

ACADEMIC CURRICULA

POSTGRADUATE DEGREE PROGRAMMES

**Master of Technology in
INTERNET OF THINGS**

Two Years(Full Time)

Learning Outcome Based Education

Choice Based Flexible Credit System

Academic Year

2020 - 2021



SRM INSTITUTE OF SCIENCE AND TECHNOLOGY

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

Kattankulathur, Chengalpattu District 603203, Tamil Nadu, India

// This page is intentionally left blank

M.Tech in Internet of Things

1. Department Vision Statement					
Stmt - 1	To become a world class department in imparting high quality knowledge				
Stmt - 2	To provide students a unique learning experience in Computer Science and Engineering and related fields.				
Stmt - 3	To instill good research experience on students for excelling in their career.				
2. Department Mission Statement					
Stmt - 1	To impart knowledge in cutting edge technologies to develop their professional skills with right attitude.				
Stmt - 2	To instill research mindset among the graduates in a methodological approach				
Stmt - 3	To demonstrate quality standards in their knowledge dissemination and research output				
Stmt - 4	To instill societal, cultural, ethical responsibilities in all professional activities with integrity and honesty				
Stmt - 5	To produce successful Computer Science and Engineering graduates who excel in their career with personal and professional responsibilities and commitment to lifelong learning				
3. Program Education Objectives (PEO)					
PEO - 1	Graduates will be able to demonstrate their knowledge and skills acquired in Computer Science and Engineering domain				
PEO - 2	Graduates will be able to successfully pursue their research in reputed institutions.				
PEO - 3	Graduates will have the proficiency to adapt, contribute and innovate new technologies and systems in their job domains with appropriate professional skills				
PEO - 4	Graduates will be ethically and socially responsible solution providers and entrepreneurs in Computer Science and other engineering disciplines.				
PEO - 5	Graduates will have the ability to excel in their career producing outstanding contribution in Computer Science and its related domains				
4. Consistency of PEO's with Mission of the Department					
	Mission Stmt. - 1	Mission Stmt. - 2	Mission Stmt. - 3	Mission Stmt. - 4	Mission Stmt. - 5
PEO - 1	H	H	H	M	H
PEO - 2	M	H	M	M	H
PEO - 3	H	M	H	M	H
PEO - 4	H	M	H	H	H
PEO - 5	M	M	H	M	H

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

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

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

6. Programme Structure(70 Total Credits)																			
1. Professional Core Courses (C) (4 Courses)								2. Professional Elective Courses (E) (5 Courses)											
Course Code	Course Title	Hours/ Week				L	T	P	C	Course Code	Course Title	Hours/ Week				L	T	P	C
		L	T	P	C							L	T	P	C				
20CSC505J	Internet of Things Architecture and Protocols	3	0	2	4					20CSE531J	Edge Computing	3	0	2	4				
20CSC506J	Cloud Storage and Computing	3	0	2	4					20CSE532J	Advanced Distributed Systems								
20CSC507J	Big Data Analytics	3	0	2	4					20CSE533J	Communication and Networking Technologies for Internet of Things	3	0	2	4				
20CSC508J	Embedded System and Software development for Internet of Things	3	0	2	4					20CSE534J	Fog Computing								
Total Learning Credits								16	Total Learning Credits								20		
3. Skill Enhancement Courses (S) (2 Courses)																			
Course Code	Course Title	Hours/ Week				L	T	P	C	Course Code	Course Title	Hours/ Week				L	T	P	C
		L	T	P	C							L	T	P	C				
20GNS501J	Research Publishing and Presenting Skills	1	0	2	2					20CSE535J	Components and Energy Optimization Techniques for Internet of Things	3	0	2	4				
20CSS503J	Research Methods in Computer Sciences	2	0	2	3					20CSE524J	Wireless Sensor Networks								
Total Learning Credits								5	Total Learning Credits								20		
4. Open Elective Courses (O) (Any 1 Course)																			
Course Code	Course Title	Hours/ Week				L	T	P	C	Course Code	Course Title	Hours/ Week				L	T	P	C
		L	T	P	C							L	T	P	C				
20MBO6xxT	Business Analytics	3	0	0	3					20CSE623J	Industrial Internet of Things Security	3	0	2	4				
20MEO6xxT	Industrial Safety	3	0	0	3					20CSE624J	Cognitive Internet of Things								
20MAO6xxT	Operations Research	3	0	0	3					Total Learning Credits								3	
20MBO6xxT	Cost Management	3	0	0	3					Total Learning Credits								3	
20NTO6xxT	Composite Materials	3	0	0	3					Total Learning Credits								3	
20CEO6xxT	Waste to Energy	3	0	0	3					Total Learning Credits								3	
20CSO602T	Evolutionary Computing	3	0	0	3					Total Learning Credits								3	
20GNO620T	MOOC	-	-	-	3					Total Learning Credits								3	
Total Learning Credits								26	Total Learning Credits								26		
5. Project Work, Internship In																			
Industry / Higher Technical Institutions (P)																			
Course Code	Course Title	Hours/ Week				L	T	P	C	Course Code	Course Title	Hours/ Week				L	T	P	C
		L	T	P	C							L	T	P	C				
20CSP601L	Internship (4-6 weeks during 2 nd sem vacation)	-	-	-	4					20CSP602L	Minor Project	0	0	8	6				
20CSP603L	Project Work Phase I	0	0	12	6					20CSP604L	Project Work Phase II	0	0	32	16				
Total Learning Credits								26	Total Learning Credits								26		

7. Mandatory Courses (M) (3 Courses)					
Course Code	Course Title	Hours/ Week			C
		L	T	P	
20PDM501J	Career Advancement for Engineers – 1	1	0	1	0
20PDM502J	Career Advancement for Engineers – 2	1	0	1	0
20PDM601J	Career Advancement for Engineers – 3	1	0	1	0

6. Audit Courses (M) (2 Courses)					
Course Code	Course Title	Hours/ Week			C
		L	T	P	
20CEA5xx	Disaster Management	1	0	1	0
20LEA5xx	Constitution of India	1	0	1	0
20LEA5xx	Value Education	1	0	1	0
20GNA5xx	Physical and Mental Health using Yoga	1	0	1	0

7. Implementation Plan

Semester - I					
Code	Course Title	Hours/ Week			C
		L	T	P	
20CSC505J	Internet of Things Architecture and Protocols	3	0	2	4
20CSC506J	Cloud Storage and Computing	3	0	2	4
20CSE531J	Edge Computing	3	0	2	4
20CSE532J	Advanced Distributed Systems				
20CSE533J	Communication and Networking Technologies for Internet of Things	3	0	2	4
20CSE534J	Fog Computing				
20GNS501J	Research Publishing and Presenting Skills	1	0	2	2
20PDM501J	Career Advancement for Engineers – 1	1	0	1	0
20PDM501J	Audit Course - 1	1	0	1	0
Total Learning Credits					18

Semester - II					
Code	Course Title	Hours/ Week			C
		L	T	P	
20CSC507J	Big Data Analytics	3	0	2	4
20CSC508J	Embedded System and Software development for Internet of Things	3	0	2	4
20CSE535J	Components and Energy Optimization Techniques for Internet of Things	3	0	2	4
20CSE524J	Wireless Sensor Networks				
20CSE536J	SDN and NFV for Internet of Things	3	0	2	4
20CSE537J	Smart Convergent Technologies				
20CSS503J	Research Methods in Computer Sciences	2	0	2	3
20PDM502J	Career Advancement for Engineers – 2	1	0	1	0
20PDM502J	Audit Course - 1	1	0	1	0
Total Learning Credits					19

Semester - III					
Code	Course Title	Hours/ Week			C
		L	T	P	
20CSE623J	Industrial Internet of Things Security	3	0	2	4
20CSE624J	Cognitive Internet of Things				
20GNO620T	Open Elective or MOOC	3	0	0	3
		-	-	-	
20CSP601L	Internship (4-6 weeks during 2nd Sem vacation)	-	-	-	4
20CSP602L	Or Minor Project	0	0	8	
20CSP603L	Project Work Phase I	0	0	12	6
20PDM601J	Career Advancement for Engineers – 3	1	0	1	0
Total Learning Credits					17

Semester - IV					
Code	Course Title	Hours/ Week			C
		L	T	P	
20CSP604L	Project Work Phase II	0	0	32	16
Total Learning Credits					16

8. Program Articulation Matrix																
Course Code	Course Name	Programme Learning Outcomes														
		Disciplinary Knowledge	Critical Thinking	Problem Solving	Analytical Reasoning	Research Skills	Team Work	Scientific Reasoning	Reflective Thinking	Self-Directed Learning	Multicultural Competence	Ethical Reasoning	Community Engagement	ICT Skills	Leadership Skills	Life Long Learning
20CSC505J	Internet of Things Architecture and Protocols	H	H	H	H	H	M	H	H	H	L	L	L	H	L	H
20CSC506J	Cloud Storage and Computing	H	H	M	M	H	M	H	H	H	L	L	L	H	L	H
20CSC507J	Big Data Analytics	H	H	H	H	H	H	H	H	H	L	L	L	H	M	H
20CSC508J	Embedded System and Software development for Internet of Things	H	H	H	H	H	H	H	H	H	L	L	M	H	L	H
20CSE531J	Edge Computing	H	H	H	H	H	H	H	H	H	M	L	M	H	L	H
20CSE532J	Advanced Distributed Systems	H	H	H	H	H	M	H	H	H	L	L	H	H	L	H
20CSE533J	Communication and Networking Technologies for Internet of Things	H	H	H	H	H	H	H	H	H	M	H	H	H	L	H
20CSE534J	Fog Computing	H	M	M	M	M	M	M	H	M	M	H	H	M	L	H
20CSE535J	Components and Energy Optimization Techniques for Internet of Things	H	H	H	H	H	H	H	H	H	H	H	H	H	M	H
20CSE524J	Wireless Sensor Networks	H	M	M	M	H	H	M	H	M	M	M	M	M	L	H
20CSE536J	SDN and NFV for Internet of Things	H	M	M	M	H	M	H	H	M	M	M	M	H	L	H
20CSE537J	Smart Convergent Technologies	H	H	H	H	H	H	H	H	H	M	H	H	H	M	H
20CSE623J	Industrial Internet of Things Security	H	M	H	H	H	M	H	H	M	M	M	M	H	L	H
20CSE624J	Cognitive Internet of Things	H	M	M	M	M	L	M	M	M	L	L	L	M	L	M
20GNS501J	Research Publishing and Presenting Skills															
20CSS503J	Research Methods in Computer Sciences	H	H	H	H	H	H	H	H	H	M	H	M	H	M	H
20MBO6xxT	Business Analytics															
20MEO6xxT	Industrial Safety															
20MAO6xxT	Operations Research															
20MBO6xxT	Cost Management															
20NTO6xxT	Composite Materials															
20CSO602T	Evolutionary Computing	H	M	H	H	H	M	H	H	H	M	M	M	H	M	H
20CEO6xxT	Waste to Energy															
20GNO620T	MOOC															
20CSP601L	Internship (4-6 weeks)															
20CSP602L	Minor Project															
20CSP603L	Project Work Phase I															
20CSP604L	Project Work Phase II															
20CEA5xx	Disaster Management															
20LEA5xx	Constitution of India															
20LEA5xx	Value Education															
20GNA5xx	Physical and Mental Health using Yoga															
20PDM501J	Career Advancement for Engineers – 1															
20PDM502J	Career Advancement for Engineers – 2															
20PDM601J	Career Advancement for Engineers – 3															
	Program Average															

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

Course Code	20CSC505J	Course Name	INTERNET OF THINGS ARCHITECTURE AND PROTOCOLS	Course Category	C	Professional Core			
						L	T	P	C
						3	0	2	4

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):		Learning			Program Learning Outcomes (PLO)														
CLR-1:		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
The purpose of learning this course is to:																			
IoT an Architectural Overview ; M2M and IoT technology fundamentals																			
IoT Reference Architecture; Other Relevant Architectural views																			
Data Link and Network Layer Protocols																			
Transport and Session Layer protocols																			
Service Layer, Security in IoT Protocols																			
Application Layer																			
Course Learning Outcomes (CLO):		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Documentation	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
At the end of this course, learners will be able to:																			
M2M and IoT analytics; Knowledge Management		3	80	70	L	H	-	H	L	-	-	-	L	L	-	H	-	-	-
Technical design constraints; Data Representation and Visualization		3	85	75	M	H	L	M	L	-	-	-	M	L	-	H	-	-	-
MAC layer protocols (3GPP, IEEE 802.11 IEEE802.15), Network Layer Protocols (IPV4,IPV5,DHCP, ICMP)		3	75	70	M	H	M	H	L	-	-	-	M	L	-	H	-	-	-
Transport Layer protocols(TCP,MPTCP,UDP,SCTP), Session Layer Protocols(HTTP,CoAP,XMPP,MQTT)		3	85	80	M	H	M	H	L	-	-	-	M	L	-	H	-	-	-
Service Layer(oneM2M,ETSI,M2M,OMA);Security in IoT Protocols		3	85	75	H	H	M	H	L	-	-	-	M	L	-	H	-	-	-
Application Layer protocols		3	80	70	L	H	-	H	L	-	-	-	L	L	-	H	-	-	-

