Sardar Patel Institute of Technology
Bhavan's Campus, Munshi Nagar, Andheri (West), Mumbai-400058-India
(Autonomous Institute Affiliated to University of Mumbai)

Sem-VII

Sardar Patel Institute of Technology

Bhavan's Campus, Munshi Nagar, Andheri (West), Mumbai-400058-India
(Autonomous Institute Affiliated to University of Mumbai)

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
PE-III	Wireless Sensor Network	2	0	2	2	6	2	0	1	3
		Examination Scheme								
EC413 (1T13)		Component	ISE		MSE		ESE			Total
		Theory	50		50		100			200
		Laboratory	50		--		50			100

Pre-requisite Course Codes, if any.	EC307: Computer Communication Networks EC311: Mobile Wireless communication

Course Objective: Wide range of applications such as disaster management, military and security have fueled the interest in sensor networks during the past few years. Sensors are typically capable of wireless communication and are significantly constrained in the number of available resources such as energy, storage and computation. Such constraints make the design and operation of sensor networks considerably different from contemporary wireless networks and necessitate the development of resource conscious protocols and management techniques. This course provides a broad coverage of challenges and latest research results related to the design and management of wireless sensor networks.

Course Outcomes (CO): ***At the end of the course students will be able to***

EC413.1	Evaluate architecture of sensor networks and its characteristics.
EC413.2	Determine suitable medium access protocols and radio resources.
EC413.3	Devise appropriate data dissemination protocols and acquisition system.
EC413.4	Explore the design space of various supportive OS, its performance, and resources.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
EC413.1		2										
EC413.2				2								
EC413.3					2							
EC413.4		3			3							

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PSO1	PSO2	PSO3
EC413.1		2				
EC413.2		2				

EC413.3		2				
EC413.4					3	

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand✓	Apply✓	Analyze	Evaluate	Create✓

Theory Component

Module No.	Unit No.	Topics	Ref.	Hrs.
1	**Title**	**Characteristics Of WSN**	1,2	**07**
	1.1	Characteristic requirements for WSN - Challenges for WSNs – WSN vs. Adhoc Networks - Sensor node architecture – Commercially available sensor nodes –Imote, IRIS, Mica Mote, EYES nodes, BTnodes, TelosB, Sunspot -Physical layer and transceiver design considerations in WSNs, Energy usage profile, Choice of modulation scheme, Dynamic modulation scaling, Antenna considerations, Power, signal processing transmission related constraints		
2	**Title**	**Medium Access Control Protocols**	1,2	**08**
	2.1	Fundamentals of MAC protocols - Low duty cycle protocolsand wakeup concepts - Contention-based protocols -Schedule-based protocols - SMAC - BMAC -, 802.11pVehicular IEE std., Traffic-adaptive medium access protocol (TRAMA) - The IEEE 802.15.4 MAC protocol, Case Study: IEEE 802.15.4 LR-WPANs Standard - Target detection and tracking - Contour/edge detection - Field sampling.		
3	**Title**	**Routing And Data Gathering/Acquisition**	1,2	**08**
	3.1	Routing Challenges and Design Issues in Wireless SensorNetworks, Flooding and gossiping – Data centric Routing – SPIN – Directed Diffusion – Energy aware routing -Gradient-based routing - Rumor Routing – COUGAR –ACQUIRE – Hierarchical Routing - LEACH, PEGASIS –Location Based Routing – GF, GAF, GEAR, GPSR – Real Time routing Protocols – TEEN, APTEEN, SPEED, RAP - Data aggregation - data aggregation operations – Aggregate Queries in Sensor Networks - Aggregation Techniques – TAG, Tiny DB.		
4	**Title**	**Embedded Operating Systems**	1,2	**05**
	4.1	Operating Systems for Wireless Sensor Networks – Introduction RTOS and operation - Operating System Design Issues – Examples of Operating Systems – TinyOS – Mate – MagnetOS – MANTIS -		

		OSPM - EYES OS – SenOS – EMERALDS – PicOS – Introduction to Tiny OS – NesC – Interfaces and Modules- Configurations and Wiring - Generic Components -Programming in Tiny OS using NesC, Emulator TOSSIM.		
5	**Self-Study**	Security challenges, Threat and attack models, Quality of service provisioning, Clock synchronization, Supporting fault tolerant operation	1,2	***05**
			Total	**28**

Laboratory Components

Lab No	Title of the Lab	Marks	Reference
	Preparatory Lab:Study of Hardware,Software,Middleware with specifications.	--	1,5
1	Embedded/RTOS OS fundamentals	5	5
2	Onboard RTOS environment settings	5	
3	MAC algorithms using NS3	5	
4	MAC algorithms using NetSim, Omnet++	5	
5	Routing algorithms using NS3	5	
6	Routing algorithms using GNS3	5	
7	Virtual Lab	5	4
8	Energy management using NS3	5	
9	QoS using NS3, NetSIM,Omnet++,GNS3, Contiki	5	
10	Build the WSN application using Python Framework (Django) and Cloud environment	5	

