

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**
**M. TECH IN COMPUTER AND COMMUNICATION ENGINEERING.  
 EFFECTIVE FROM ACADEMIC YEAR 2017- 18 ADMITTED BATCH**
**COURSE STRUCTURE AND SYLLABUS**
**I Semester**

Category	Course Title	Int. marks	Ext. marks	L	T	P	C
PC-1	Advanced Data Communications	25	75	4	0	0	4
PC-2	TCP/IP Internetworking	25	75	4	0	0	4
PC-3	Wireless Communications and Networks	25	75	4	0	0	4
PE-1	Mobile Computing Technologies Queueing Theory and Applications 3G Networks	25	75	3	0	0	3
PE-2	Voice over Internet Protocol Cognitive Radio Networks Spread Spectrum Communications	25	75	3	0	0	3
OE-1	<b>*Open Elective – I</b>	25	75	3	0	0	3
Laboratory I	Wireless Communications and Networks Lab	25	75	0	0	3	2
Seminar I	Seminar - I	100	0	0	0	3	2
<b>Total</b>		<b>275</b>	<b>525</b>	<b>21</b>	<b>0</b>	<b>6</b>	<b>25</b>

**II Semester**

Category	Course Title	Int. marks	Ext. marks	L	T	P	C
PC-4	Coding Theory and Techniques	25	75	4	0	0	4
PC-5	Network Security and Cryptography	25	75	4	0	0	4
PC-6	Advanced Communications and Networks	25	75	4	0	0	4
PE-3	Broadband Communications Adhoc Wireless Networks Wireless LANs and PANs	25	75	3	0	0	3
PE4	Optical Communications and Networks Wireless Sensor Networks QoS in Packet Networks	25	75	3	0	0	3
OE-2	<b>*Open Elective – II</b>	25	75	3	0	0	3
Laboratory II	Advanced Communications and Networks Lab	25	75	0	0	3	2
Seminar II	Seminar - II	100	0	0	0	3	2
<b>Total</b>		<b>275</b>	<b>525</b>	<b>21</b>	<b>0</b>	<b>6</b>	<b>25</b>

**III Semester**

Course Title	Int. marks	Ext. marks	L	T	P	C
Technical Paper Writing	100	0	0	3	0	2
Comprehensive Viva-Voce	0	100	0	0	0	4
Project work Review II	100	0	0	0	22	8
<b>Total</b>	<b>200</b>	<b>100</b>	<b>0</b>	<b>3</b>	<b>22</b>	<b>14</b>

**IV Semester**

Course Title	Int. marks	Ext. marks	L	T	P	C
Project work Review III	100	0	0	0	24	8
Project Evaluation (Viva-Voce)	0	100	0	0	0	16
<b>Total</b>	<b>100</b>	<b>100</b>	<b>0</b>	<b>0</b>	<b>24</b>	<b>24</b>

\*Open Elective subjects must be chosen from the list of open electives offered by **OTHER** departments.

# For Project review I, please refer 7.10 in R17 Academic Regulations.

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**M. TECH. I YEAR II SEMESTER COMPUTER AND COMMUNICATION ENGINEERING**

**CODING THEORY AND TECHNIQUES (PC - 4)**

**UNIT – I**

**Coding for Reliable Digital Transmission and storage:** Mathematical model of Information, A Logarithmic Measure of Information, Average and Mutual Information and Entropy, Types of Errors, Error Control Strategies.

**Linear Block Codes:** Introduction to Linear Block Codes, Syndrome and Error Detection, Minimum Distance of a Block code, Error-Detecting and Error-correcting Capabilities of a Block code, Standard array and Syndrome Decoding, Probability of an undetected error for Linear Codes over a BSC, Hamming Codes. Applications of Block codes for Error control in data storage system

**UNIT - II**

**Cyclic Codes:** Description, Generator and Parity-check Matrices, Encoding, Syndrome Computation and Error Detection, Decoding, Cyclic Hamming Codes, Shortened cyclic codes, Error-trapping decoding for cyclic codes, Majority logic decoding for cyclic codes.

**UNIT – III**

**Convolutional Codes:** Encoding of Convolutional Codes, Structural and Distance Properties, maximum likelihood decoding, Sequential decoding, Majority- logic decoding of Convolution codes. Application of Viterbi Decoding and Sequential Decoding, Applications of Convolutional codes in ARQ system.