Duration (hour)	15	15	15	15	15	
S-1	SLO-1	OVERVIEW-Introduction	REFERENCE ARCHITECTURE Introduction	IoT Data Link Layer and Network Layer Protocols-Introduction	Transport and Session Layer Protocols	Service Layer
	SLO-2	IoT-An Architectural Overview	IoT Architecture	MAC Layer-3GPP(3 rd generation partnership project)	Introduction	Introduction
S-2	SLO-1	Building an Architecture	State of the Art	MTC-(Machine Type Communication for mobile)	Transport Layer-TCP (Transmission Control Protocol)	Sensors connectivity
	SLO-2	Main Design Principles	Reference model and Architecture	Dynamic massive access for MTC in LTE	MPTCP(MultiPath TCP)	M2M connectivity
S-3	SLO-1	Needed capabilities	IoT Reference Model	IEEE 802.11	UDP(User Datagram Protocol)	Edge connectivity
	SLO-2	An IoT Architecture outline	IoT Reference Architecture	IEEE 802.15	DCCP(Datagram Congestion Control Protocol)	Connectivity protocols
S 4-5	SLO-1	Lab 1: Study of IoT Architecture and design principles	Lab 4 :Study of Reference model and Architecture	Lab 7 :Implementation of MAC Layer protocols	Lab 10: Implementation of Transport Layer Protocol (TCP,UDP,DCCP)	Lab 13:Implementation of Session Layer Protocols(XMPP, AMQP, MQTT)
	SLO-2	Standards and considerations	Introduction	Wireless HART (Highway Addressable Remote Transducer Protocol) wireless sensor networking technology	SCTP(Stream Control Transmission Protocol)	OneM2M
S-6	SLO-1	M2M fundamentals	functional view	ZWave Bluetooth low energy	TLS(Transport Layer Security)	Standards for M2M and IoT
	SLO-2	IoT Technology fundamentals	Information view	Zigbee smart energy	DTLS (Datagram Transport Layer Security)	ETSI and its standard
S-7	SLO-1	Devices	Deployment view	DASH7 Alliance Protocol(Open wireless sensor and Actuator Network Protocol)	Merits of Transport Layer Protocols	M2M (Machine to Machine direct communication-sensor, actuators,embedded system)
	SLO-2	Gateways	Operational view	Network Layer-IPV4 (Internet Protocol version 4)	Session Layer Protocols	OMA (Open Mobile Alliance)
S-8	SLO-1	Local Area Networking	Other Relevant Architectural views	IPV6 (Internet Protocol version 6)	Introduction	BBF(Broadband Forum) protocol
	SLO-2					

S 9-10	SLO-1	Lab 2: Study of standards, Devices, Gateways and LAN	Lab 5: Study of different architectural views	Lab 8: Implementation of Bluetooth and zigbee smart energy	Lab 11: Implementation of Transport Layer Protocol (SCTP, TLS, DTLS)	Lab 14: Implementation of Service Layer Protocols (oneM2M, ETSI, BFF)
	SLO-2					
S-11	SLO-1	Wide Area Networking	Real-world design constraints	6LoWPAN (Low-power Wireless Personal Area network for small devices)	HTTP (Hypertext Transfer Protocol)	Security in IoT Protocols
	SLO-2	Data Management	Introduction	6TiSCH (IPV6 over TSCH-Time Slotted Channel Hopping), ND (Neighbor Discovery Protocol)	CoAP (Constrained Application Protocol)	MAC 802.15.4
S-12	SLO-1	Business Processes in IoT	Technical Design constraints	DHCP (Dynamic Host Configuration Protocol)	XMPP (Extensible Messaging and Presence Protocol)	6LoWPAN (Low power Wireless Personal Area Networks)
	SLO-2	Everything as a service (XaaS)	Hardware popularity	ICMP (Internet Control Message Protocol)	AMQP (Advanced Message Queueing Protocol)	RPL
S-13	SLO-1	Declaring Structure and accessing	Data Representation and Visualization	RPL (Routing Protocol for Low-Power and Lossy networks)	MQTT (MQ Telemetry Transport Protocol)	Application Layer
	SLO-2	M2M and IoT Analytics	Interaction and Remote Control	CORPL (Cognitive RPL), CARP (Common Address Redundancy Protocol)	Merits of Session Layer Protocols	Merits of Service Layer Protocols
S 14-15	SLO-1	Knowledge Management	Lab 6: Implementation of Data representation and visualization	Lab 9: Implementation of Network Layer Protocols	Lab 12: Implementation of Session Layer Protocol (http, CoAP)	Lab 15: Implementation of Service Layer Protocols
	SLO-2					

Learning Resources	1. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karmouskos, David Boyle, "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", 1st Edition, Academic Press, 2014	5. Vijay Madiseti and Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)", 1st Edition, VPT, 2014. 6. http://www.cse.wustl.edu/~jain/cse570-15/ftp/iot_prot/index.html
	2. Peter Waher, "Learning Internet of Things", PACKT publishing, BIRMINGHAM – MUMBAI 3. Bernd Scholz-Reiter, Florian Michahelles, "Architecting the Internet of Things", ISBN 978-3-642-19156-5 e-ISBN 978-3-642-19157-2, Springer 4. Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", ISBN: 978-1-118-47347-4, 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 Understand	20%	20%	15%	15%	15%	15%	15%	15%	15%	15%
Level 2	Apply Analyze	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Level 3	Evaluate Create	10%	10%	15%	15%	15%	15%	15%	15%	15%	15%
	Total	100 %		100 %		100 %		100 %		-	

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

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Mr. Hariharan Ramalingam, Vertical Delivery Head, Wipro Ltd,	1. Dr.A.Amuthan, Associate Dean, Dept. of CSE, Pondicherry Engg. College, Pondicherry	1. Dr.M.MURLI, SRMIST
2. Mr. Surendra Sampath, Software Analyst Honda of America Manufacturing - Client of Wipro Technologies	2. Dr. Noor Mohammad, IIITDM, Kancheepuram, noor@iiitdm.ac.in	

Course Code	20CSC506J	Course Name	CLOUD STORAGE AND COMPUTING	Course Category	C	Professional Core	L	T	P	C
							3	0	2	4

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	CS2162
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 Cloud service Models, Virtualization concepts	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:	Utilize Cloud storage services to store and retrieve the data from cloud				L	H	-	H	L	-	-	-	L	L	-	H	-	H	-	-	-	-
CLR-3:	Utilize different Cloud storage models to implement real time applications				M	H	L	M	L	-	-	-	M	L	-	H	-	-	-	-	-	-
CLR-4:	Utilize data storage structure for real-time applications				M	H	M	H	L	-	-	-	M	L	-	H	-	-	-	-	-	-
CLR-5:	Utilize Hashing and security algorithms for real-time application development				M	H	M	H	L	-	-	-	M	L	-	H	-	-	-	-	-	-
CLR-6:	Utilize the different types of cloud storage services and its operations for real-time programming applications				H	H	M	H	L	-	-	-	M	L	-	H	-	-	-	-	-	-
CLO-1:	Identify cloud virtualization and service models	3	80	70	L	H	-	H	L	-	-	-	L	L	-	H	-	-	-			
CLO-2:	Create the different types of Cloud storage models and evaluate its operations	3	85	75	M	H	L	M	L	-	-	-	M	L	-	H	-	-	-			
CLO-3:	Construct Google and AWS based storage applications and evaluate its operations	3	75	70	M	H	M	H	L	-	-	-	M	L	-	H	-	-	-			
CLO-4:	Create Storage Architectures for cloud service models and its security	3	85	80	M	H	M	H	L	-	-	-	M	L	-	H	-	-	-			
CLO-5:	Create SQL database and connect the user applications	3	85	75	H	H	M	H	L	-	-	-	M	L	-	H	-	-	-			
CLO-6:	Construct the different types of Cloud storage models and launching an Virtual instance remotely.	3	80	70	L	H	-	H	L	-	-	-	L	L	-	H	-	-	-			

Duration (hour)	15	15	15	15	15	
S-1	SLO-1	Introduction to Cloud Computing	Cloud Storage	Architecture of storage	Global storage management locations	Object life cycle
	SLO-2	History of Cloud Computing	Storage Access	Analysis and planning	scalability	Accessing S3 objects
S-2	SLO-1	Cloud Service Models	BR Tree Structure	Storage network design considerations;	operational efficiency	Glacier storage
	SLO-2	Cloud Deployment Models	Architecture	Data and Storage access –DAS, NAS ,SAN	Global storage distribution	AWS Relational Databases-Services
S-3	SLO-1	Business Concern in Cloud	Local Operation on BR-Tree	NAS and FC SANs,	terabytes to peta bytes and greater	Amazon Redshift
	SLO-2	Challenges in Cloud Computing	Distributed BR Trees	hybrid storage networking technologies	Policy based information management	DynamoDB
S-4-5	SLO-1	Lab 1: Case Study on Cloud Storage services	Lab 4 :Implementation of Openstack cloud Installation and configuration	Lab 7 :Implementation Hadoop Distributed File system single node	Lab 10: Implementation of AWS S3 bucket data storing and removal.	Lab 13: Installation and configuration of VMware workstation.
	SLO-2					
S-6	SLO-1	Virtualization	Hashing-GHBA design	iSCSI,	metadata attitudes	Google – Cloud SQL
	SLO-2	Types of Virtualization	Semantic Aware Query extraction	FCIP	file systems or object storage	BigTable, BigQuery
S-7	SLO-1	Load Balancing	Searchable analytics for Image	FCoE	Cloud Service Provider	Datastore
	SLO-2	Hypervisors	Distributed File systems	design for storage virtualization	Amazon S3	Cloud Dataproc
S-8	SLO-1	Machine Imaging	Precursors	host system design considerations.	Rackspace	Relational

	SLO-2	Cloud Marketplace overview	Parallel File systems	Types of storage system access	Salesforce Cloud	NoSQL Databases
S 9-10	SLO-1	Lab 2: Implementation of Hypervisor and Multiple Virtual Machine Creation	Lab 5: Launching and connecting virtual Instance through PHP based Web Interface	Lab 8: Implementation of Google Cloud SQL Database	Lab 11: Installation and configuration of Openstack cloud	Lab 14 :Implementation of customer Database application in Salesforce cloud
	SLO-2					
S-11	SLO-1	Comparison on Cloud providers	Google File systems	block-based storage system	PCloud,IDrive	Elements of Cloud storage
	SLO-2	Cloud Architecture Model	NoSQL Databases	File level storage system	DropBox,Onedrive	Open stack swift Architecture
S-12	SLO-1	Web based Cloud Services	Cryptographic key management	object level Storage systems	Google Drive	logical organization of Objects
	SLO-2	Characteristics of Cloud services	Secure cloud architecture	Unified storage system	Own Cloud	Physical data organization
S-13	SLO-1	Cloud other service models	OS and Network security	Unified storage system Architecture	Applecloud	Data paths
	SLO-2	Cloud Services-Cons and pros	Side channel attack	Comparison of storage systems	Egnyte	Replication
S 14-15	SLO-1	Lab 3: Implementation of Eucalyptus Cloud Installation and configuration	Lab 6: Implementation of Authentication of VM Instances through SSH	Lab 9: Implementation of AWS S3 bucket	Lab 12:Implementation Openstack swift server for setting up Storage server	Lab 15 :Configuring and Launching an EC2 instance in AWS Cloud.
	SLO-2					

Learning Resources	1.Yu Hua, Xue Liu, <i>Searchable Storage in Cloud Computing</i> , Springer Nature Singapore Pte Ltd. 2019.	8. <i>Cloud Computing Bible</i> . Barrie Sosinsky. John Wiley & Sons. ISBN-13: 978-0470903568.
	2.Jagannath Kallakurchi, Donald J. Houde, Dr. Deven Shah, Kogent Learning Solutions Kailash Jayaswal, <i>Cloud Computing Black Book</i> ,dreamtech press,Kindle Edition,2014.	
	3.Dan C. Marinescu, <i>Cloud Computing: Theory and Practice</i> , Morgan Kaufmann; 2nd edition,Elesvier 2018	9. <i>Amazon Web Services For Dummies</i> . Bernard Golden. For Dummies. ISBN-13: 978-18571835
	4.John R. Vacca, <i>Cloud Computing Security: Foundations and Challenges</i> ,1st Edition,CRC Press,2016	10.RajikumarBanyu, <i>Cloud Computing: Principles and Paradigms</i> , John Wiley & Sons, First Edition
	5. Amar Kapadia, Sreedhar Varma, Kris Rajana , <i>Implementing Cloud Storage with OpenStack Swift</i> , Packet publisher,2014.	
	6. Viithal Srinivasan, Janani Ravi, <i>Google Cloud Platform for Architects: Design</i> ,Kindle Edition,2018	
	7.Joe Baron, Hisham Baz, Tim Bixler, <i>AWS Certified Solutions Architect Study Guide</i> ,John Wiley & sons,20	

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

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.R.Shivakumar,Senior Software Engineer,Hexaware Technologies,sivakumarr2@hexaware.com	1. Dr.E.Ilavarasan,Professor,Pondicherry Engineering college, eilavarasan@pec.edu	Dr.M.Murali,Associate Professor,SRMIST.