Text Books

Sr. No	Title	Edition	Authors	Publisher	Year
1	Wireless Sensor Networks Technology,Protocols, and Applications	--	Kazem Sohraby, Daniel Minoli and Taieb Znati	John Wiley and Sons	2007
2	Protocols and Architectures for Wireless Sensor Networks	--	Holger Karl and Andreas Willig	John Wiley and Sons	2005
3	Wireless Sensor Networks	--	Cauligi S. Raghavendra, Krishna Sivalingam, Taieb M. Znati	Springer, ISBN 1-4020-7883	2004
4	A Guide to Wireless Sensor Network	--	A. Swapna Kumar	University Science Press	2013

Reference Books

Sr. No	Title	Edition	Authors	Publisher	Year
1	A survey of routing protocols in wireless sensor networks	--	K. Akkaya and M. Younis	Elsevier Ad Hoc Network Journal, Vol. 3, no. 3, pp. 325—349	--
2.	Tiny OS Programming	--	Philip Levis.	--	--
3.	Wireless Sensor Network- Technology and Applications	--	Edited by Mohammad A. Matin	INTECH	2012

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Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
PE-IV	Next Generation Network	3	0	0	3	6	3	0	0	3
EC -414 (1T14)		Examination Scheme								
		Component	ISE		MSE		ESE			Total
		Theory	75		75		150			300
		Laboratory	--		--		--			--

Pre-requisite Course Codes, if any.	EC307: Computer Communication Networks EC311: Mobile Wireless communication
Course Objective: To provide a working knowledge of emerging network technologies, how they are used, what their advantages or disadvantages are, and what their future offers. Consider the business potential for current and future services. Summarize architecture and technology options for Multi-Service Networks. Identify the key technologies for core, access and infrastructure.	
Course Outcomes (CO): ***At the end of the course students will be able to***	
EC414.1	Describe technical features and design considerations of the next generation networks.
EC414.2	Apply the concept of convergence of service.
EC414.3	Identify the NGN services in business-oriented aspects.
EC414.4	Demonstrate technologies for next generation networks.
EC414.5	Evaluate the performance of Next Generation Networks.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
EC414.1	3		2									
EC414.2		2										
EC414.3		2										
EC414.4					3							
EC414.5					3							

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PSO1	PSO2	PSO3
EC414.1		2				
EC414.2		2				
EC414.3		2				

EC414.4		2			3	
EC414.5		2				

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply✓	Analyze✓	Evaluate✓	Create

Theory Component

Module No.	Unit No.	Topics	Ref.	Hrs.
1	**Title**	**Introduction to Next generation Network and ITU standards, IPv6**	1,2	**12**
	1.1	Introduction Evolution of public mobile services - Main drivers to Next Generation Networks – NGN, ITU NGN standards. SG13		
	1.2	All-IP network concept, Numbering, naming and addressing for all NGN, NGN control architectures and protocols, Transport Stratum, Service Stratum, Service Management, Application Functions. Wireless NG Technologies, 5G networks and small cells types, Integration with services.		
	1.3	Transition of IP networks to NGN, Future packet-based network. IPv6 NGN implementation, NGN business challenges, NGN evaluation.		
2	**Title**	**IMS and Convergent Management IMS Architecture**	2,3	**08**
	2.1	IMS services, QoS Control and Authentication, Network and Service management for NGN, IMS advantages		
	2.2	Next Generation OSS Architecture - standards important to OSS architecture, Information framework, OSS interaction with IMS, NGN OSS function/ information view reference model, DMTF CIM, Push to Talk over Cellular (PoC) Service, MS-Based FMC Service.		
3	**Title**	**NGN Services: Technology, Business Aspects**	2	**08**
	3.1	VoIP, IPTV, rich multimedia, future web, Quality of Service (QoS), Quality of Experience (QoE) in NGN		
	3.2	Control and Signaling protocols for NGN, NGN security, Service convergence, Business, and regulatory aspects of NGN, Ubiquitous Sensor Network Services-USN Functional Architecture, USN Applications, Business models and regulation of the NGN services.		
4	**Title**	**MPLS and VPN Technology**	1,2	**07**
	4.1	MPLS & QoS, MPLS services and components – layer 2 MPLS		

		multicast, IPv6 and MPLS - Technology overview, Future of MPLS – Integrating IP and optical networks, Future Layer2 layer3 services		
	4.2	VPN, layer Internetworking, VPN services, signaling, layer 3 VPN – Technology overview, Remote Access, and IPsec integration with MPLS VPN. VPN services in NGN with emerging Internet of Things (IoT) and Web of Things (WoT)		
5	**Title**	**NGN Management and Future Evaluation**	2,3	**07**
	5.1	Configuration, Accounting, performance, security, case study for MPLS,		
	5.2	Future enhancements – Adaptive self-healing networks, Intelligent Networks, Self-organizing Network (SON)		
6	**Self-Study**	Software Defined Networks (SDN) & NFV, Network Automation and Containerized NFV, IMS Advantages, NEXT GENERATION OSS ARCHITECTURE, Services Implemented on NGN	5,6	**06**
			Total	**42+6**

