-based software systems, and be able to apply techniques for designing change-resistant systems from pre-packaged code.																			
CLR-5 :	Analyze and apply numerous administration tools and technical concepts that relate to software administration																			

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 :	Explaintermsusedinmakechangeofexistingsystemsbothtechnicallychallenginginandrisky,andtheprocesses	3	80	70	H	H	H	H	H	-	-	-	H	H	-	H	-	-	-
CLO-2 :	Incorporateaknowledgeandunderstandingofthespecificproblemsinherentinthereengineeringandevolutionof	3	85	75	M	H	H	M	H	-	-	-	M	H	-	H	-	-	-
CLO-3 :	Identify challenges that inherent in the reengineering and evolution of data-intensive systems that are able to apply some of the techniques	3	75	70	M	H	M	H	H	-	-	-	M	H	-	H	-	-	-
CLO-4 :	Apply techniques for designing change-resistant systems from pre-packaged code.	3	85	80	M	H	M	H	H	-	-	-	M	H	-	H	-	-	-
CLO-5 :	Apply numerous administration tools and technical concepts that relate to software administration	3	85	75	H	H	M	H	H	-	-	-	M	H	-	H	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Meaning of software maintenance, software change, ongoing support, economic implications of modifying software, the nomenclature and image problem	Definition, purposes and objectives	Definition for configuration management,	Quality Assurance,	Analyzing system logs,
	SLO-2			change control,		operating system updates,
S-2	SLO-1	Software maintenance framework,	levels of reverse Engineering,	documentation	fourth generation languages,	patches,
	SLO-2					configuration changes
S-3	SLO-1	Potential solutions to maintenance problem.	supports techniques,	Management and organizational issues	object oriented paradigms	Performing backups. Installing
	SLO-2		benefits			Configuring new hardware and software.
S-4	SLO-1	Maintenance process models	Reuse and reusability: Definitions,	Management responsibilities	Maintenance tools	Adding,
	SLO-2	Definition of critical appraisal of traditional process models,				removing,
S-5	SLO-1	Maintenance process models.	objective and benefit of reuse	Enhancing maintenance productivity	Criteria for selecting tools,	resetting passwords,
	SLO-2					System performance tuning
S-6	SLO-1	Program understanding: Aims of program comprehension,	approach to reuse,	maintenance teams	taxonomy of tools,	updating user account information,
	SLO-2					

S-7	SLO-1	maintainers and their information needs	Domain Analysis,	Personnel Education and Training	Program understanding and reverse engineering testing,	Performing routine audits of systems and software
	SLO-2	comprehension process models	Components engineering,			
S-8	SLO-1	Mental models, program comprehension strategies,	reuse process model,	Personnel Education and Training	Configuration management, and other tasks.	Performing routine audits of software
	SLO-2	factors that affect understanding,	Factors that impact upon reuse.			
S-9	SLO-1	implications of comprehension theories and studies	Maintenance measures, Definitions, objectives of software measurement, example measures, guidelines for selecting maintenance measures	Organization modes	Past, present and future of software maintenance	Performing routine audits of systems and software
	SLO-2					

Learning Resources	1. Armstrong A Takang and Penny A.Grubb, "Software Maintenance: concepts and Practice", International Thomson Computer press, London,2015	2. Roger S Pressman, "Software Engineering", 6th edition, Tata McGraw-Hill, 2004

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Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
		1. MrS.Selvakumara Samy., SRMIST
		2., Ms.D.Hema,SRMIST