Course Code	20CSC507J	Course Name	BIG DATA ANALYTICS	Course Category	C	Professional Core	L	T	P	C
							3	0	2	4

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):		Learning			Program Learning Outcomes (PLO)															
CLR-1:		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
Provide an overview of an exciting growing field of big data analytics					Engineering Knowledge															
Introduce the tools required to manage and analyze big data like Hadoop, MapReduce					Problem Analysis															
Learn principles in achieving big data analytics with scalability and streaming capability					Design & Development															
Apply big data processing and mining techniques					Analysis, Design, Research															
Understand how to perform cluster analysis using machine Learning Tools					Modern Tool Usage															
Understand how big data analytics affect society					Society & Culture															
					Environment & Sustainability															
					Ethics															
					Individual & Team Work															
					Communication															
					Project Mgt. & Finance															
					Life Long Learning															
					PSO - 1															
					PSO - 2															
					PSO - 3															

Duration (hour)	15	15	15	15	15	
S-1	SLO-1	Big Data introduction	Hadoop Architecture	Hive Architecture and Installation	Introduction to Machine Learning	Introduction to Sustainability Data and Analytics
	SLO-2	Big data: definition and taxonomy	Hadoop Architecture		Introduction to Machine Learning	Sustainability Data and Analytics
S-2	SLO-1	Big Data Platforms for the Internet of Things:	Hadoop Storage: HDFS	Comparison with Traditional Database	Machine learning tools	Sustainability Data and Analytics in Cloud-Based M2M Systems
	SLO-2	network protocols	Hadoop Storage: HDFS	Introduction to the SQL Language	Machine learning tools	Sustainability Data and Analytics in Cloud-Based M2M Systems
S-3	SLO-1	Big data value for the enterprise	Common Hadoop Shell commands	From SQL to HiveQL	Spark	potential stakeholders and their complex relationships to data and analytics applications
	SLO-2	Setting up the demo environment	Anatomy of File Write and Read	From SQL to HiveQL	Spark	potential stakeholders and their complex relationships to data and analytics applications
S 4-5	SLO-1	Lab 1: Perform setting up and Installing Hadoop in its two operating modes	Lab 4 : Create and test an Apache Hadoop cluster	Lab 7 : HiveQL Queries	Lab 10: Data analytics using Apache Spark on Amazon food dataset	Lab 13: Write Pig Latin scripts to sort, group, join, project, and filter your data.
	SLO-2					
S-6	SLO-1	First steps with the Hadoop "ecosystem"	NameNode, Secondary NameNode	HiveQL - Querying Data	SparkML	Social Networking Analysis
	SLO-2	Hadoop components: MapReduce/Pig/Hive/HBase	DataNode	Sorting & Aggregating	SparkML	Social Networking Analysis
S-7	SLO-1	Loading data into Hadoop	Hadoop MapReduce paradigm	Map Reduce Scripts,	H2O	Building a useful understanding of a social network
	SLO-2	Loading data into Hadoop	Hadoop MapReduce paradigm	Map Reduce Scripts,	H2O	Building a useful understanding of a social network
S-8	SLO-1	Handling files in Hadoop	Map and Reduce tasks	Joins & Subqueries	H2O Tools	Leveraging Social Media

	SLO-2	Handling files in Hadoop	Map and Reduce tasks	Joins & Subqueries	H2O Tools	Leveraging Social Media
S 9-10	SLO-1	Lab 2: Use web based tools to monitor your Hadoop setup	Lab 5: Basic Word Count Map Reduce program	Lab 8: Mapreduce program that mines weather data (Weather sensors collecting data every hour at many locations across the globe gather large volume of log data)	Lab 11: Install, Deploy & configure Apache Spark Cluster	Lab 14 : Write a Pig Latin scripts for finding TF-IDF value for book dataset (A corpus of eBooks available at: Project Gutenberg)
	SLO-2					
S-11	SLO-1	-Getting data from Hadoop	Understanding inputs and outputs of MapReduce	Using Hive to query Hadoop files	Azure ML	IoT to Bootstrap Smart Environments
	SLO-2	Getting data from Hadoop	Data Serialization	HBase concepts, Schema Design	Azure ML	IoT to Bootstrap Smart Environments
S-12	SLO-1	Smart City Applications	Job, Task trackers	Advance Indexing - PIG	case studies on Software used : Apache Hadoop.	lightweight Cyber Physical Social Systems
	SLO-2	Big Data challenges and requirements coming from different Smart City applications	Cluster Setup	Zookeeper - how it helps in monitoring a cluster	case studies on Software used : Apache Hadoop.	lightweight Cyber Physical Social Systems
S-13	SLO-1	Case Study 1:Big Data challenges and requirements coming from different Smart City applications	SSH & Hadoop Configuration	HBase uses Zookeeper	case studies on Software used : Apache Hadoop.	citizen actuation
	SLO-2	Case Study 2:Big Data challenges and requirements coming from different Smart City applications	HDFS Administering –Monitoring & Maintenance.	how to Build Applications with Zookeeper	case studies on Software used : Apache Hadoop.	citizen actuation
S 14-15	SLO-1	Lab 3: Implement the file management tasks in Hadoop	Lab 6: Performing a MapReduce Job for word search	Lab 9: Install and Run Hive	Lab 12: Apache spark applications using Scala.	Lab 15 : Construct Smart Transport Intelligent system
	SLO-2					

Learning Resources	1. Chris Eaton, Dirk deRosier et al., "Understanding Big data", McGraw Hill, 2012.	4. Tom White, "HADOOP: The definitive Guide", O Reilly 2012. 5. Stackowiak, R., Licht, A., Mantha, V., Nagode, L., "Big Data and The Internet of Things Enterprise Information Architecture for A New Age", Apress, 2015 6. Dr. John Bates, "Thingalytics - Smart Big Data Analytics for the Internet of Things", John Bates, 2015
	2. Big data. Architettura, tecnologie e metodi per l'utilizzo di grandibasi di dati, A. Rezzani, Apogeo Education, 2013	
	3. Jy Liebowitz, "Big Data and Business analytics", CRC 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	20%	20%	15%	15%	15%	15%	15%	15%	15%	15%
Level 2	Apply Analyze	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Level 3	Evaluate Create	10%	10%	15%	15%	15%	15%	15%	15%	15%	15%
	Total	100 %		100 %		100 %		100 %		-	

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

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
		Dr.M.Umadevi,CSE/SRMIST

Course Code	20CSC508J	Course Name	EMBEDDED SYSTEM AND SOFTWARE DEVELOPMENT FOR INTERNET OF THINGS	Course Category	C	Professional Core				L	T	P	C
										3	0	2	4

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:	Building Blocks of Embedded System	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3				
CLR-2:	Various Embedded Development Strategies				L	H	L	M	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
CLR-3:	Bus Communication in processors, Input/output interfacing.				M	H	L	M	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
CLR-4:	Various processor scheduling algorithms				M	H	M	H	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
CLR-5:	To understand fundamentals of IoT and embedded system including essence, basic design strategy and process modeling.				M	H	M	H	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
CLR-6:	To introduce students a set of advanced topics in embedded IoT and lead them to understand research in network.				H	H	M	H	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																						
CLO-1:	To provide a clear understanding on the basic concepts, Building Blocks of Embedded System	3	80	70	L	H	L	M	L	L	L	L	L	L	L	L	L	L	L	L			
CLO-2:	To teach the fundamentals of Embedded processor Modeling , Bus Communication in processors, Input/output interfacing	3	85	75	M	H	L	M	L	L	L	L	L	L	L	L	L	L	L	L			
CLO-3:	To introduce on processor scheduling algorithms , Basics of Real time operating system	3	75	70	M	H	M	H	L	L	L	L	L	L	L	L	L	L	L	L			
CLO-4:	To discuss on aspects required in developing a new embedded processor, different Phases & Modeling of embedded system	3	85	80	M	H	M	H	L	L	L	L	L	L	L	L	L	L	L	L			
CLO-5:	Solve the given societal challenge using IoT	3	85	75	H	H	M	H	L	L	L	L	L	L	L	L	L	L	L	L			
CLO-6:	Choose between available technologies and devices for stated IoT challenge	3	80	70	L	H	L	M	L	L	L	L	L	L	L	L	L	L	L	L			

Duration (hour)	15		15		15		15		15	
S-1	SLO-1	Introduction to Embedded Systems	Embedded Product Development Life Cycle- objectives	Embedded Software for the IoT: How to select an OS -	Introduction to Xbee wireless modules	Introduction to ESP8266				
	SLO-2	The build process for embedded systems	Different phases of EDLC, Modelling of EDLC;	Open source, GNU licensing and Linux	Pin layout- configuring modules	Hardware requirement				
S-2	SLO-1	Structural units in Embedded processor ,	Issues in Hardware-software Co-design,	Which CPU to use ? - CPU core, CPU architecture, Word size,	Configuring the router	Hardware configuration				
	SLO-2	selection of processor & memory devices	Data Flow Graph, state machine model,	MMU-memory managed unit	Loading the firmware for the modules	Installing the Arduino IDE for the ESP8266				
S-3	SLO-1	DMA – Memory management methods	Sequential Program Model,	RAM, Cache, EEPROM and flash ,FPU-floating point unit,	Configuring the XBee modules	Connection your module to your wi-fi network				
	SLO-2	Timer and Counting devices,	Concurrent Model, object oriented Model.	DSP, Crypto engine, Upgrade path, Second sources	Testing the network	Controlling LED				
S-4-5	SLO-1	Lab 1: Study of ARM evaluation system	Lab 4 : Interfacing real time clock and serial port.	Lab 7 : Interrupt performance characteristics of ARM and FPGA.	Lab 10: Study of Connectivity and configuration of Raspberry-Pi /Arduino board circuit with basic peripherals, LEDs. Understanding GPIO and its use in program.	Lab 13: Study of ESP8266 and Arduino				
	SLO-2									
S-6	SLO-1	Watchdog Timer, Real Time Clock, In circuit emulator	Introduction to basic concepts of RTOS- Task, process & threads.	RoHS-compliance, Evaluation boards, Tool-chain,	Arduino based sensor nodes	Reading data from a GPIO pin				
	SLO-2	Target Hardware Debugging.	Interrupt routines in RTOS, Multiprocessing and Multitasking,	Benchmarking, Power consumption, JTAG debugger, Peripherals	Arduino models	Grabbing the content from a web page				
S-7	SLO-1	<i>Embedded Networking: Introduction,</i>	Preemptive and non-preemptive scheduling,	Software architecture: Design for performance,	The Arduino IDE	Reading data from a digital sensor				
	SLO-2	<i>I/O Device Ports & Buses</i>	Task communication shared memory, message passing,	Layers, Object model ,	Hosting sensors with arduino					
S-8	SLO-1	Serial Bus communication protocols - RS232 standard	Inter process Communication –	Case: CANOpen, Message passing, Middleware	Hardware and software setup	Cloud Data logging- Hardware and software requirement				

	SLO-2	RS422 – RS485 - CAN Bus	synchronization between processes-semaphores,	Case: architectural reuse in LAN-XI,	Using an Arduino as a Data collector for Xbee sensor nodes	Hardware configuration
S 9-10	SLO-1	Lab 2: Interfacing ADC and DAC.	Lab 5: Interfacing keyboard and LCD.	Lab 8 Interfacing stepper motor and temperature sensor.	Lab 11: Understanding the connectivity of Raspberry-Pi /Arduino board circuit with IR sensor. Write an application to detect obstacle and notify user using LEDs.	Lab 14 :Implementation of ESP8266 based LED control
	SLO-2					
S-11	SLO-1	Serial Peripheral Interface (SPI)	Mailbox, pipes,	Understanding C	Raspberry Pi based sensor nodes	Logging data
	SLO-2	Inter Integrated Circuits (I2C).	Priority inversion, priority inheritance,	Debug tools : Simulator, ICE – in-circuit emulator,	Models	Displaying data
S-12	SLO-1	Application Domain and Characteristic of Embedded System,	Comparison of Real time Operating systems: Vx Works, uC/OS-II, RT Linux.	Background or JTAG debugger	Installing a Boot Image	Case study: Controlling a Door Lock from the Cloud
	SLO-2	Real time systems and Real-time scheduling,	Case Study of Washing Machine	Target stand-in, Debugger, Strace,	GPIO pin mapping	Case study: Building a physical Bitcoin ticker
S-13	SLO-1	Processor basics and System-On-Chip,	Automotive Application	Debugging without special tools	Hosting sensors with Raspberry Pi	Cloud based Home automation system
	SLO-2	Introduction to ARM processor and its architecture.	Smart card System Application	Monitoring messages, Test traffic	Hardware and software setup	Case study: Wireless Gardening with the ESP8266
S 14-15	SLO-1	Lab 3: Interfacing LED and PWM.	Lab 6: Interfacing EPROM and interrupt.	Lab 9: Implementing zigbee protocol with ARM.	Lab 12: Understanding and connectivity of Raspberry-Pi /Arduino board with camera. Write an application to capture and store the image.	Lab 15 :Implementation of Cloud data logging with the ESP8266
	SLO-2					

Learning Resources	<ol style="list-style-type: none"> 1. Peckol, "Embedded system Design", John Wiley & Sons, 2010 2. Lyla B Das, "Embedded Systems-An Integrated Approach", Pearson, 2013 3. Shibu. K.V, "Introduction to Embedded Systems", 2e, Mc graw Hill, 2017 4. Raj Kamal, 'Embedded System-Architecture, Programming, Design', Mc Graw Hill, 2013. 5. C.R.Sarma, "Embedded Systems Engineering", University Press (India) Pvt. Ltd, 2013. 6. Tammy Noergaard, "Embedded Systems Architecture", Elsevier, 2006. 	<ol style="list-style-type: none"> 7. Han-Way Huang, "Embedded system Design Using C8051", Cengage Learning, 2009. 8. Rajib Mall "Real-Time systems Theory and Practice" Pearson Education, 2007. 9. Schwartz, M. "Internet of Things with ESP8266/Marco Schwartz", 2016, Packt Publishing 10. Elk, Klaus. Embedded Software for the IoT. Walter de Gruyter GmbH & Co KG, 2018. 11. Bell, Charles. Beginning sensor networks with Arduino and Raspberry Pi. Apress, 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	20%	20%	15%	15%	15%	15%	15%	15%	15%	15%
Level 2	Apply Analyze	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Level 3	Evaluate Create	10%	10%	15%	15%	15%	15%	15%	15%	15%	15%
	Total	100 %		100 %		100 %		100 %		-	

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

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Mr.B.Nagarajan, Software Engineer Cisco System, Texas, USA	Dr.G.Nagarajan, Professor, Sathyabama University, Chennai.	Dr.R.I.Minu, Associate Professor, SRMIST

	SLO-2			IoT Solutions	MEC in the enterprise setting	
S 9-10	SLO-1	Lab 2: Deploy micro services and writing your own microservices	Lab 5: Deploy your microservices	Lab 8: Writing micro services	Lab 11: System-Bluetooth REST API	Lab 14 :ioFog agents CLI usage
	SLO-2					
S-11	SLO-1	Shared and Central resources versus exclusive and local computation	Deployment operation service framework(Smart services)	Standards for self_organization, self_configuration, self_discovery	Enabling MEC in 4G networks	MEC Market – the new vertical perspective
	SLO-2			Trust/Decentralized trust		New players in 5G role of verticals
S-12	SLO-1	IOT disrupts the cloud	Full_life cycle data service	I/IOT using edge computing	MEC in 5G networks	Overview of vertical segments – Smart Manufacturing
	SLO-2					Smart Transportation
S-13	SLO-1	Characteristics of new computing model	Security service	Use cases –Technical Analytics	Network evolution towards 5G	Entertainment
	SLO-2	Blueprint of edge computing intelligence			Network performance drivers for 5G systems	E-Health
S 14-15	SLO-1	Lab 3: Platform development	Lab 6: Introduction to iofogtcl, common header YAML	Lab 9: Using microservices catalog	Lab 12: JSON REST API and open weather map	Lab 15 :Implementation of Minimal Spanning Tree
	SLO-2					