Text Books

Sr. No	Title	Edition	Authors	Publisher	Year
1	Next generation Telecommunication Networks, Services and Management	--	Thomas Plavyk	Wiley and IEEE Press Publications	2010
2	NGN Architectures, Protocols and Services	--	Toni Janevski	John Wiley and Sons	2014
3	Next Generation Network –AComplete Guide	--	Gerardus Blokdyk	5 STAR Cooks	2018

Reference Books

Sr. No	Title	Edition	Authors	Publisher	Year
1	Next Generation Network Services: Technologies and Strategies	--	Neill Wilkinson	John Wiley Publications	2002
2.	Foundations of Modern Networking-SDN, NFV and QoE,IoT and Cloud	--	William Stallings	Pearson Publications	2015
3.	SDN: Software Defined Networks: An Authoritative Review of Network Programmability Technologies	--	Thomas D. Nadeau and Ken Gray	Oreilly Publications	2013

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Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
PE- III	Image and Video Processing	2	-	2	5	8	2	-	1	3
EC423 (1T23)		Examination Scheme								
		Component	ISE		MSE		ESE			Total
		Theory	50		50		100			200
		Laboratory	50		--		50			100

Pre-requisite Course Codes, if any.	EC207: Signals and Systems EC303: Digital Signal Processing
Course Objective: To study the image and video fundamentals and mathematical transforms necessary for processing and enhancement techniques. To study image restoration procedures and compression procedures for different applications.	
Course Outcomes (CO): ***At the end of the course students will be able to***	
EC423.1	Apply the image fundamentals and mathematical models for digital image and video processing.
EC423.2	Analyze time and frequency domain techniques for image enhancement.
EC423.3	Apply segmentation and compression techniques.
EC423.4	Develop image and video processing applications.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
EC423.1	3	3										
EC423.2			3	2	3							2
EC423.3					3							
EC423.4	2	2			3	2			3	3		3

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
EC423.1		2					
EC423.2					3		
EC423.3			2				
EC423.4			2			3	

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BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply✓	Analyze✓	Evaluate✓	Create

Theory Component

Module No.	Unit No.	Topics	Ref.	Hrs.
1	Title	**Fundamental of Image and Video**	1,6	04
	1.1	Structure of the Human Eye, Light, Brightness adaption and discrimination, Pixels, coordinate conventions,		
	1.2	Imaging Geometry, Image acquisition, sampling and quantization, image resolution, basic relationship between pixels, colour images, RGB, HSI and other models		
2	Title	**Two Dimensional Transforms and Image Enhancement**	1,5	06
	2.1	Discrete Fourier Transform, Discrete Cosine Transform, KL Transform, and Discrete Wavelet Transform		
	2.2	Intensity transformations, contrast stretching, histogram equalization, Correlation and convolution, smoothing filters, sharpening filters, gradient and Laplacian, Frequency domain filtering.		
3	Title	**Image Segmentation and Compression**	1,5	05
	3.1	Point, line and edge detection, edge linking using Hough transform and graph theoretic approach, thresholding, and region-based segmentation, Morphological operations.		
	3.2	JPEG and MPEG compression standard, H.265 video compression standard		
4	Title	**Image Restoration**	1,6	04
	4.1	Basic Framework, Image degradation model, Noise characterization, Noise restoration filters,		
	4.2	Adaptive filters, and Estimation of Degradation functions, Restoration Techniques.		
5	Title	**Video Formation and Representation**	2,3	05
	5.1	Digital Video Sampling, Video Frame classifications, I, P and B frames, Notation		
	5.2	Video Capture and display: Principle of color video camera, video camera, digital video Sampling of video Signals: Required sampling rates, sampling in two dimensions and three dimensions, progressive virus interlaced scans		
6	Title	**Motion Estimation**	2,3	04
	6.1	Optical Flow: Motion Vs optical flow, optical flow equations, motion representation, motion estimation criteria, optimization		

		method.		
	6.2	Pixel based motion estimation, Block Matching Algorithms, Multi resolution Motion Estimation: General formulation.		
7	**Self-Study**	Study of different format of image and video, Basics of image and video terminology, ITU-RBT 601, Digital Video formats, Digital video quality measure.		
			Total	**28**

Laboratory:

Sr. No	**Title of the Experiment**
1.	Image Enhancement
2.	Image Transformations.
3.	Image Filtering
4.	Image Segmentations
5.	Image Compression
6.	Image Restoration
7.	Object Detection in video
8.	Motion Estimation on video
9.	Color Image Segmentation
10.	Discrete Wavelet Transforms on image

Textbook

Sr. No	Title	Edition	Authors	Publisher	Year
1	Computer Vision and applications-A GuideforStudents andPractitioners	First	Bernd Jahne and Host HauBecker	Elsevier	--
2	Digital Image and Video Processing	First	Dhananjay Theckedath	Pearson Education	2019