**UNIT – IV**

**Turbo Codes:** LDPC Codes- Codes based on sparse graphs, Decoding for binary erasure channel, Log-likelihood algebra, Brief propagation, Product codes, Iterative decoding of product codes, Concatenated convolutional codes- Parallel concatenation, The UMTS Turbo code, Serial concatenation, Parallel concatenation, Turbo decoding

**UNIT - V**

**Space-Time Codes:** Introduction, Digital modulation schemes, Diversity, Orthogonal space- Time Block codes, Alamouti's schemes, Extension to more than Two Transmit Antennas, Simulation Results, Spatial Multiplexing : General Concept, Iterative APP Preprocessing and Per-layer Decoding, Linear Multilayer Detection, Original BLAST Detection, QL Decomposition and Interface Cancellation, Performance of Multi – Layer Detection Schemes, Unified Description by Linear Dispersion Codes.

**TEXT BOOKS:**

1. Shu Lin, Daniel J. Costello, Jr, "Error Control Coding- Fundamentals and Applications ", Prentice Hall, Inc.
2. Man Young Rhee, "Error Correcting Coding Theory ", 1989, McGraw-Hill

**REFERENCE BOOKS:**

1. Bernard Sklar, "Digital Communications-Fundamental and Application", PE.
2. John G. Proakis, "Digital Communications", 5<sup>th</sup> Edition, 2008, TMH.
3. Salvatore Gravano, "Introduction to Error Control Codes", Oxford
4. Todd K. Moon, "Error Correction Coding – Mathematical Methods and Algorithms", 2006, Wiley India.
5. Ranjan Bose, "Information Theory, Coding and Cryptography ", 2<sup>nd</sup> Edition, 2009, TMH.

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**NETWORK SECURITY AND CRYPTOGRAPHY (PC - 5)**

**UNIT- I**

**Introduction:** Attacks, Services and Mechanisms, Security attacks, Security services, A Model for Internetwork security, Classical Techniques: Conventional Encryption model, Steganography, Classical Encryption Techniques.

**Modern Techniques:** Simplified DES, Block Cipher Principles, Data Encryption standard, Strength of DES, Block Cipher Design Principles.

**UNIT- II**

**Encryption Algorithms:** Triple DES, International Data Encryption algorithm, Blowfish, RC5, Characteristics of Advanced Symmetric block ciphers.

**Conventional Encryption:** Placement of Encryption function, Traffic confidentiality, Key distribution, Random Number Generation.

**UNIT - III**

**Public Key Cryptography:** Principles, RSA Algorithm, Key Management, Diffie-Hellman Key exchange, Elliptic Curve Cryptography.

**Number Theory:** Prime and Relatively prime numbers, Modular arithmetic, Fermat's and Euler's theorems, Testing for primality, Euclid's Algorithm, the Chinese remainder theorem, Discrete logarithms.

**UNIT- IV**

**Message Authentication and Hash Functions:** Authentication requirements and functions, Message Authentication, Hash functions, Security of Hash functions and MACs.

**Hash and Mac Algorithms:** MD File, Message digest Algorithm, Secure Hash Algorithm.

Digital signatures and Authentication protocols: Digital signatures, Authentication Protocols, Digital signature standards.

**Authentication Applications:** Kerberos, Electronic Mail Security: Pretty Good Privacy, S/MIME.

**UNIT – V**

**IP Security:** Overview, Architecture, Authentication, Encapsulating Security Payload, Key Management. Web Security: Web Security requirements, Secure sockets layer and Transport layer security, Secure Electronic Transaction.

**Intruders, Viruses and Worms:** Intruders, Viruses and Related threats.

**Fire Walls:** Fire wall Design Principles, Trusted systems.

**TEXT BOOKS:**

1. William Stallings, "Cryptography and Network Security: Principles and Practice", Pearson Education.
2. William Stallings, "Network Security Essentials (Applications and Standards)", Pearson Education.

**REFERENCE BOOKS:**

1. Eric Maiwald, "Fundamentals of Network Security", Dreamtech press
2. Charlie Kaufman, Radia Perlman and Mike Speciner, "Network Security - Private Communication in a Public World", Pearson/PHI.
3. Whitman, "Principles of Information Security", Thomson.
4. Robert Bragg, Mark Rhodes, "Network Security: The complete reference", TMH
5. Buchman, "Introduction to Cryptography", Springer.

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**ADVANCED COMMUNICATIONS AND NETWORKS (PC - 6)**

**UNIT - I**

**Spread Spectrum Communications:** Spreading sequences- Properties of Spreading Sequences, Pseudo- noise sequence, Gold sequences, Kasami sequences, Walsh Sequences, Orthogonal Variable Spreading Factor Sequences, Barker Sequence, and Complementary Codes.

**Direct sequence spread spectrum** – DS-CDMA Model, Conventional receiver, Rake Receiver, Synchronization in CDMA, Power Control, Soft handoff, Multiuser detection – Optimum multiuser detector, Linear multiuser detection.