Learning Resources	1. Ajit Singh, <i>Edge Computing: Simply In Depth</i> , 2019	3. Cao, Jie, Zhang, Quan, Shi, Weisong., <i>Edge Computing: A Primer</i> , Pearson Education, Springer, 2018
	2. Dario Sabella , Alex Reznik, Rui Frazao), <i>Multi-Access Edge Computing in Action</i> , CRC Press, 2019	4. Rajkumar Buyya, Satish Narayana Srirama, <i>Fog and Edge Computing: Principles and Paradigms</i> , Wiley, 2019

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

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. Jagatheeswaran, Tech lead, Auxolabs jagatheeswarans.iot@auxolabs.in	1. Dr. Bhalaji, Associate Professor, SSN	Dr.M.Pushpalatha, Professor, CSE

S-11	SLO-1	Architectural patterns	Indirect communication	Asynchronous operation	Coordination	Role of group communication
	SLO-2	Associated middleware solution	Group communication	Serialized and Concurrent invocations	Failure assumptions and failure detectors	Fault tolerant services
S-12	SLO-1	Fundamental models	Publish – Subscribe systems	Operating system architecture	Distributed mutual exclusion	Passive replication
	SLO-2	Interaction model	Implementation issues	Monolithic and Micro kernel	Elections	Active replication
S-13	SLO-1	Failure model	Message queues	Virtualization at operating system level	Coordination and agreement in group communication	Case study: CODA Architecture, replication strategy, Semantics
	SLO-2	Security model	Shared memory approaches	Xen approach to virtualization	Consensus and related problems	Cache coherence, performance
S 14-15	SLO-1	Lab 3: Implementation of UDP communication in C	Lab 6: Implementation of Publish – Subscribe Paradigm	Lab 9: Implementation of shared memory concept	Lab 12: Implementing the mutual exclusion mechanism	Lab 15 : Implementation of deadlock avoidance program
	SLO-2					

Learning Resources	1. Coulouris, George F., Jean Dollimore, and Tim Kindberg. <i>Distributed systems: concepts and design</i> , Fifth edition, Pearson education, 2011	5. Sukumar Ghosh, <i>Distributed System An Algorithmic approach</i> , Second edition, CRC Press, 2014 6. Nicola Santoro, <i>Design and Analysis of Distributed Algorithms</i> , Wiley, 2008
	2. Tanenbaum, Andrew S., and Maarten Van Steen. <i>Distributed systems: principles and paradigms</i> . Prentice-Hall, 2007	
	3. Kshemkalyani, Ajay D., and Mukesh Singhal. <i>Distributed computing: principles, algorithms, and systems</i> . Cambridge University Press, 2011.	
	4. M.L. Liu, <i>Distributed Computing, Principles and Applications</i> , Pearson Education, 2004.	

Learning Assessment

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

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

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Dr. Pethuru Raj, Vice President, SRE, Reliance Jio, peterindia@gmail.com	1. Dr. N. Shivakumar, Pondicherry Engineering college, sivakumar11@pec.edu	1. Dr.B.Baranidharan, SRMIST

Course Code	20CSE533J	Course Name	COMMUNICATION AND NETWORKING FOR INTERNET OF THINGS	Course Category	E	Professional Elective	L	T	P	C
							3	0	2	4

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:	CLR-2:	CLR-3:	CLR-4:	CLR-5:	CLR-6:	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Utilize the different data communication and networking concept for constructing IoT networks and data transfer.	Utilize IoT concepts and understand about various IoT deployment	Utilize IoT reference model and architecture model for real-time applications	Utilize the traditional security concept and customize the security model for various IoT deployments	Utilize IoT platforms and understand the hardware deployment for IoT.	Utilize the concept of 5G technology and its operations for Machine to Machine communications				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
						Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	L	H	-	H	L	-	-	-	L	L	-	H	-	-	-
						3	80	70	M	H	L	M	L	-	-	-	M	L	-	H	-	-	-
						3	85	75	M	H	M	H	L	-	-	-	M	L	-	H	-	-	-
						3	75	70	M	H	M	H	L	-	-	-	M	L	-	H	-	-	-
						3	85	80	H	H	M	H	L	-	-	-	M	L	-	H	-	-	-
						3	85	75	L	H	-	H	L	-	-	-	L	L	-	H	-	-	-
						3	80	70															

Duration (hour)	15	15	15	15	15
S-1	SLO-1	Introduction to IoT and Data Communications	Designing the Architecture of an IP-based Internet of Things	Applications in the IoT	Hardware for the IoT
	SLO-2	IoT, An Architectural Overview	Communication protocol groups relevant for IoT scenarios	Cloud IoT platform architecture	Classes of Constrained Devices
S-2	SLO-1	Building an architecture,	IEEE 802.15.4 and ZigBee	REST Architectures: The Web of Things	Hardware Platforms
	SLO-2	Main design principles	Low-power Wi-Fi	Resource Representations and Identifiers	TelosB
S-3	SLO-1	State of the Art and needed capabilities.	Bluetooth and BLE	Applications as Finite-state Machines	Zolertia Z1
	SLO-2	Reference Model and Architecture	Powerline Communications	Hypermedia as the Engine of Application State	OpenMote
S 4-5	SLO-1	Lab 1: To understand the procedure for utilizing Contiki-Cooja Simulator for implementation of IoT	Lab 4: Create a sensor network and broadcast a hello packet to all the nodes in the sensor network	Lab 7: Add several sky-websense nodes to your simulation to have multihop communication. Try to ping the nodes.	Lab 10: I Find out how to set the number of routing entries (ROUTES in contiki/contiki-default-conf.h). Configure your system to use 8 routes
	SLO-2				Lab 13: Setup an IPv6 network with CoAP resources

S-6	SLO-1	IoT Reference Model	IP based IoT	Dual-network Management Protocol	Arduino	Machine-to-machine (M2M) communications for smart cities
	SLO-2	Functional View	The 6LoWPAN Adaptation Layer	DNMP Operations	Intel Galileo	Smart city technologies
S-7	SLO-1	Information View		DNMP message format	Software for the IoT	Smart city platform
	SLO-2	Deployment and Operational View	Transport layer communication in the IoT	Route establishment in DNMP	Contiki OS	Smart city challenges
S-8	SLO-1	Technical Design Constrains	Dedicated application layer	Implementation of DNMP with IEEE 802.15.4 and IEEE 802.11s	Simulation and Programming model in Contiki	Machine-to-machine (M2M) communications for e-health applications
	SLO-2	Data Representation	MQTT Protocol	Performance Evaluation	Features of Contiki	E-Health Applications and Network Architecture
S 9-10	SLO-1	Lab 2: Familiarize with Cooja Simulator and understand the procedure for connecting motes	Lab 5: Write a program that loops indefinitely, checks if a button has been pressed, and if so, toggles LEDs and prints out (printf) a message. Test it on your mote.	Lab 8: Try out the web-server that is running in each of the nodes.	Lab 11: Modify your sky-websense.c application so that it prints the energy consumption every 4 seconds. Then, add a project-conf.h configuration file to your application and try several RDC layers (ContikiMAC, X-MAC, LPP, NullRDC). Trace changes in the energy consumption.	Lab 14 : Setup your CoAP-based network using real Tmote sky mote attached to the USB port of your computer running the border-router process.
	SLO-2					
S-11	SLO-1	Interaction and Remote Control	Constrained Application Protocol (CoAP)	Security Issues in the IoT	Vision and Architecture of a Testbed for the Web of Things	On the Track of 5G Radio Access Network for IoT Wireless Spectrum Sharing in Device Positioning Applications
	SLO-2	Devices and Gateways	Constrained Application Protocol (CoAP) Stack	Security Mechanisms for IoT	All-IP-based Infrastructure for Smart Objects	Millimetre Wave Communication for 5G IoT Applications
S-12	SLO-1	NFC, RFID and Tags	CoAP embedded IoT-oriented features	Lightweight Cryptography	Enabling Interactions with Smart Objects through the IoT Hub	Challenges Implementing Internet of Things (IoT) Using Cognitive Radio Capabilities in 5G Mobile Networks
	SLO-2	Local and Wide Area Networking	CoAP messaging model.	Lightweight Cryptographic Hash Functions	WoT Applications for Mobile and Wearable Devices	A Vision of 6G
S-13	SLO-1	Data Management in IoT	CoAP message format	Homomorphic Encryption Schemes.	Wearable Computing for the IoT	System on Chip technology (SoC)
	SLO-2	Distributed Cloud and Edge Computing	CoAP group communication.	Authorization Mechanisms for Secure IoT Services	Effective Authorization for the Web of Things	Reconfigurable SoC
S 14-15	SLO-1	Lab 3: Install the test-button program from the examples/sky directory.	Lab 6: Write a program that loops indefinitely, waits for an event, then checks whether this event is a button press and if the timer has expired. Upon button press, toggle the LEDs and print out" Button press!". When the timer expires, simply toggle the LEDs and print out" Timer!". Test the program on your mote.	Lab 9: Trace the effect of using ContikiMAC+CSMA vs. NullRDC+NullMAC in terms of code size of the firmware?	Lab 12: Modify your sky-websense.c application so that it turns off the radio every second. Measure the RX power consumption every second to see the effect.	Lab 15 : Try to ping the CoAP server from your computer and access its CoAP resources from your web browser.
	SLO-2					

Learning Resources	<ol style="list-style-type: none"> 1. Simon Cirani, Gianluigi Ferrari, Marco Picone, Luca Vetri <i>Internet of Things, Architectures, Protocols and Standards</i>, Wiley, 2016 2. Mavromoustakis, Constandinos, Mastorakis, George, Batalla, Jordi Mongay, <i>Internet of Things (IoT) in 5G Mobile Technologies</i>, Springer, 2016 3. Carles Anton-Haro Mischa Dohler, <i>Machine-to-machine (M2M) Communications, Architecture, Performance and Applications</i>, 1st Edition, Elsevier 2015 	<ol style="list-style-type: none"> 4. Peter Waher, "Learning Internet of Things", PACKT publishing, BIRMINGHAM – MUMBAI. (T2) 5. Wei Xiang, Kan Zheng, Xuemin (Sherman) Shen, - <i>5G Mobile Communications</i>, Springer, 2017 6. Afif Osseiran, Jose F. Monserrat and Patrick Marsch, - <i>5G Mobile and Wireless Communications Technology</i>, Cambridge University Press, 2016.

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

Level 1	Remember	20%	20%	15%	15%	15%	15%	15%	15%	15%	15%
	Understand										
Level 2	Apply	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
	Analyze										
Level 3	Evaluate	10%	10%	15%	15%	15%	15%	15%	15%	15%	15%
	Create										
	Total	100 %		100 %		100 %		100 %		-	

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. Nagaveer, CEO, Campus Corporate Connect, nagaveer@campuscorporateconnect.com	1. Dr. Srinivasa Rao Bakshi, IITM, Chennai, sbakshi@iitm.ac.in	1. Dr. B. Amudha, HOD, SRMIST
2. Dr. Sricharan Srinivasan, Wipro Technologies, sricharanms@gmail.com	2. Dr. Ramesh Babu, N , nrbabu@iitm.ac.in	2. Dr.K.Pradeep Mohan Kumar, SRMIST
	3. Dr.Noor Mohammad, IIITDM, Kancheepuram, noor@iiitdm.ac.in	3. Mss. R. Jeya, SRMIST
		4. Mr C. Rajesh Babu. SRMIST

9-10	SLO-2	Lab 2: Implementation of Fog Nodes with different configuration set up	Lab 4: Simulation of application models using iFog Master Worker application models	Lab 6: Design of sensor nodes and simulate with different tuple emission rates	Lab 8: Connection of lower level fog device with Gateway	
S-11	SLO-1	Needs of FOG with EDGE	Unified Architectures to Account for Heterogeneity	Data Storage and Data Placement 1	Context Monitoring and Prediction	Data driven intelligent transport system
	SLO-2	Needs of FOG with IoT	Public usability of edge nodes	e-Health Case Study	Selection of Participating Devices	Mission critical requirements
S-12	SLO-1	Business models	Interoperability with Communication Networks	Proposed Architecture	Scheduling and Resource Management	Energy consumption
	SLO-2		Network Slices for Edge Systems	Fog and Device Layer	Network Management	Modelling and simulation of fog and edge using iFogSim Toolkit
S-13	SLO-1	Examples and Illustrations	The Modeling Challenge	Defining the Level of Data Computation and Storage	Mobility Management	Simulator and components
	SLO-2		Computational Resource Modeling			Case study Examples
S	SLO-1					
14-15	SLO-2	Myths of Fog Computing	Network Modeling	Future Research and Direction 1		

Learning Resources	1. Satish NarayanaSrirama,RajkumarBuyya" Fog and Edge Computing" Wiley Publisher 2. ZaighamMahmood "FOG Computing :Concepts, Frameworks and Technologies",Springer Publications	3. Gounder,sa,Bhushan,S,BArath,Rayani,Praveen Kumar "Architecture and Security Issues in FOG Computing "IGI Global 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 Understand	20%	20%	15%	15%	15%	15%	15%	15%	15%	15%
Level 2	Apply Analyze	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Level 3	Evaluate Create	10%	10%	15%	15%	15%	15%	15%	15%	15%	15%
	Total	100 %		100 %		100 %		100 %		-	

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

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Dr. Raju Ramasamy	Dr. S. Surendran, Sri Krishna College of Engineering and Technology	Dr. P. Madhavan SRMIST