Reference Books

Sr. No	Title	Edition	Authors	Publisher	Year
1	Digital Image Processing	Third	Rafael C. Gonzalez and Richard E. Woods	Pearson Education	2010
2	Digital Video Processing	Second	Murat Tekalp	Pearson Education	2010
3	Handbook on Image and Video Processing	---	A.I.Bovik	Academic Press	2009

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Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
PE- IV	Principles of Soft Computing	2	0	2	6	8	2	0	1	3
		Examination Scheme								
		Component	ISE		MSE		ESE			Total
EC424 (1T24)		Theory	50		50		100			200
		Laboratory	50		--		50			100

Pre-requisite Course Codes, if any.	MA101: Engineering Calculus MA102: Differential Equations and Complex Analysis
Course Objective: To implement soft computing-based solutions for solving real-world problems	
Course Outcomes (CO): ***At the end of the course students will be able to***	
EC424.1	Identify soft computing techniques and their roles in building intelligent Machines.
EC424.2	Apply fuzzy logic reasoning to build model for solving various engineering problems.
EC424.3	Analyze optimization issues using Genetic Algorithm.
EC424.4	Design various hybrid soft computing models by using different techniques .

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
EC424.1	2	2			3							
EC424.2		2	2		3							
EC424.3			2		3							
EC424.4				2	3							

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PSO1	PSO2	PSO3
EC424.1	2			2	2	
EC424.2	2			2	2	
EC424.3	2				2	
EC424.4		3			2	3

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	✓ Apply	✓ Analyze	✓ Evaluate	Create

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Theory Component

Module No.	Unit No.	Topics	Ref.	Hrs.
1	**Title**	**Introduction To Soft Computing and Neural Networks**	1,2	**04**
	1.1	Introduction to Soft Computing, Difference between Hard and Soft Computing. Conventional AI, Computational Intelligence		
2	**Title**	**Neural Networks**	1,2	**10**
	2.1	Biological neuron, Artificial Neuron Model, Single layer Multilayer Architecture of Neural Networks Architecture, Activation functions, Learning rules.		
	2.2	Supervised Learning Neural Network: Back Propagation Network, Radial Basis Function Network.		
	2.3	Unsupervised Learning Neural Network: Adaptive Resonance Architecture.		
3	**Title**	**Fuzzy Logic**	3	**6**
	3.1	Fuzzy Sets, Operations on Fuzzy Sets, Fuzzy Relations		
	3.2	Membership Functions, Fuzzy Rules and Fuzzy Reasoning		
	3.3	Fuzzy Inference Systems, Fuzzy Models.		
4	**Title**	**Genetic Algorithm**	3	**8**
	4.1	Introduction to Genetic Algorithm, Working Principle of Genetic Algorithm.		
	4.2	Various Encoding methods, Fitness function.		
5	**Self-Study**	Analyse advanced soft computing techniques.		
			Total	**28**

Laboratory Component

Sr. No	Title of the Experiment
1	Linear & Nonlinear analysis using single &multiplayer neural network
2	Supervised learning neural network
3	Unsupervised learning neural network
4	Fuzzy logic operations
5	Fuzzy system design
6	Genetic Algorithm
7	Design Neuro-fuzzy model
8	Hybrid Design/Expert system Design

Text Books

Sr. No	Title	Edition	Authors	Publisher	Year
1	Introduction to Artificial Neural Systems	--	Jacek M. Zurada	PWS Publishing Company	1995
2	Principles of Soft Computing	Third	S.N.Sivanandam and S.N.Deepa	Wiley Publication,	2018
3	Neural Networks, Fuzzy Logic and Genetic Algorithms	--	S.Rajasekaran and G. A. Vijayalakshami	Prentice-Hall of India	2004

Reference Books

Sr. No	Title	Edition	Authors	Publisher	Year
1	Neural Networks: A Comprehensive Foundation	--	Simon Haykin	Macmillan College Publishing Company	1994
2	Neural Network Design	--	Martin Hagan	CENGAGE Learning, India	2008
3	Fuzzy Sets and Fuzzy Logic: Theory and Applications	--	George J. Klir and Bo Yuan	Prentice-Hall of India	1994

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Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
PE- III	Artificial Intelligence and Machine Learning	2	0	2	2	6	2	0	1	3
EC433 (1P)		Examination Scheme								
		Component	ISE		MSE		ESE			Total
		Theory	50		50		100			200
		Laboratory	50		--		50			100

Pre-requisite Course Codes, if any.	MA201: Linear Algebra MA203: Probability and Stochastic Processes
Course Objective: To provide a strong foundation and basic exposition to the goals and methods of Artificial Intelligence and Machine Learning. To enable them to apply these techniques in applications which involve perception, reasoning and learning.	
Course Outcomes (CO): ***At the end of the course students will be able to***	
EC433.1	Describe the basic concepts and techniques of Machine Learning.
EC433.2	Evaluate Supervised and Unsupervised Machine Learning Algorithms based on applications.
EC433.3	Analyze the deep learning algorithms for various types of learning tasks in various domains.
EC433.4	Apply knowledge representation, reasoning, and machine learning techniques to real-world problems.