**UNIT - II**

**Orthogonal Frequency Division Multiplexing:** Basic Principles of Orthogonality, Single vs Multicarrier Systems, OFDM Block Diagram and Its Explanation, OFDM Signal Mathematical Representation, Selection parameter for Modulation, Pulse shaping in OFDM Signal and Spectral Efficiency, Window in OFDM Signal and Spectrum, Synchronization in OFDM, Pilot Insert in OFDM Transmission and Channel Estimation, Amplitude Limitations in OFDM, FFT Point Selection Constraints in OFDM, CDMA vs OFDM, Hybrid OFDM.

**UNIT - III**

**MIMO Systems:** Introduction, Space Diversity and System Based on Space Diversity, Smart Antenna system and MIMO, MIMO Based System Architecture, MIMO Exploits Multipath, Space – Time Processing, Antenna Consideration for MIMO, MIMO Channel Modelling, MIMO Channel Measurement, MIMO Channel Capacity, Cyclic Delay Diversity (CDD), Space Time Coding, Advantages and Applications of MIMO in Present Context, MIMO Applications in 3G Wireless System and Beyond, MIMO-OFDM

**UNIT - IV**

**Wireless LANs/IEEE 802.11x:** Introduction to IEEE802.11x Technologies, Evolution of wireless LANs, IEEE 802.11 Design Issues, IEEE 802.11 Services, IEEE 802.11 MAC Layer operations, IEEE 802.11 Layer1, IEEE 802.11 a/b/g Higher Rate Standards, Wireless LAN Security, Computing Wireless Technologies, Typical WLAN Hardware

**UNIT - V**

**Wireless PANs/IEEE 802.15x: Introduction to IEEE 802.15x Technologies,** Wireless PAN Applications and Architecture, IEEE 802.15.1 Physical Layer Details, Bluetooth Link Controllers Basics, Bluetooth Link Controllers Operational States, IEEE 802.15.1 Protocols and Host Control Interface. Evaluation of IEEE 802.15 Standards

**Broad Band Wireless MANs/IEEE 802.16x:** Introduction to WMAN/IEEE 802.16x Technology, IEEE 802.16Wireless MANs, IEEE 802.16 MAC Layer Details, IEEE 802.16 Physical Layer Details, IEEE 802.16 Physical Layer Details for 2-11 GHz, IEEE 802.16 Common System Operations.

**TEXT BOOKS:**

1. Gary J. Mullett, "Introduction to Wireless Telecommunications Systems and Networks", CENGAGE
2. Upena Dalal, "Wireless Communication", Oxford University Press, 2009

**REFERENCES:**

1. Ke-Lin Du & M N S Swamy, "Wireless Communication System", Cambridge University Press, 2010
2. Gottapu Sasibhusan Rao, " Mobile Cellular Communication ", PEARSON

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**BROADBAND COMMUNICATIONS (PE - 3)**

**UNIT – I**

**ISDN:** Switching Techniques, Principles of ISDN, Architecture, ISDN standards, I-series, Recommendations, Transmission structure, User network interface, ISDN protocol, architecture, ISDN connections, Addressing, Interworking

**UNIT – II**

**B-ISDN:** Architecture and standards, B-ISDN Services, Conversational, Messaging, Retrieval, Distribution, Business and Residential requirements, B-ISDN protocols User plane, Control plane, Physical layer, Line coding, Transmission structure, SONET- Requirement, Signal Hierarchy, System Hierarchy.

**UNIT – III**

**ATM:** Overview, Virtual channels, Virtual paths, VP and VC switching, ATM cells, Header format, Generic flow control, Header error control, Transmission of ATM cells, Adaptation layer, AAL services and protocols.

**UNIT – IV**

**ATM switching:** ATM switching building blocks, ATM cell processing in a switch, Matrix type switch, Input, Output buffering, Central buffering, Performance aspects of buffering switching networks.

**UNIT – V**

**ATM Traffic and congestion Control:** Requirements for ATM Traffic and Congestion Control, Cell-Delay Variation, ATM Service Categories, Traffic and Congestion Control Framework, Traffic Control, Congestion Control

**TEXT BOOKS:**

1. William Stallings, "ISDN and Broadband ISDN with Frame Relay and ATM", Prentice-Hall, 4th edition

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**ADHOC WIRELESS NETWORKS (PE - 3)**

**UNIT - I**

**Wireless Local Area Networks:** Introduction, wireless LAN Topologies, Wireless LAN Requirements, Physical Layer- Infrared Physical Layer, Microwave based Physical Layer Alternatives, Medium Access Control Layer- HIPERLAN 1 Sublayer, IEEE 802.11 MAC Sublayer and Latest Developments-802.11a, 802.11b, 802.11g

**Personal Area Networks:** Introduction to PAN technology and Applications, Bluetooth - specifications, Radio Channel, Piconets and Scatternets, Inquiry, Paging and Link Establishment, Packet Format, Link Types, Power Management, Security, Home RF -Physical and MAC Layer

**UNIT - II**

**MAC Protocols:** Introduction, Issues in Designing a MAC protocol for Ad Hoc Wireless Networks, Design goals of a MAC Protocol for Ad Hoc Wireless Networks, Classifications of MAC Protocols, Contention - Based Protocols, Contention - Based Protocols with reservation Mechanisms, Contention - Based MAC Protocols with Scheduling Mechanisms, MAC Protocols that use Directional Antennas, Other MAC Protocols.