	SLO-2	Industrial sensors	RF Module	Hardware - Interfacing the hardware	Data driven scheme, mobility based scheme	Hardware based green IoT techniques
S-7	SLO-1	Description & Characteristics	Sensing Module	Creating a controller	Static energy Efficient algorithms	Policy based techniques
	SLO-2	First Generation	ACOEM Eagle	Representing sensor values	Exact allocation algorithm	Awareness based Approach - Toward Green IoT, Energy Awareness Campaigns
S-8	SLO-1	Description & Characteristics	EnOcean Push Button	Parsing sensor data	Best Fit Heuristic Algorithm	Communication Technology Creating Awareness About Green Information, Promoting Recycling
	SLO-2	Advanced Generation	NEST Sensor	Calculating control states	Dynamic energy efficient algorithms	Habitual Based Techniques
S-9-10	SLO-1	Lab 2: IOT industrial sensors study	Lab 5: Embedded system initial prototype with Sensors	Lab 8: Raspberry Pi3 to Cloud Communication using LAN or Wifi	Lab 11: Implementation and analysis of MAC layer protocols	Lab 14 : Implementation of sensor cloud –a step toward green IOT
	SLO-2					
S-11	SLO-1	Description & Characteristics	Ninja Blocks	Creating a camera	Hardware Level Solution	Comparative analysis of different green IoT approaches
	SLO-2	Integrated IoT Sensors	Focus on Wearable Electronics	Hardware -Accessing the serial port on Raspberry Pi	Dynamic Voltage Frequency Scaling (DVFS)	Case study: impact of smart phones on the environment in present and future trends
S-12	SLO-1	Description & Characteristics	Creating the sensor project	Interfacing the hardware	Software Level Solution	Reduce the environmental impact life cycle assesment of smatphones, smart phone emission and selling rate
	SLO-2	Polytronics Systems	Preparing Raspberry Pi	Creating persistent default settings - Adding configurable properties	First Fit Decreasing algorithm (FFD)	Bluetooth Low Energy (BLE) Introduction,
S-13	SLO-1	Description & Characteristics	Clayster libraries	Persisting the settings	Modified Best Fit Decreasing algorithm (MBFD)	BLE importance
	SLO-2	Sensors' Swarm	Hardware	Working with the current settings - Initializing the camera	Compare and contrast static and dynamic energy efficient algorithms	BLE challenges
S-14-15	SLO-1	Lab 3: Formulation of Project Idea	Lab 6: Embedded system prototype with Raspberry Pi Microcontroller and Sensors	Lab 9: - Mobile interface to Cloud	Lab 12: Implementation of static energy efficient algorithms	Lab 15 : Design weather monitoring using BLE
	SLO-2					

Learning Resources	<ol style="list-style-type: none"> 1. Dr. Guillaume Girardin , Antoine Bonnabel, Dr. Eric Mounier, 'Technologies & Sensors for the Internet of Things Businesses & Market Trends 2014 - 2024', Yole Développement Copyrights , 2014 2. Peter Waher, 'Learning Internet of Things', Packt Publishing, 2015 3. Editors Ovidiu Vermesan, Peter Friess, 'Internet of Things – From Research and Innovation to Market Deployment', River Publishers, 2014 4. N. Ida, Sensors, Actuators and Their Interfaces, Scitech Publishers, 2014 	<ol style="list-style-type: none"> 5. "Energy Conservation for IoT Devices Concepts, Paradigms and Solutions", Mamta Mittal, Sudeep Tanwar, Basant Agarwal, Lalit Mohan Goyal, Studies in Systems, Decision and Control 206, 2019 6. "IoT projects with Bluetooth Low Energy- Harness the power of connected things", Madhur Bhargava, 2017 7. Green 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, and applications, 2017
--------------------	---	--

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

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. T. Ashokan, Project Head, Kerry Indev Logisitics pvt ltd, asohan.thangavel@kerryindev.com	1. Dr. B. Muthu Senthil, Associate Professor, Valliammai Engg. College, Chennai, muthusenthilb.cse@valliammai.co.in	1. Dr. K. Sreekumar, SRMIST, sreekumk@srmist.edu.in
		2. Dr. T. Sujithra, SRMIST

Course Code	20CSE536J	Course Name	SDN AND NFV FOR INTERNET OF THINGS	Course Category	E	Professional Elective			
						L	T	P	C
						3	0	2	4

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 principles behind the Modern Network approaches such as SDN NFV and IoT			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15			
CLR-2:	Ability to analyze Data Center topologies and virtualized environment			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, <small>Open network</small>	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 data traversal over virtualized environment for IoT						L	H	-	H	H	H	H	-	-	-	L	L	-	H	-	-	-	-
CLR-4:	Design algorithms for virtualization over multi-tenant environments						M	H	H	M	H	-	-	-	M	L	L	-	H	-	-	-	-	-
CLR-5:	Understand the various types of key routing and switching techniques used in modern networks.						M	H	M	H	H	-	-	-	M	L	L	-	H	-	-	-	-	-
CLR-6:	Understanding IoT Security and Privacy Requirements.						H	H	M	H	H	-	-	-	M	L	L	-	H	-	-	-	-	-
CLR-6:	Understanding IoT Security and Privacy Requirements.						L	H	-	H	L	-	-	-	L	L	L	-	H	-	-	-	-	-
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																							
CLO-1:	Apply SDN and NFV concepts on IOT applications			3	80	70																		
CLO-2:	Create different data center topologies and implement SDN.			3	85	75																		
CLO-3:	Design and apply algorithms for virtualization over multi-tenant environment			3	75	70																		
CLO-4:	Create IoT applications based on SDN			3	85	80																		
CLO-5:	Implement various types of routing and switching techniques			3	85	75																		
CLO-6:	Create an IOT Security framework.			3	80	70																		

Duration (hour)	15		15		15		15		15	
S-1	SLO-1	Introduction-Cloud Computing	Evolving Network Requirements	Background and motivation for NFV	The IoT Era Begins	Security Requirements				
	SLO-2	IoT Evolution	The SDN Approach	Virtual machine	Scope of IoT	SDN security				
S-2	SLO-1	IoT and its application	Characteristics of Software defined networking	Architectural Approaches	Components of IoT enabled Things	Threats to SDN				
	SLO-2	IoT Architecture	Open development Initiative	Container Virtualization	Sensors	Software Defined Security				
S-3	SLO-1	Types of Network	Data plane function	Simple example of the use of NFV	Actuators	NFV - Security				
	SLO-2	Internet Traffic	Data plane protocols	NFV Benefits	Microcontrollers	Attack Surfaces				
S-4-5	SLO-1	Lab 1: Study on SDN controllers.	Lab 4 : Implementation of Load balancing Algorithm.	Lab 7 : Scheduling Algorithm	Lab 10: A Study on Integrating SDN with IoT.	Lab 13: Connecting smart IoT sensors with cloud				
	SLO-2									
S-6	SLO-1	Big Data	Flow table structure	NFV Requirements	Transceivers	ETSI security Perspective				
	SLO-2	Cloud Computing concepts	Flow table pipeline	NFV Reference Architecture	IoT Architecture	Security Technique				
S-7	SLO-1	Benefits of Cloud Computing	Open Flow protocol	NFV Management and Orchestration	ITU- T IoT Reference Model	IoT security				

	SLO-2	Cloud Network and Cloud Storage	SDN control plane architecture	Container Interface	IoT world forum reference Model	The patching Vulnerability
S-8	SLO-1	QOS and QOE.	Control plane function	Deployment of NFVI Containers	IoT implementation	IoT security and privacy requirement defined by ITU-T
	SLO-2	Routing and packet forwarding	South bound Interface	Compute Domain	IoTivity	An IoT security framework
S 9-10	SLO-1	Lab 2: Creating Virtual network using Mininet and connecting to the controller.	Lab 5: Quality of service configuring using SDN	Lab 8: Design and develop small application based on SDN	Lab 11: Calibration of sensors.	Lab 14 : Mini project – 1 IoT applications based on SDN
	SLO-2					
S-11	SLO-1	Congestion control	North bound Interface	HyperVisor Domain	Cisco IoTsystem	Cloud security
	SLO-2	Effects of Congestion.	Rest API	Infrastructure Network Domains	Network connectivity	Risk and Counter measures
S-12	SLO-1	Introduction to SDN	SDN Application plane	Virtualization Network Function	Fog Computing and security	Cloud security as a service
	SLO-2	SDN Architecture	Network applications	NFV Management and Orchestration	Data Analytics, Management and Automation	Data protection in Cloud
S-13	SLO-1	Network function Virtualization	User Interface	NFV use cases	Application Enablement platform	The impact of the New Networking on IT Careers.
	SLO-2	Modern Networking Elements	Network services Abstraction Layer	SDN and NFV	ioBridge, SDN and NFV over IoT deployment.	
S 14-15	SLO-1	Lab 3: Understanding the operations of OpenFlow protocol	Lab 6: Traffic management using SDN	Lab 9: Getting familiar with Raspberry pi3	Lab 12: Case study on SDN and NFV for IOT	Lab 15 : Mini project – 1 IoT applications based on SDN
	SLO-2					

Learning Resources	1. "Foundations of Modern Networking: SDN, NFV, QoE, IoT, and Cloud" William Stallings Publisher: Addison-Wesley 2015 ISBN: 9780134175393	3. Network Function virtualization with a touch of sdn by Paresh Shah, Syed Farrukh Hassan, RajendraChayapathi.
	2. SDN and NFV Simplified: A Visual Guide to Understanding Software Defined Networks and Network Function Virtualization 1st Edition by Jim Doherty.	

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

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

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
		1. Mrs. T.Manoranjitham, SRMIST

	SLO-2	Microwave	VPNs: Layer 3, 2, Security	HANs, PANs	ETSI BRAN	UWB – UltraWide Band
S-8	SLO-1	Satellite	Unified communications	Wireless Broadband PLT	iBurst	IEEE 802.15.4(ZigBee)
	SLO-2	Fiber Optics	IP voice and IPTV	Wireless Impairments	Flash -OFDM	Mesh Networks
S 9-10	SLO-1	Lab 2: To Study Different Types of Transmission Media	Lab 5: Virtual Lab for IPv4 Subnetting	Lab 8: Measuring optical power attenuation in your plastic optical fiber	Lab 11: Packet Tracer - IP telephony basic configuration	Lab 14 : To implement mobile network using simulator
	SLO-2					
S-11	SLO-1	Data Communications Basics	The Broadband Infrastructure	Antennas	UMTS	Mobile IP
	SLO-2	Data Communications Basics	Quality of Service	Wireless Bandwidth	Single Carrier Modulation Techniques	IP Multimedia Subsystem
S-12	SLO-1	The Evolution of Data Communications	Virtualization	Wireless Signal Modulation	Multi Carrier Modulation Techniques	Applications
	SLO-2	Data Flow	Cloud Computing	Spectrum Utilization	WiBro	Mobile Video
S-13	SLO-1	OSI Reference Model	Next Generation Networks - Convergence	Spread Spectrum	DMB - Digital multimedia Broadcasting	Mobile TV
	SLO-2	TCP/IP Reference Model	Next Generation Networks - Infrastructures	Compression Techniques	Virtual Fiber	Mobile Content
S 14-15	SLO-1	Lab 3: Virtual Lab for Peer to Peer Topology	Lab 6: To study the VoIP implementation on VOIP Trainer kit.	Lab 9: Measuring the Angular misalignment loss of your plastic optical fiber	Lab 12: Packet Tracer - IP telephony Advanced configuration	Lab 15 : Study Assignment 1: Detailed study of Bluetooth
	SLO-2					

Learning Resources	<ol style="list-style-type: none"> LIDO Telecommunications Essentials: by Lillian Goleniewski, 2nd edition, Addison-Wesley Professional, Copyright: 2007, 928 pp, ISBN 10: 0-321-42761-0 -- ISBN-13: 9780321427618 Network+ Guide to Networks, Tamara Dean, March 9th 2009 by Course Technology (first published 2009) ISBN: 1423902459/(ISBN 13: 9781423902454)
---------------------------	--

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

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

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
		1. Dr. J. Selvin Paul Peter, SRMIST

Course Code	20CSE623J	Course Name	INDUSTRIAL INTERNET OF THINGS SECURITY	Course Category	E	Professional Elective	L	T	P	C
							3	0	2	4

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	18CSC204J
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 crucial concepts of multi layered IIoT security framework	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-2:	Gain insight on securing identity, access, and configuration management for large-scale IIoT deployments	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:	Secure your machine-to-machine (M2M) and machine-to-cloud (M2C) connectivity																		
CLR-4:	Build a concrete security program for your IIoT deployment																		
CLR-5:	Understand the concept of Cyber-Physical Systems																		
CLR-6:	Learn risk management and mitigation planning																		
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																		
CLO-1:	Application of IoT in Industrial and Commercial Building Automation and Real World Design Constraints.	3	80	70	L	H	-	H	L	-	-	-	L	L	-	H	-	-	-
CLO-2:	Ability to understand the End point vulnerabilities and end point security using isolation techniques.	3	85	75	M	H	L	M	L	-	-	-	M	L	-	H	-	-	-
CLO-3:	Understand the features of IIoT Connectivity and Cloud Security Architecture	3	75	70	M	H	M	H	L	-	-	-	M	L	-	H	-	-	-
CLO-4:	To learn the product lifecycle and Cyber Security Threat Landscape for Internet of Things.	3	85	80	M	H	M	H	L	-	-	-	M	L	-	H	-	-	-
CLO-5:	To learn Industrial Cyber-Physical Systems and its various applications.	3	85	75	H	H	M	H	L	-	-	-	M	L	-	H	-	-	-
CLO-6:	Ability to understand the communication system for Cyber Physical Systems and various areas of its applications.	3	80	70	L	H	-	H	L	-	-	-	L	L	-	H	-	-	-

Duration (hour)	15		15		15		15		15	
S-1	SLO-1	Introduction - Industrial IoT	IIoT Identity and Access Management A Primer on Identity and access control	Securing connectivity and communications	Cyber Security Threat Landscape for The Internet of Things	Communication and Networking for the Industrial Internet of Things				
	SLO-2	Industrial IoT Security	Distinguishing features of IAM in IIoT	Features of IIoT connectivity	Internet of Things Devices and System Integration Security	Communications for Cyber-Physical Systems				
S-2	SLO-1	Cyber Security versus Cyber -Physical IoT Security	Identity Management across the device life cycle	IIoT connectivity architectures	Threat Modeling and Risk Assessments for Internet of Things Product Development	Artificial Intelligence and Data Analytics for Manufacturing				
	SLO-2	Industrial "things", connectivity and operational technologies	Authentication and authorization frameworks for IIoT	Controls for IIoT connectivity protection	Threat Actors	Application of CPS in Machine Tools				
S-3	SLO-1	Industrial IoT deployment architecture	Trust models	Connectivity frameworks standards	Product Lifecycle Phases/Sprints and cyber security	Going Smart—CPS for Digital Production				
	SLO-2	Divergence in IT and OT security fundamentals	Messaging protocols	Connectivity transport standards	Design, Architecture and Technology stack selection	Manufacturing Cyber-Physical Systems (Industrial Internet of Things)				
S-4-5	SLO-1	Lab 1: The definition of the Internet of Things, main assumptions and perspectives. Platform for IoT devices Device architectures.	Lab 4 : The data processing for IoT Organization of data processing for the Internet of things. Cloud computing. Fog computing. Applications Smart Grid. Home Automation. Smart City.	Lab 7 : Connecting to the Internet (eg. the device showing the current weather forecast)	Lab 9: Machine-to-machine communication (broadcast communication protocols)	Lab 11: Analysis the Security Vulnerabilities of E-commerce services.				
	SLO-2	Conventional and renewable power sources for resource-constrained devices. Operating systems for resource-constrained devices.								