CO-PO Correlation Matrix: (1-Weak, 2-Medium 3-Strong)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO9	PO10	PO12
EC433.1		3								
EC433.2		3	2		3					
EC433.3				2	3	2	3			
EC433.4				2	3			2	3	2

CO-PEO/PSO Correlation Matrix : (1-Weak, 2-Medium 3-Strong)

	PEO1	PEO2	PEO3	PSO1	PSO2	PSO3
EC433.1	2					
EC433.2		3		3		
EC433.3			2		2	
EC433.4				3		

BLOOM'S Levels Targeted (Pl. Tick appropriate)

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Remember	Understand	✓ Apply	✓ Analyze	✓ Evaluate	Create

Theory Component

Module No.	Unit No.	Topics	Ref.	Hrs.
1	Title	**Fundamental of Machine Learning and Artificial Intelligence**	1	06
	1.1	Notation of Dataset, Training Set and Test Set, No Free Lunch Rule, Relationships with Other Disciplines, Basic definitions of ML and AI, Machine Learning vs AI, Machine Learning vs Deep Learning.		
	1.2	Types of Machine Learning-Supervised, Unsupervised, Reinforcement, General Steps or Process of Machine Learning-Feature Extraction, Feature Correlation, Feature Transform, Train Model, Ensemble, Evaluate, Data cleaning, data transform/fitting.		
2	Title	**Supervised Learning**	2	07
	2.1	Regression: Linear Regression, Regularization Techniques (LASSO), Polynomial Regression, Support Vector Machine (SVM) and Regression (SVR, Extension to Multi-class Problems and usage) etc.		
	2.2	Classification, Random Forest, Decision Trees, Logistic Regression Support Vector Machines, KNN, Naïve Bayes.		
3	Title	**Unsupervised Learning and Reinforcement Learning**	1,3	06
	3.1	Clustering, K-Means, K Nearest Neighbours, Association Rule Learning, Dimensionality Reduction, PCA, SVD, tSNE		
	3.2	Markov Decision, Monte Carlo Prediction.		
4	Title	**Neural Networks/Deep Learning**	2	07
	4.1	Introduction to ANN CNN, RNN/LSTM/GRU, Transfer Learning, Case Study (CNN)		
	4.2	**Natural Language Processing:** Text Mining. Generation, Applications		
	4.3	**Predictive Analytics – Forecasting,** Logistic, Time Series (ARIMA), etc. Case Study (Time Series)		
5	Title	**Applications of AI and Machine Learning.**	3,6	02
6	Self-Study	Multivariate Regression, Gaussian Mixture Models, Ensemble Methods		04
			Total	28

Laboratory Component

Sr. No	Title of the Experiment
1	FIND-S algorithm used for finding the most specific hypothesis
2	Implement and demonstrate the Candidate-Elimination algorithm.
3	Write program to demonstrate the working of the decision tree based ID3 algorithm
4	Implement program for classifier
5	Implement the naïve Bayesian Classifier model to classify set of documents that you have assumed Calculate the accuracy, precision, and recall for your data set.
6	Apply EM algorithm to cluster a set of data stored. (k-Mean's algorithm)
7	Write program to implement k-Nearest Neighbor algorithm to classify the data set.
8	Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points while selecting appropriate data set for your experiment and draw graphs.
9	Build an Artificial Neural Network (ANN) by implementing the Back-propagation algorithm
10	Case Study on Clustering/Anomaly/Fraud Detection

Text Books

Sr. No	Title	Edition	Authors	Publisher	Year
1	Machine Learning	--	Andriy Burkov	McGraw Hill Education	2009
2	Neural Networks and Deep Learning	-	Michael Nielsen	-	-

Reference Books

Sr. No	Title	Edition	Authors	Publisher	Year
1	Introduction to Machine Learning	Second	Ethem Alpaydın	MIT Press Cambridge, Massachusetts London, England	2010
2	Introduction to Machine Learning with Python	--	Andreas C. Muller and Sarah Guido	Oreilly Publication	---
3	Artificial Intelligence. A Modern Approach,	Third	Stuard Russell and Peter Norvig	Prentice Hall	2010
4	Pattern Recognition and Machine Learning		Christopher M. Bishop	Springer	2006

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Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
PE- IV	Telecom Network Operations and Management	2	0	2	2	6	2	0	1	3
		Examination Scheme								
		Component	ISE		MSE		ESE			Total
EC434 (1Q)		Theory	50		50		100			200
		Laboratory	50		--		50			100

Pre-requisite Course Codes, if any.	EC307: Computer Communication Network
Course Objective: To develop understanding the concept of Telecommunication network management, architecture and protocol. Appreciate the need for interoperable network management. This course offers students a hands-on experience managing network hardware and essential network services such as DHCP, DNS, ARP, FTP, Telnet, HTTP, SSH, SMTP, TFTP, and SNMP through the use of scripting and python programming.	
Course Outcomes (CO): ***At the end of the course students will be able to***	
EC434.1	Identify network requirements and apply the concept of structured wiring, structured Network Design and select the best solutions to meet the needs of a business.
EC434.2	Analyze the network management standards and protocols to support FCAPS Model of Network Management.
EC434.3	Identify the functions of the Network Manager and show how management information is stored & accessed within a managed object.
EC434.4	Apply effective troubleshooting and debugging techniques to resolve the network problems.
EC434.5	Apply fundamental components of Network Management and implement server and agent architectures to monitor and control networks, devices and applications.
EC434.6	Develop programs in Python to solve real problems in Network Management.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
EC434.1			2	2								
EC434.2			2	2								
EC434.3					3							
EC434.4					3							
EC434.5					3							
EC434.6					3							

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PSO1	PSO2	PSO3
EC434.1			2			
EC434.2		2				
EC434.3			2			
EC434.4		2		3	2	
EC434.5			2		3	
EC434.6		2			2	

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	✓ Apply	✓ Analyze	✓ Evaluate	✓ Create

Theory Component

Module No.	Unit No.	Topics	Ref.	Hrs.
1	Title	**Introduction to Enterprise Network Design**	2,1,3	08
	1.1	Introducing Network Design Concepts: Medium Enterprise Design Profile (MEDP)—LAN Design, LAN design principles, LAN design model for the medium enterprise, Considerations of a multi-tier LAN design model for medium enterprises, Designing network foundation services for LAN designs in medium enterprise, Scalability, Service uptime, WAN Design, Business and network-based economy.		
	1.2	Challenges of IT managers, Network management architecture and organization network management perspectives management: Goals, organization and functions		
2	Title	**OSI Network Management**	1,2,3	02
	2.1	Network management standards, Network management models, Organization model, Information model Communication model and functional model, Abstract syntax notation – encoding structure, macros, functional model CMIP/CMISE		
3	Title	**Internet Management (SNMP)**	1,2,3	08
	3.1	SNMP-organizational model-System overview. Information model, communication model, functional model, SNMP proxy server, Management information, Protocol SNMPv1,v2 and V3, Remote monitoring. RMON, Limitations of SNMP, Beyond SNMP, NETCONF/YANG		

4	**Title**	**Telecommunication Management Networks (TMN)**	1,2.3	**03**
	4.1	Need for TMN, Conceptual TNM model, TMN Network Management Architecture, TMN management services architecture and TMN implementation		
5	**Title**	**Network Management Tools and Applications**	1,4,5	**07**
	5.1	System Utilities for network management, Network statistics and measurements, NMS Design, NMS components, NMS Server Architecture, Network Management Systems and FCAPS, Automatic Fault Management and Event correlation Techniques, Security Management		
6	**Self Study**	**Broadband Network Management:** ATM Network Management and Wireless Network Management		**04**
			Total	**28**

Laboratory Component

Sr. No	Title of the Experiment
1	Network Monitoring tools: a) Status b) Route c) Traffic Tools d) Audit
2	Monitoring and management network using SNMP: a) Basic SNMP b) Advanced SNMP v3 Authentication/Encryption and ACL c) SNMP Trap Daemon Implementation
3	Configuration SNMP Protocol on Cisco Router using Packet Tracer
4	Configuration manageable Switch: L2/L3 Switch
5	LAN Troubleshooting using tcpdump and Wireshark
6	Monitoring of services and Servers using a) Observium/ Cacti b)Nagios/Icinga
7	Implementation of Centralized Logging infrastructure and security event correlation
8	Open Source SIEM Project
9	Python scripts for Network Monitoring
10	Network Management using Python

Reference Books

Sr. No	Title	Edition	Authors	Publisher	Year
1	Network Management Principles and Practice	--	Mani Subramaniam	Addison Wisely, New York	2000
2	Designing and Supporting Computer Networks, CCNA Discovery Learning Guide	--	Kenneth Stewart, Aubrey Adams, Allan Reid, Jim Lorenz	Cisco Press	---

3	Network Management: Concepts and Practice, A Hands-On Approach	--	J. Richard Burke	Pearson Publications.	--
4	Network Management: Accounting and Performance Strategies	--	Benoit Claise- CCIE No. 2686; Ralf Wolter	Cisco Press	--
5	Network Management Fundamentals	--	Alexander Clemm	Cisco Press, ISBN-13: 978-158720137	2006
6	Python for Software Design	--	Allen B. Downey	Cambridge University Press ISBN-13: 978-0521725965	2009

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Sem-VIII

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Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
*PE	Fundamentals of Antenna	3	-	-	6	09	3	-	-	3
		Examination Scheme								
		Component	ISE		MSE		ESE			Total
EC306		Theory	75		75		150			300
		Laboratory	--		--		--			--

*** Only for Category 2 Students.**

Pre-requisite Course Codes, if any.	EC304: Electromagnetic Waves
Course Objective: The objective of the course is to provide a fundamental understanding of Antennas	
Course Outcomes (CO): ***At the end of the course students will be able to***	
EC306.1	Calculate the fundamental parameters of Antenna.
EC306.2	Describe fundamental theory of antennas.
EC306.3	Select antenna based on applications.
EC306.4	Evaluate antenna based on applications.
EC306.5	Design Antenna Arrays.
EC306.6	Design antenna based on given requirements.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
EC306.1	2	3						2	2	2		
EC306.2	2	3						2	2	2		
EC306.3		2						2	2	2		
EC306.4		2		2				2	2	2		
EC306.5		2		2				2	2	2		
EC306.6	2	1						2	2	2		