S-6	SLO-1	Industrial threats, vulnerabilities, and risk factors	Monitoring and management capabilities	Connectivity network standards	Implementation Verification and Testing Product Security sustainment and Maintenance	Big Data and Machine Learning for the Smart Factory—Solutions for Condition Monitoring, Diagnosis and Optimization
	SLO-2	Evolution of cyber-physical attacks	Building an IAM strategy for IIoT Deployment	Data link and physical access standards	Industrial Internet of Things and Cyber Manufacturing Systems	Overview of the CPS for Smart Factories Project
S-7	SLO-1	Industrial IoT use cases	IIoT endpoint	IIoT Cloud Security Architecture	An Application Map for Industrial Cyber-Physical Systems	Applying Multi-objective Optimization Algorithms to a Weaving Machine as Cyber-Physical Production System
	SLO-2	Cyber-attack on industrial control system	IIoT endpoint vulnerabilities	Defense –in-depth cloud security strategy	Cyber-Physical Electronics Production	Cyber Physical Production Control
S-8	SLO-1	Smart city and autonomous transportation	Establishing trust in hardware	Infrastructure security	Cyber-Physical Systems Engineering for Manufacturing	A Versatile and Scalable Production Planning and Control System for Small Batch Series
	SLO-2	Healthcare and pharmaceuticals	Endpoint Identify and access control	Application security	Model-Based Engineering of Supervisory Controllers for Cyber-Physical Systems	CPS and the Worker: Reorientation and Requalification
S-9-10	SLO-1	Lab 2: Communication protocols for IoT Service oriented protocols (COAP). Communication protocols based on the exchange of messages (MQTT). Service discovery protocols.	Lab 5: Interacting with device peripherals (using GPIO , ADC , servos)	Lab 8: Exposition of device functionality as services (1) (COAP protocol)	Lab 10: Machine-to-machine communication (communication based on the message exchange – MQTT protocol)	Lab 12 : Analysis the security vulnerabilities of E-Mail Application
	SLO-2					
S-11	SLO-1	The Ransom ware attack on the healthcare enterprise	Initialization and boot process integrity	Data protection ,Data encryption	Evaluation Model for Assessment of Cyber-Physical Production Systems	Towards User-Driven Cyber-Physical Systems
	SLO-2	Primer on IIOT attacks and countermeasures	End point data integrity	Cloud security operation life cycle	Architectural Design Patterns for CMS and IIoT	Competence Management in the Age of Cyber Physical Systems
S-12	SLO-1	Trustworthiness of an IIOT system	End point security using isolation techniques	Secure device management	CPS-Based Manufacturing with Semantic Object Memories	Cyber-Physical Systems for Agricultural and Construction Machinery—Current Applications and Future Potential
	SLO-2	Industrial big data pipeline and architectures	Machine learning enabled endpoint security	Securing processes across the IIoT life cycle	Integration of a Knowledge Database and Machine Vision Within a Robot-Based CPS	Application of CPS Within Wind Energy—Current Implementation and Future Potential
S-13	SLO-1	Industrial IOT security architecture	End point security testing and certification	Understanding security roles	Interoperability in Smart Automation of Cyber Physical Systems	Transfer Printing for Cyber-Manufacturing Systems
	SLO-2		End point production industry standards	Elements of an IIoT security program		
S-14-15	SLO-1	Lab 3: Study of different types of vulnerabilities for hacking a websites / Web Applications.	Lab 6: Study of System threat attacks - Denial of Services.	IIoT security	Enhancing Resiliency in Production Facilities Through Cyber Physical Systems	Advanced Manufacturing Innovation Ecosystems
	SLO-2					

Learning Resources	<ol style="list-style-type: none"> 1. Sravani Bhattacharjee, <i>Practical Industrial Internet of Things security</i>, Packt Publishing, 2018 2. Ollie Whitehouse, <i>Security of Things: An Implementers' Guide to Cyber-Security for Internet of Things Devices and Beyond</i>. NCC Group 2014 3. Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat <i>Industrial Internet of Things Cybermanufacturing Systems</i>, Springer 2017
---------------------------	--

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

Level 3	Evaluate	10%	10%	15%	15%	15%	15%	15%	15%	15%	15%
	Create										
Total		100 %		100 %		100 %		100 %		-	

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. Robin Thomas, CEO, Green Olive Innovation labs ,robinembedded@gmail.com	1. Dr. Venkatesan, NITK, Surathkal, venkisakthi77@gmail.com	1. Dr. S.Babu, SRMIST
2. Mr. Hariprakash, CTO, Logic Research Labs, hari@logicresearchlabs.com	2. Dr. N.Bhalaji, bhalajin@ssn.edu.in	2. Dr.P.Madhavan, SRMIST
	3. Dr.Noor Mahammad, IIITDM, Kancheepuram, noor@iiitdm.ac.in	3. Dr.S.Ramamoorthy, SRMIST

Course Code	20CSE624J	Course Name	COGNITIVE INTERNET OF THINGS	Course Category	E	Professional Elective	L	T	P	C
							3	0	2	4

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 some of the advanced topics in IoT	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, <small>Decision</small>	Modern Tool Usage	Society & Culture	Environment & <small>Customizability</small>	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3		
CLR-2:	Understand how IoT application can be built and deployed				L	H	-	H	L	-	-	-	L	L	-	H	-	-	-	-	-
CLR-3:	Understand how Neural Networks can be used in IoT				M	H	L	M	L	-	-	-	M	L	-	H	-	-	-	-	-
CLR-4:	Understand State of the Art in IoT, Industrial IoT				M	H	M	H	L	-	-	-	M	L	-	H	-	-	-	-	-
CLR-5:	Understand how to program different IoT Hardware				M	H	M	H	L	-	-	-	M	L	-	H	-	-	-	-	-
CLR-6:	Understand how to manage a large IoT Network				H	H	M	H	L	-	-	-	M	L	-	H	-	-	-	-	-
		L	H	-	H	L	-	-	-	L	L	-	H	-	-	-	-	-			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1:	Set up a network for deploying IoT Hardwares	3	80	70
CLO-2:	Distinguish between different IoT standards and Protocols	3	85	75
CLO-3:	Get the technical know-how to fix issues in an IoT network	3	75	70
CLO-4:	Fix interoperability issues between different Hardware and Software in IoT networks	3	85	80
CLO-5:	Apply Machine Intelligence and DNNs to IoT applications	3	85	75
CLO-6:	Confidently learn, investigate and program any new hardware device relating to IoT	3	80	70

Duration (hour)	15	15	15	15	15	
S-1	SLO-1	Course overview, IoT definitions	Data Analytics	Cloud Computing in IoT	Introduction to GPUs	Introduction to FPGAs
	SLO-2	IoT Characteristics	Data Analytics for IoT Basics	Edge Computing in IoT	Parallel Programming for GPUs	Introduction to Zynq 7000 SoCs
S-2	SLO-1	Impacts of IoT	Regression & Classification Techniques	Event Driven Programming	GPU Parallel Programming in CUDA - 1	FPGA's for IoT (Part 1)
	SLO-2	Cognitive Computing	Data Analytics for IoT Regression, Classification	JavaScript Basics	GPU Parallel Programming in CUDA - 2	FPGA's for IoT (Part 2)
S-3	SLO-1	IoT and Cognition	Artificial Neural Networks and CNN's - 1	Node JS, Angular JS	CNN inference in GPU - 1	Programming Zynq 7000 SoCs - 1
	SLO-2	Applications	Artificial Neural Networks and CNN's - 2	IoT Programming using Node RED	CNN inference in GPU - 2	Programming Zynq 7000 SoCs - 2
S-4-5	SLO-1	Lab 1: Interfacing Sensors with Arduino & ADC – DAC Conversion	Lab 4: Building a DNN based Autonomous Robot	Lab 7: Building an Event Driven IoT Application using Node JS and Python	Lab 10: NVIDIA Jetson, RTX 2060 Programming - 1	Lab 13: FPGA Programming - 1 (Ubuntu, GnuRadio, MATLAB)
	SLO-2	Client and Server Side Scripting for IoT	CNN based Classification	Programming the Raspberry Pi using Node RED - 1	Real Time Operating Systems - Introduction	Programming Zynq 7000 SoCs – PYNQ for Zynq
S-6	SLO-1	MQTT and CoAP	ANN based Classification	Programming the Raspberry Pi using Node RED - 2	Real Time Operating Systems – Key Characteristics	Programming Zynq 7000 SoCs - 3
	SLO-2	Raspberry Pi and Python – Introduction	Deep Neural Networks - 1	Introduction to Intel Curie/Quark, BeagleBone	Real Time Operating Systems - Issues	Other Case Studies - 1
S-7	SLO-1	Raspberry Pi and Python	Deep Neural Networks - 2	Programming in Intel Curie/Quark, BeagleBone	Real Time Operating Systems – Use Cases	Other Case Studies - 2
	SLO-2	Machine Learning Overview	Data Analytics using DNN	Introduction to NVIDIA Tegra K1 / Nano	Real Time Operating Systems – Applications	Other Case Studies - 3

	SLO-2	Machine Learning Techniques	Assignment 2 – Topic Assignment	Assignment 3 – Topic Assignment	Assignment 4 – Topic Assignment	Latest Research Papers Discussion
S 9-10	SLO-1	Lab 2: Setting up a Smart Home (Clients & Server) – Raspberry Pi	Lab 5: Building an Emotional DNN based IoT Application	Lab 8: NodeRED IoT Programming	Lab 11: RTOS Programming - 1	Lab 14 : FPGA Programming – 2 (PYNQ, FreeRTOS, Zephyr)
	SLO-2					
S-11	SLO-1	Latest Research Papers Discussion	Minor Project Review - 1	Minor Project Review - 2	Minor Project Review - 3	Minor Project Presentations - 1
	SLO-2	Assignment 1 – Topic Assignment	Latest Research Papers Discussion	Latest Research Papers Discussion	Latest Research Papers Discussion	Minor Project Presentations - 2
S-12	SLO-1	Forming Minor Project Teams (Max 2 per team)	Programming DNNs using TensorFlow – 1	Programming in NVIDIA Tegra K1 / Nano	Introduction to RTOS hardware devices	Minor Project Presentations - 3
	SLO-2	Introduction to TensorFlow	Industrial IoT	Introduction to Jetson	Introduction to FreeRTOS, Zephyr	Minor Project Presentations - 4
S-13	SLO-1	Introduction to PyTorch	Industrial IoT Use Cases	Programming in Jetson	Programming in FreeRTOS, Zephyr	Minor Project Expo and Poster Presentations – Open House
	SLO-2	Assignment 1 - Deadline and Discussion	Assignment 2 - Deadline and Discussion	Assignment 3 - Deadline and Discussion	Assignment 4 - Deadline and Discussion	Course Feedback and Suggestions
S 14-15	SLO-1	Lab 3: Controlling Smart Phone using Mobile Phone and Web Interface	Lab 6: Building an Industrial IoT Application for Anomaly and Failure Detection	Lab 9: Jetson IoT Programming	Lab 12: Real Time Video and Audio Streaming Using Web Cam	Lab 15 : FPGA Programming – 3 (Real Time Radio Communications / Optical Fiber Communications)
	SLO-2					

Learning Resources	1. Machine Learning with Python for Everyone, By Mark Fenner, Pearson Education, 2019	4. Reema Thareja, Python Programming., Oxford Higher Education, 2018
	2. Real-Time Embedded Components and Systems with Linux and RTOS, Sam Siewert and John Pratt, Mercury Learning 2015	5. Deep Learning with TensorFlow, By Giancarlo Zaccane, Md. Rezaul Karim, Ahmed Menshawy, Packt Publishing, 2017
	3. Deep Learning with TensorFlow 2 and Keras, By Antonio Gulli, Amita Kapoor, Sujit Pal, Packt Publishing, 2019	6. Exploring Zynq Mpsoc: With Pynq and Machine Learning Applications, Crockett H. Louise, Northcote David, Ramsay Craig, Strathclyde Academic Media, 2019

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (5%)		CLA – 2 (10%)		CLA – 3 (10%)		CLA – 4 (25%)#		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember	20%	20%	15%	15%	15%	15%	15%	15%	15%	15%
Level 2	Understand	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
	Apply										
Level 3	Analyze	10%	10%	15%	15%	15%	15%	15%	15%	15%	15%
	Evaluate										
	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
		1. Mr Karthik Nanmaran, SRMIST
		2. Dr. S. Ganesh Kumar, SRMIST
		3. Dr.Subalalitha C.N, SRMIST

Course Code	20CSO602T	Course Name	EVOLUTIONARY COMPUTING	Course Category	O	Open Elective	L	T	P	C
							3	0	0	3

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning			Program Learning Outcomes (PLO)																	
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15			
CLR-1:	To analysis evolutionary computation to various algorithms: genetic Algorithm; Swarm intelligence and Simulated Annealing	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Document	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 discuss the Genetic Algorithms with suitable operators and parameters				L	H	-	H	L	-	-	-	L	L	-	H	-	-	-	-	-	-
CLR-3:	To implement the optimization methods: Newton-Raphson and multi variant method into genetic Algorithms				M	H	L	M	L	-	-	-	M	L	-	H	-	-	-	-	-	-
CLR-4:	To discuss the GA and swarm intelligence algorithm to optimize the multi-objective problem				M	H	M	H	L	-	-	-	M	L	-	H	-	-	-	-	-	-
CLR-5:	To discuss the fuzzy systems & its mechanisms and evaluate hybrid systems with Neuro and fuzzy systems				M	H	M	H	L	-	-	-	M	L	-	H	-	-	-	-	-	-
CLR-6:	To analysis neural networks and back propagation in GA and fuzzy systems				H	H	M	H	L	-	-	-	M	L	-	H	-	-	-	-	-	-
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:				L	H	-	H	L	-	-	-	L	L	-	H	-	-	-			
CLO-1:	Identify various evolutionary computation algorithms relating with genetic programming and other meta heuristic algorithm	3	80	70																		
CLO-2:	Create genetic algorithm formulation based on multi variant and convex function and discussion on genetic programming operators and parameters	3	85	75																		
CLO-3:	Construct real coded genetic algorithm and various other algorithms related to multi objective function	3	75	70																		
CLO-4:	Create an optimization algorithm based on Discrete and Continuous problems and swarm intelligence techniques and hybridization	3	85	80																		
CLO-5:	Create a fuzzy systems with specific membership functions and hybrid systems with the integration of neural and fuzzy logic	3	85	75																		
CLO-6:	Construct neural networks based on back propagation algorithms relating to Genetic programming and fuzzy systems	3	80	70																		

Duration (hour)	Evolutionary Computing	Genetic Algorithms: Operators and parameters	Real Coded Genetic Algorithm and Multi-objective GA and Swarm intelligence	Fuzzy Logic and hybrid Systems	Neural Networks and BP: GA and fuzzy	
S-1	SLO-1	Introduction to Evolutionary Computing	Introduction to Genetic Algorithms	Real Coded Genetic Algorithm	Introduction: Fuzzy Logic	Introduction to Neural Networks
	SLO-2	Evolutionary algorithms: Concepts, Algorithms and applications	Optimization Methods and formulation	Genetic algorithm: Real Coded and mutation	Fuzzy Sets & Fuzzy versus Crisp set	Learning rules and various activation functions
S-2	SLO-1	Principles of Evolutionary Computing	Newton-Raphson Elimination method	Multi Modal optimization: Fitness Value and Hand Calculation	Membership Functions: Fuzzy Rules and Fuzzy Reasoning, Fuzzy Inference Systems,	Single layer and Multi-layer Perceptrons
	SLO-2	Evolutionary computation over various other approaches	Multi Variant: Newton Method	Multi objective optimization	Membership Functions: Fuzzy Expert Systems, Fuzzy Decision Making	Back Propagation networks: Input, Output and hidden layer.
S-3	SLO-1	Evolutionary Strategies and programming	Optimization problem: Convex Function	Multi Objective Optimization Algorithms: VEGA	Operations on Fuzzy Sets	Forward BP Model
	SLO-2	Evolutionary Computation: Case Study	Multivariable Problem: Equality and Inequality Constraints	Genetic Algorithm: WBGA, MOGA,	Fuzzy Relations; rules, propositions, implications and inferences.	Backwards BP Model
	SLO-2					
S-6	SLO-1	Genetic Programming	Interior and Exterior penalty: optimization methods	Genetic Algorithm: NSGA and NSGA II	Fuzzification and Defuzzification Method	Architecture of Back propagation (BP) Networks,

	SLO-2	Genetic Learning Classifier Systems (LCS)	Multi variant Problem: Quadratic optimization	Constraints handling: Genetic Algorithm	Minmax Composition	Back propagation Learning
S-7	SLO-1	Genetic Taxonomy: parameter tuning and control	Linear Programming: Characteristics and formulation	Genetic Operators: Two Member Evolutionary strategies	Fuzzy Rule based systems, Predicate logic	Variation of Standard Back propagation Neural Network
	SLO-2	Diffusion model and Multi Objective problem	Linear programming: Convex and Non-Convex Search Space	Genetic Operators: Multi Member Evolutionary strategies	Fuzzy Decision Making	Introduction to Associative Memory
S-8	SLO-1	Multi objective evolutionary optimization: Principles and Solutions	Linear programming: Simplex Method	Introduction to Swarm Intelligence	Fuzzy Control Systems, Fuzzy Classification	Adaptive Resonance theory and Self Organizing Map, Recent Applications.
	SLO-2	Multi-objective evolutionary : Hybridization	Artificial variables: Linear programming	Swarm Intelligence: Models and Concept of Computational Intelligence	Fuzzy logic controller design and applications	Adaptive Resonance theory and Self Organizing Map, Recent Applications.
	SLO-2					
S-11	SLO-1	Multi-objective evolutionary : Memetic	Genetic Algorithm Evolution and Optimizations	Discrete and Continuous Optimization Problems	Introduction to Hybrid Systems	GA based BP Networks: GA based Weight Determination
	SLO-2	Meta heuristic Evolutionary optimization	Genetic Algorithm Optimizations	Classification of Optimization Algorithms	Sequential Hybrid Systems	GA based BP Networks: K - factor determination in Columns
S-12	SLO-1	Evolutionary Applications: Engineering Design and Optimization	Simple Genetic Algorithms	Evolutionary Computation Theory and Paradigm,	Auxiliary Hybrid Systems	Fuzzy Back propagation Networks
	SLO-2	Meta heuristic algorithm: Environmental Motivation	GA operators and parameters: Different techniques for selecting the genetic algorithm & Examples	Swarm and Collective intelligence	Embedded Hybrid Systems	LR type Fuzzy numbers & Fuzzy Neuron
S-13	SLO-1	Environmental: Swarm Intelligence algorithm	GA operators and parameters: Crossover methods, operators & Examples	Swarm Intelligence Techniques: Particle Swarm Optimization, Ant Colony Optimization, Artificial Bees and Firefly Algorithm etc.,	Neuro-Fuzzy Hybrid Systems	Fuzzy BP Architecture
	SLO-2	Environmental: Simulated annealing	GA operators and parameters: Mutation; Elitism & Examples	Hybridization and Comparisons of Swarm Techniques and Application	Neuro-Genetic Hybrid Systems, Fuzzy-Genetic Hybrid Systems	Learning in Fuzzy BP, Application of Fuzzy BP Networks
	SLO-2					

Learning Resources	12. K. Deb, <i>Multi-Objective Optimization Using Evolutionary Algorithms</i> , Wiley and Sons, 2009.	15. Neuro-Fuzzy Systems, Chin Teng Lin, C. S. George Lee, PHI 16. Fuzzy Logic: A Practical approach, F. Martin, , Mc neill, and Ellen Thro, AP Professional, 2000. 17. Fuzzy Logic with Engineering Applications (3rd Edn.), Timothy J. Ross, Willey, 2010.
	13. Goldberg D.E. <i>Genetic Algorithms in Search, Optimization and Machine Learning</i> . Pearson Education Asia 2002 14. M. Mitchell, <i>An introduction to genetic algorithms</i> , MIT Press, 1996	

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 %		-	

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. G A Vijayakumar, Consultant Architect, Cisco, vijayga@hotmail.sg	1. Prof. P. Sakthivel, Professor, Anna University, CEG Campus, , Chennai, psv@annauniv.edu.in	1. Dr. Ramkumar J, Assistant professor, SRMIST
1. Mr. Venkatesh, Team Lead / Software Engineer, Accenture, venkatanziegers@gmail.com	2. Dr.P.Jayashree, Associate professor, Anna University, MIT-Campus, Chennai, pjshree@annauniv.edu	2. Dr. M. Baskar, Assistant professor, SRMIST
		3. Dr. A. Sudha, Assistant professor, SRMIST

Course Code	20GNS501J	Course Name	RESEARCH PUBLISHING AND PRESENTING SKILLS	Course Category	S	Skill Enhancement	L	T	P	C
							1	0	2	2

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:	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:	Practice different oral presentation material preparations	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Disciplinary Knowledge	Critical Thinking	Problem Solving	Analytical Reasoning	Research Skills	Team Work	Scientific Reasoning	Reflective Thinking	Self-Directed Learning	Multicultural Competence	Ethical Reasoning	Community Engagement	ICT Skills	Leadership Skills	Life Long Learning	
CLR-2:	Practice presenting techniques suitable for different audiences				L	H	H	M	M	-	L	H	M	-	H	-	L	-	M	
CLR-3:	Prepare and typeset scientific documents for disseminating research findings				L	H	H	M	M	-	L	H	M	-	H	-	L	-	M	
CLR-4:	Analyze different disseminating techniques available				L	H	H	M	M	-	L	H	M	-	H	-	L	-	M	
CLR-5:	Utilize different intellectual property sharing mechanisms				L	H	H	M	M	-	L	H	M	-	H	-	L	-	M	
CLR-6:	Evaluate amongst different options available to present, publish research findings				L	H	H	M	M	-	L	H	M	-	H	-	L	-	M	
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																			
CLO-1:	Identify different oral presentation elements, materials and technologies	3	85	80	L	H	H	M	M	-	L	H	M	-	H	-	L	-	M	
CLO-2:	Practice high impact presentation skills	3	85	80	L	H	H	M	M	-	L	H	M	-	H	-	L	-	M	
CLO-3:	Identify ways to present technical / scientific content structure and elements	3	85	80	L	H	H	M	M	-	L	H	M	-	H	-	L	-	M	
CLO-4:	Practice the different disseminating techniques used in scientific research findings	3	85	80	L	H	H	M	M	-	L	H	M	-	H	-	L	-	M	
CLO-5:	Identify intellectual property and its components, ways to protect, share intellectual information	3	85	80	L	H	H	M	M	-	L	H	M	-	H	-	L	-	M	
CLO-6:	Analyze the different oral and written publishing techniques to disseminate research findings	3	85	80	L	H	H	M	M	-	L	H	M	-	H	-	L	-	M	

Duration (hour)	Oral Content Preparation	Presenting Methods	Written Content Preparation	Publishing Methods	Intellectual Property & Plagiarism
	9	9	9	9	9
S-1	SLO-1 Oral Presentation Structure: Manuscript, Impromptu, Memory, Extempore	Describe Audience; knowledge, Experience, Needs, Goals	Writing Preface, Prelude, Prologue, foreword, Introduction, Abstract.	Typesetting: LaTeX, Word, XML etc.,	Public License, Creative Commons, Share-alike, Reciprocal License.
	SLO-2 context, need, agenda ,task, and object of the presentation document	Plan, Prepare, Practice, Present Creating a Positive First Impression,	Writing Dedication, Acknowledgement, Forward, Background	Indexing: ISI, SCI, SCIE, SCOPUS, SCIMAGO, ESCI, WoS,	Copyleft, Patentleft, Open patent, Public Domain
S 2-3	SLO-1 Practice-1: Create Structure of a Presentation	Practice-4: Building rapport with Audience	Practice-7: Writing Preface, Prelude, Prologue, foreword, Introduction, Abstract	Practice-12: LaTeX Editor, Word Editor	Practice-13: GNU-GPL, Public License Creative Commons License, Unlicense
	SLO-2 Gather data, evidence to present, visual-auditory balance, engagement techniques	Increasing Credibility, Presenting Complex Material, Communicating with Impact	Literature Review: Narrative, Systematic, Argumentative, Integrative, Theoretical	Disseminating Research Findings: Public Domain, Open Information, Wikipedia	Intellectual Property Rights, Copyrights, Patents, Trademarks, and Trade secrets
S-4	SLO-1 Introduction, body, closure, question-answer	Motivating Others, Responding to Pressure Situations, Inspiring People	Writing Problem Statement, Limitations, Method Adapted, Tools & Technology used	Media, Press Release, Flyers, Brochure, Research Summary, Posters, Websites	Industrial design rights, Plant variety rights, trade dress, geographical indications
	SLO-2 Practice-2: Create a structured oral presentation module	Practice-5: Communicating with Greater Impact, Rehearsals and Retrials	Practice-8: Writing Literature Review	Practice-11: Study of Various Open Publishing Methods	Practice-14: IPR Law, Private Domain Publishing Methods
S-7	SLO-1 Tools: Presentation Slides, Whiteboard Animators, Immersive Technologies Handouts, Visual Aids, Demonstrative Aids, Thought Provoking Questions	Delivery Styles: Visual, Freeform, Lessig Instructor, Coach, Storytelling, Connector Persuasive, Interactive, Decision Making, Educational, Takahasi Arousing	Main Body: Analysis, Design, Development Steps, Implementation Steps, Evaluations Referencing: Documentary, Parenthetical, Numbered, Vancouver, IEEE, Harvard etc.,	Patents, Journals, Conferences, Reports, RFCs etc., Journal Index, Impact Factor, Quality Standards	Infringements: Copylefts, Copyrights, Patentlefts, Patentrightts, Plagiarism: Paraphrasing, Verbatim, Mosaic, Global, Self, Accidental etc.,
	SLO-2 Practice-3: Demonstrating a multi technology oral presentation	Practice-6: Presenting same content using different delivery styles	Practice-9: Writing Main Body	Practice-12: Study of h-index, i10-index, g-index, r-index, π - index	Practice-15: Plagiarism checking and correcting techniques

Learning Resources	1. Dale Carnegie, "Develop Self-Confidence, Improve Public Speaking", Amazing Reads, 2018 2. Dale Carnegie, "The Art of Public Speaking", Amazing Reads, 2018	4. Rajesh Singh, Sanjeev Kumar Sinha, Samir Kumar, "Unfolding Intellectual Property Rights : A Practical Patent Guide for Researchers, Academicians and start-ups", Notion Press, 2019
--------------------	--	--

	3. Joseph Mugah, "Essentials of Scientific Writing: How to Write Effective Titles and Abstracts for Research Papers and Proposals", Authorhouse, 2016	5. Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New Technological Age", 2016
--	---	--