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
EC306.1		2				-	
EC306.2		2				2	
EC306.3		2				2	
EC306.4		2				2	
EC306.5		2				2	
EC306.6		1				1	

BLOOM'S Levels Targeted (Pl. Tick appropriate)

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Remember√	Understand√	Apply√	Analyze√	Evaluate	Create

Theory Component

Module No.	Unit No.	Topics	Ref.	Hrs.
1 (CO1)		**Fundamental Concepts:**	1	08
	1.1	Introduction, types of Antennas, Radiation mechanism, Poynting vector, Steradian concept, Power intensity		
	1.2	Antenna Parameter: Radiation pattern, Radiation power density, Radiation Intensity, Gain, Directivity, HPBW, FNBW, Beam efficiency, Bandwidth, Polarization, Input Impedance, Reflection coefficient, Return loss, VSWR, Antenna Efficiency, Effective Aperture, Communication link and Friis transmission equation.		
2 (CO2, CO3)		**Radiation from wires and loops**	1	10
	2.1	Introduction, Infinitesimal dipole: Radiation zones, Total radiated power, Radiation resistance, Directivity, Effective area, Short dipole, Finite-length dipole: Radiated power, Radiation resistance, Directivity, Effective area, Half-wave dipole and its properties, Loop antenna.		
3 (CO3, CO4)		**Aperture Antennas**	1	06
	3.1	Introduction, Field equivalence principle, Love's equivalence principle, Electrical and magnetic conductor equivalence principle, Computation of field quantities of aperture antenna, Relation between wire and aperture antennas, Horn antenna design principle.		
4 (CO5)		**Antenna Arrays**	1	10
	4.1	Introduction, Two-element array, Example problems, Pattern multiplication concept, N-element array, Uniform array, Array factor, Broad-side and end-fire arrays, Phased array, Directivity and pattern characteristic of linear uniform array, non-uniform array, Binomial array, Dolph-Chebyshev array concept, Design principle of Chebyshev array and examples, Planar arrays		
5 (CO6)		**Microstrip Antennas**		
	3.1	Introduction: Rectangular Patch, Circular Patch, Parametric study, Circularly polarized antennas, Axial Ratio, MSA suspended Configuration.	1,4	08
	3.2	MSA Arrays and Feed Networks, Corporate and Series Feeds		
6 (Self Study)		**Advanced Antennas:** Reflector antenna, Dielectric Resonator antenna, Metamaterial based antennas, Wearable antenna, Reconfigurable antennas, Ultra-wideband antennas, Smart Antennas		06
			Total	**42**

Text Books:

S. N.	Title	Authors	Edition	Publisher	Year
1	Antenna Theory: Analysis and Design	Constantine A. Balanis	Fourth	Wiley	1982

Reference Books:

S. N.	Title	Authors	Edition	Publisher	Year
1	Antennas & Wave Propagation	J.D. Kraus, R.J. Marhefka, and A.S. Khan	Fourth	McGraw Hill	2011
2	Handbook of Microstrip Antennas	R. James and P.S. Hall	Third	Peter Peregrinus	1989
3	Antennas and Radio Wave Propagation	R. E. Collin	Fourth	McGraw-Hill	1985
4	Broadband Microstrip antennas	Girish Kumar and K.P. Ray	First	Artech House	2003

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Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
*PE	Computer Communication Networks	3	-	-	5	08	3	-	-	3
		Examination Scheme								
		Component	ISE		MSE		ESE			Total
EC307		Theory	75		75		150			300
		Laboratory	--		--		--			--

* **Only for Category 2 Students.**

Pre-requisite Course Codes, if any.	EC301: Analog and Digital Communication
Course Objective: The objective of the course is to provide a fundamental understanding of ComputerCommunication networks.	
Course Outcomes (CO): ***At the end of the course students will be able to***	
EC307.1	Apply Conceptual understanding and functional aspects of computer communication and telecom networks.
EC307.2	Analyze design and configure small and medium sized computer network that meets a specific need for communications.
EC307.3	Simulate computer networks and analyze the simulation results including troubleshoot connectivity problem occurring at layers of TCP/IP model.
EC307.4	Apply the principles behind the Modern Network approaches such as SDN NFV and IoT and security issues.