Learning Assessment									
	Bloom's Level of Thinking	Continuous Learning Assessment (60% weightage)						Final Examination (40% weightage)	
		CLA – 1 (20%)		CLA – 2 (25%)		CLA – 3 (15%)		Theory	Practice
		Theory	Practice	Theory	Practice	Theory	Practice		
Level 1	Remember Understand	20%	20%	15%	15%	15%	15%	15%	15%
Level 2	Apply Analyze	20%	20%	20%	20%	20%	20%	20%	20%
Level 3	Evaluate Create	10%	10%	15%	15%	15%	15%	15%	15%
	Total	100 %		100 %		100 %		100 %	

CLA – 3 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. Sainarayanan Gopalakrishnan, HCL Technologies, sai.jgk@gmail.com	1. Dr. Venkat Adhikari, Technology Licensing Manager, IISC, venkatadhikari@iisc.ac.in	1. Dr. Rajeev Sukumaran SRMIST	
2. Dr. Sricharan Srinivasan, Wipro Technologies, sricharanms@gmail.com	2. Mr. Ateet Palmurkar, Senior Manager IP Licensing, IITM, ipmarketing@iitm.ac.in	2. Dr. V. Nithyanathan SRMIST	

Course Code	20PDM501T	Course Name	Career Advancement Course for Engineers-I	Course Category	M	Mandatory	L	T	P	C
							1	0	1	0

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

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

CLR-1:	Become an expert in communication and problem solving skills	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-2:	Recapitulate fundamental mathematical concepts and skills																		
CLR-3:	Strengthen writing skills professionally and understand commercial mathematical applications																		
CLR-4:	Identification of relationships between words based on their function, usage and characteristics																		
CLR-5:	Sharpen logical and critical reasoning through skillful conceptualization																		
CLR-6:	Acquire the right knowledge, skill and aptitude to face any competitive examination																		

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 communication and problem solving skills	2	80	75	-	H	-	H	-	-	-	-	H	H	-	H	-	-	-	-
CLO-2:	Build a strong base in the fundamental mathematical concepts	2	75	70	-	H	-	H	-	-	-	-	H	H	-	H	-	-	-	-
CLO-3:	Acquire writing skill to communicate with clarity	2	80	75	-	H	-	H	-	-	-	-	H	H	-	H	-	-	-	-
CLO-4:	Use apt vocabulary to embellish language	3	75	70	-	H	-	H	-	-	-	-	H	H	-	H	-	-	-	-
CLO-5:	Gain appropriate skills to succeed in preliminary selection process for recruitment	3	85	80	-	H	-	H	-	-	-	-	H	H	-	H	-	-	-	-
CLO-6:	Enhance aptitude skills though systematic application of knowledge	2	85	80	-	H	-	H	-	-	-	-	H	H	-	H	-	-	-	-

Duration (hour)	6		6		6		6		6	
S-1	SLO-1	Types of numbers, Divisibility tests	Fractions and Decimals, Surds	Percentage - Introduction	Sentence Correction	Number and Alphabet Series				
	SLO-2	Solving Problems	Solving Problems	Solving Problems	Practice	Direction Test				
S-2	SLO-1	LCM and GCD	Square roots, Cube roots, Remainder	Percentage Problems	Reading Comprehension	Blood Relations				
	SLO-2	Solving Problems	Solving Problems	Solving Problems	Practice	Arrangements Linear, Circular				
S-3	SLO-1	Unit digit, Number of zeroes, Factorial notation	Identities	Profit and Loss	Reading Comprehension	Ranking				
	SLO-2	Solving Problems	Solving Problems	Solving Problems	Practice	Practice				
S-4	SLO-1	Verbal Reasoning-Vocabulary	Spotting Errors	Discount	Reading Comprehension	Critical Reasoning-Strengthening				
	SLO-2	Practice	Practice	Solving Problems	Practice	Practice				
S-5	SLO-1	Verbal Reasoning-Vocabulary	Spotting Errors	Sentence Correction	Linear Equations	Critical Reasoning-Weakening				
	SLO-2	Practice	Practice	Practice	Solving Problems	Practice				

S-6	SLO-1	Verbal Reasoning-Vocabulary	Spotting Errors	Sentence Correction	Logical Reasoning-Intro	Critical Reasoning-Assumption
	SLO-2	Practice	Practice	Practice	Coding and Decoding	Practice
Learning Resources	1. Khattar D. "Quantitative Aptitude", Pearson's Publications, Third Edition (2015). 2. Praveen R.V. "Quantitative Aptitude and Reasoning", EEE Publications, Third Edition (2016) 3. Guha A. "Quantitative Aptitude", TATA McGraw Hill Publications, Sixth Edition (2017). 4. P.A. Anand, "Quantitative Aptitude for Competitive Examination", WILEY Publications (2019)			5. Arihant. "IBPS PO - CWE Success Master", Arihant Publications(I) Pvt.Ltd – Meerut, First Edition (2018) 6. Nishit Sinha. "Verbal Ability for CAT", Pearson India, First Edition (2018). 7. Archana Ram, "Placemator", Oxford University Press, (2018) 8. Bharadwaj A.P. "General English for Competitive Examination", Pearson Education, First Edition (2013) 9. Thorpe S. "English for Competitive Examination", Pearson Education, Sixth Edition (2012).		

Learning Assessment :

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

Note: CLA-2 (Surprise Test, Assignment-1, Assignment-2)

Course Designers		
Experts from Industry	Internal Experts	
1. Mr. Ajay Zener, Career Launcher, ajay.z@careerlauncher.com	1. Dr. P. Madhusoodhanan, Head CDC, SRMIST	2. Dr. M. Snehalatha,, Assistant Professor, SRMIST
	3. Mr. J.Jayapragash , Assistant Professor, SRMIST	4. Dr.A.Clement, Assistant Professor, SRMIST

Course Code	20PDM502T	Course Name	Career Advancement Course For Engineers - II	Course Category	M	Mandatory	L	T	P	C
							1	0	1	0

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning			Program Learning Outcomes (PLO)														
CLR-1:	Recapitulate fundamental mathematical concepts and building the resume	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-2:	Become an expert in communication and problem solving skills	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:	Sharpen interpretational skills through skillful conceptualization,	2	80	75	-	H	-	M	-	-	-	-	H	H	-	H	-	-	-
CLR-4:	Sharpen analytical reasoning skills and professional skills	2	75	70	-	H	-	M	-	-	-	-	H	H	-	H	-	-	-
CLR-5:	Utilize professionalism with idealistic, practical and moral values that govern the behavior	2	80	75	-	H	-	M	-	-	-	-	H	H	-	H	-	-	-
CLR-6:	Acquire the right knowledge, skill and aptitude to face any competitive examination	3	75	70	-	H	-	M	-	-	-	-	H	H	-	H	-	-	-
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	2	85	80	-	H	-	M	-	-	-	-	H	H	-	H	-	-	-
CLO-1:	Build a strong base in the fundamental mathematical concepts and resume	2	80	75	-	H	-	M	-	-	-	-	H	H	-	H	-	-	-
CLO-2:	Acquire communication and problem solving skills.	2	75	70	-	H	-	M	-	-	-	-	H	H	-	H	-	-	-
CLO-3:	Gain appropriate skills to succeed in preliminary selection process for recruitment	2	80	75	-	H	-	M	-	-	-	-	H	H	-	H	-	-	-
CLO-4:	Acquire interpretational skills and professional skills	3	75	70	-	H	-	M	-	-	-	-	H	H	-	H	-	-	-
CLO-5:	Develop professionalism with idealistic, practical and moral values	3	85	80	-	H	-	M	-	-	-	-	H	H	-	H	-	-	-
CLO-6:	Enhance lexical skills through systematic application of concepts and careful analysis of style, syntax, semantics and logic	2	85	80	-	H	-	M	-	-	-	-	H	H	-	H	-	-	-

Duration (hour)	6		6		6		6		6	
S-1	SLO-1	Ratio and Proportion-Intro	Sets-Rules	Group Discussion-3	Data Sufficiency-Intro	Personal Interview				
	SLO-2	Solving Problems	Solving Problems	Practice	Solving Problems	Practice				
S-2	SLO-1	Ratio and Proportion	Sets-Identities, Venn Diagram	Group Discussion-4	Data Sufficiency	Personal Interview				
	SLO-2	Solving Problems	Solving Problems	Practice	Solving Problems	Practice				
S-3	SLO-1	Mixture and Solutions-Intro	Functions-Intro	Group Discussion-5	Analytical Reasoning-Intro	Mock Interview				
	SLO-2	Solving Problems	Solving Problems	Practice	Solving Problems	Mock Interview				
S-4	SLO-1	Mixture and Solutions	Group Discussion- Do's and Don'ts	Data Interpretation-Intro	Analytical Reasoning	Mock Interview				
	SLO-2	Solving Problems	Practice	Solving Problems	Solving Problems	Mock Interview				
S-5	SLO-1	Profile Building	Group Discussion-1	Data Interpretation-Tables, Pie Chart	Personal Interview-Do's and Don'ts	Mock Interview				

	SLO-2	Profile Building	Practice	Solving Problems	Practice	Mock Interview
S-6	SLO-1	Resume Building	Group Discussion-2	Data Interpretation-Lines, Bar Graphs	Personal Interview	Quantitative Reasoning Revision
	SLO-2	Resume Building	Practice	Solving Problems	Practice	Solving Problems
Learning Resources	1. Khattar D. "Quantitative Aptitude", Pearson's Publications, Third Edition (2015). 2. Guha A. "Quantitative Aptitude", TATA McGraw Hill Publications, Sixth Edition (2017). 3. Butterfield J. "Soft Skills for Everyone", Cengage Learning India Private Ltd, First Edition, (2011).			4. Bono E.D. "Six Thinking Hats is a book", Little Brown and Company, First Edition (1981) 5. P.A. Anand, "Quantitative Aptitude for Competitive Examination", WILEY Publications (2019) 6. Archana Ram, "Placementor", Oxford University Press, (2018)		

Learning Assessment :

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

Course Designers		
Experts from Industry	Internal Experts	
1. Mr. Ajay Zener, Career Launcher, ajay.z@careerlauncher.com	1. Dr. P. Madhusoodhanan, Head CDC, SRMIST	2. Dr. M. Snehalatha,, Assistant Professor, SRMIST
	3. Mr.P.Priyanand , Assistant Professor, SRMIST	4. Mrs.Kaviatha Srisarann, Assistant Professor, SRMIST

Course Code	20PDM601T	Course Name	Career Advancement Course For Engineers - III	Course Category	M		Mandatory	L	T	P	C
								1	0	1	0

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

Course Learning Rationale (CLR):	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 on planning, preparing and designing a learning program				Engineering Knowledge														
CLR-2: prepare effective learning resources for active practice sessions				Problem Analysis														
CLR-3: facilitate active learning with new methodologies and approaches				Design & Development														
CLR-4: create balanced assessment tools				Analysis, Design, Research														
CLR-5: hone teaching skills for further enrichment				Modern Tool Usage														
CLR-6: define standards, goals and objectives				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: Build a strong foundation in designing a lesson plan	2	80	75															
CLO-2: Acquire knowledge of learning resources for effective delivery	2	75	70															
CLO-3: Sharpen teaching skills with the latest methodologies and techniques	2	80	75															
CLO-4: Develop practical assessment tools to ensure validity and flexibility	3	75	70															
CLO-5: Enhance effective presentation and teaching methods	3	85	80															
CLO-6: Reinforce Bloom's Taxonomy of educational goals and objectives	2	85	80															

Duration (hour)	6		6		6		6		6	
S-1	SLO-1	Lower and Higher order learning	Definition and purpose of assessment	Peer Teaching practice	Live Teaching Sessions	Live Teaching Sessions				
	SLO-2	Outcomes from lower order learning	Practice	Discussion and feedback	Live Teaching Sessions	Live Teaching Sessions				
S-2	SLO-1	Planning and preparing a learning programme and session	Distinction between formative and summative assessment	Peer Teaching practice	Live Teaching Sessions	Live Teaching Sessions				
	SLO-2	Practice	Examples and discussions	Discussion and feedback	Live Teaching Sessions	Live Teaching Sessions				
S-3	SLO-1	Teacher and Student-Centered class room	Instructional materials	Cooperative learning procedure	Live Teaching Sessions	Live Teaching Sessions				
	SLO-2	Discussion	Examples and discussion	Different models of cooperative learning	Live Teaching Sessions	Live Teaching Sessions				
S-4	SLO-1	Roles of teachers and students	Instructional design	Limitations of cooperative learning	Live Teaching Sessions	Live Teaching Sessions				
	SLO-2	Discussion	Practice	Discussion	Live Teaching Sessions	Live Teaching Sessions				

S-5	SLO-1	Discussion Strategies	Presentation of lesson plans	Structure of a lecture	Live Teaching Sessions	Live Teaching Sessions
	SLO-2	Practice	Discussion	Practice	Live Teaching Sessions	Live Teaching Sessions
S-6	SLO-1	Bloom's Taxonomy of educational goal	Group Work in learning	Live Teaching Sessions	Live Teaching Sessions	Live Teaching Sessions
	SLO-2	Practice	Discussion	Live Teaching Sessions	Live Teaching Sessions	Live Teaching Sessions
Learning Resources	1. Barker I. "Cambridge International Diploma for Teachers and Trainers", Cambridge University Press, 2006. 2. Whitehead Jack, Creating a Living Educational Theory from Questions of the kind: How do I improve my Practice? Cambridge Journal of Education, 2006			3. Vicki Phillips and Lynn Olson, "Ensuring Effective Instruction: How do I improve teaching using multiple measures?" Bill & Melinda Gates Foundation, 2013 4. Dr G M Chaudhary, "Teaching Methodology: Effective Teaching Strategies", Independently Published, 2019		

Learning Assessment :

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

Note: **CLA-1 (Lesson Plan Design)** **CLA-2 (Assessment Tools)** **CLA-3 (Teaching Practice)**

Course Designers			
Experts from Industry		Internal Experts	
1. Mr Ajay Zener, Career Launcher, ajay.z@careerlauncher.com		1. Dr. P. Madhusoodhanan, Head CDC, SRMIST	2. Dr. M. Snehalatha., Assistant Professor, SRMIST
		3. Mr J.Jayapragash , Assistant Professor, SRMIST	4. Dr.A.Clement, Assistant Professor, SRMIST