CO-PO Correlation Matrix: (1-Weak, 2-Medium, 3-Strong)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
EC307.1	3	3										
EC307.2			3	2	3							2
EC307.3			3		3	2						
EC307.4	2	2							3	3		3

CO-PEO/PSO Correlation Matrix : **(1-Weak, 2-Medium 3-Strong)**

	PEO1	PEO2	PEO3	PSO1	PSO2	PSO3
EC307.1		2				
EC307.2		2		3		
EC307.3		2			3	
EC307.4		2				

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BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply	Analyze	Evaluate	Create

Theory Component

Module No.	Unit No.	Topics	Ref.	Hrs.
1	**Title**	**Fundamental of Computer Networks**	1	08
	1.1	Basic definitions. Networking devices. Layering architecture: The OSI model. Description of layers.		
	1.2	The Internet protocols TCP/IP protocol suit, IP Protocol and address. What is the Internet? Delay in the Internet (trace route and ping). History of the Internet. Security in the Internet.		
2	**Title**	**Enterprise Network Design**	2	06
	2.1	Network requirements, Planning and Design, Structured Wiring and Structured Network Design consist of Core Layer, Distribution Layer, and Access.		
	2.2	Network Design methodology &Network Design considerations Core La yer Technologies. Investigating Server Farms and Security Integrating, Remote Sites into the Network Design.		
3	**Title**	**Transport and Application Layer**	1,3	06
	3.1	Transport Protocols introduction. Reliable data transfer - Stop-and-wait and Go-back-N design and evaluation. TCP and UDP semantics and syntax. TCP RTT estimation. Principles of congestion control - efficiency and fairness, reactive and proactive. Socket's programming A simple client-server implementation.		
	3.2	Application layer: Application layer protocols, Client-server as a key model. Web, HTTP, FTP, SMTP, POP3, and DNS. Peer-to-peer file sharing networks.		
4	**Title**	**Software Defined Network and Network Function Visualization**	5	10
	4.1	Network Requirements - The SDN Approach - SDN- and NFV-Related Standards - SDN Data Plane - OpenFlow Logical Network Device - OpenFlow Protocol - SDN Control Plane Architecture - REST API - SDN Application Plane Architecture.		
	4.2	NFV Concepts - NFV Reference Architecture - NFV Infrastructure - Virtualized Network Functions - NFV Management and Orchestration - NFV Use Cases - SDN and NFV		
5	**Title**	**Internet of Things (IoT) SECURITY**	1,3	10
	5.1	Threats and attacks. Symmetric and public key cryptography. IPsec-Authentication Header-Encapsulating security payload,		

	5.2	Secure sockets-Secure Socket Layer (SSL) - Firewalls and Internet access- Packet filter firewall- Proxy firewall- VPNs – Mobile IP – Header Compression – Voice over IP –		
	Title	**Networks**		5
6	Self-Study	Types of Networks, Transmission media, Network Topologies		
Total				**42**

Textbooks

Sr. No	Title	Edition	Authors	Publisher	Year
1	TCP/IP protocol suit	Fourth	Behrouz A. Forouzan (Author)	McGraw Hill Education	2009
2	Introducing Network Design Concepts	-	CCNA Discovery Learning Guide	-	-
3	Computer Networking: A Top-Down Approach	Fifth	J. F. Kurose and K. W. Ross	Prentice Hall	2009
4	Data Communication and Networking	Fourth	B.A.Forouzan	McGraw Hill	2017
5	Information Security: Principles and Practice	First	Deven Shah	Wiley	2007

Reference Books

Sr. No	Title	Edition	Authors	Publisher	Year
1	Foundations of Modern Networking: SDN, NFV, QoE, IoT, and Cloud	--	William Stallings	Addison-Wesley ISBN: 9780134175393	2015
2	Computer Networks	Fifth	A.Tanenbaum	Pearson Education	2013
3	Data and Computer Communications	Tenth	William Stallings	Pearson Education	2013

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PROGRAM ELECTIVE COURSES

Assumptions

- Some Elective courses may be of interest to the students of both the branches.
- 4 Electives are sufficient to specialize in a particular vertical/thread/area.

PE/TD	PE1	PE2	PE3	PE4	PE5	PE6
THREAD 1: Communication	1T11: Mobile and Wireless communication	1T12: Microwave Communication	1T13: Wireless Sensor Networks	1T14: Next Generation Network	1T11, 1T12, 1T21, 1T22, 1X, 1Y, 2X, 2Y 2T11, 2T12, 2T21, 2T22 EC306 *	1T11, 1T12, 1T21, 1T22, 1X, 1Y, 2X, 2Y 2T11, 2T12, 2T21, 2T22 EC307*
THREAD 2: Signal Processing	1T21: Speech and Audio Processing	1T22: DSP Processors	1T23: Image& Video Processing	1T24: Principles Soft Computing		
General	1X: Information Theory and Coding 1T11,1T12, 1T21,1T22, 1X,1Y, 2X, 2Y 2T11,2T12, 2T21,2T22	1Y: Optical fiber Communication 1T11,1T12, 1T21,1T22, 1X, 1Y, 2X ,2Y 2T11,2T12, 2T21,2T22	1P: Artificial Intelligence and Machine Learning 1T13,1T23, 2T13,2T23, 1P, 1Q, 2P, 2Q	1Q: Telecomm Network Operations & Management 1T13,1T23, 2T13,2T23, 1P,1Q, 2P, 2Q		

*EC306 (Fundamentals of Antenna) and EC307 (Computer Communication Networks) in PE5 and PE6 are available only for Category 2 Students.