**UNIT - III**

**Routing Protocols:** Introduction, Issues in Designing a Routing Protocol for Ad Hoc Wireless Networks, Classification of Routing Protocols, Table -Driven Routing Protocols, On - Demand Routing Protocols, Hybrid Routing Protocols, Routing Protocols with Efficient Flooding Mechanisms, Hierarchical Routing Protocols, Power - Aware Routing Protocols.

**UNIT - IV**

**Transport Layer Protocols:** Introduction, Issues in Designing a Transport Layer Protocol for Ad Hoc Wireless Networks, Design Goals of a Transport Layer Protocol for Ad Hoc Wireless Networks, Classification of Transport Layer Solutions, TCP Over Ad Hoc Wireless Networks, Other Transport Layer Protocol for Ad Hoc Wireless Networks.

**UNIT - V**

**Quality of Service in Ad Hoc Wireless Networks:** Introduction, Real Time Traffic Support in Ad Hoc Wireless Networks, QoS Parameters in Ad Hoc Wireless Network, Issues and Challenges in providing QoS in Ad Hoc Wireless Networks, Classification of QoS Solutions: MAC Layer Solutions, Cluster TDMA, IEEE 802.11e, DBASE, Network Layer Solutions, QoS Routing Protocols, Ticket Based QoS Routing Protocol, Predictive Location Based QoS routing protocol, Trigger Based Distributed QoS Routing Protocol, QoS enabled AODV Routing Protocol, Bandwidth QoS Routing Protocol, On Demand QoS Routing Protocol, On Demand Link-State Multipath QoS Routing Protocol, Asynchronous Slot Allocation Strategies. QoS Frameworks for Ad Hoc Wireless Networks.

**TEXT BOOKS:**

1. C. Siva Ram Murthy and B.S.Manoj, "Ad Hoc Wireless Networks: Architectures and Protocols", 2004, PHI.
2. P Nicopolitidis and M S Obaidat, "Wireless Networks ", Wiley India Edition 2003.

**REFERENCE BOOKS:**

1. Roy Blake, "Wireless Communication Technology", CENGAGE, 2012
2. Jagannathan Sarangapani, "Wireless Ad- hoc and Sensor Networks: Protocols, Performance and Control", CRC Press.



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**WIRELESS LANs AND PANs (PE - 3)**

**UNIT – I**

**Wireless System & Random Access Protocols:** Introduction, First and Second Generation Cellular Systems, Cellular Communications from 1G to 3G, Wireless 4G systems, The Wireless Spectrum; Random Access Methods: Pure ALOHA, Slotted ALOHA, Carrier Sense Multiple Access (CSMA), Carrier Sense Multiple Access with Collision Detection (CSMA/CD), Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA).

**UNIT – II**

**Wireless LANs:** Introduction, importance of Wireless LANs, WLAN Topologies, Transmission Techniques: Wired Networks, Wireless Networks, comparison of wired and Wireless LANs; WLAN Technologies: Infrared technology, UHF narrowband technology, Spread Spectrum technology

**UNIT – III**

**The IEEE 802.11 Standard for Wireless LANs:** Network Architecture, Physical layer, The Medium Access Control Layer; MAC Layer issues: Hidden Terminal Problem, Reliability, Collision avoidance, Congestion avoidance, Congestion control, Security, The IEEE 802.11e MAC protocol

**UNIT – IV**

**Wireless PANs:** Introduction, importance of Wireless PANs, The Bluetooth technology: history and applications, technical overview, the Bluetooth specifications, piconet synchronization and Bluetooth clocks, Master-Slave Switch; Bluetooth security; Enhancements to Bluetooth: Bluetooth interference issues, Intra and Inter Piconet scheduling, Bridge selection, Traffic Engineering, QoS and Dynamics Slot Assignment, Scatternet formation.

**UNIT – V**

**The IEEE 802.15 working Group for WPANs:** The IEEE 802.15.3, The IEEE 802.15.4, ZigBee Technology, ZigBee components and network topologies, The IEEE 802.15.4 LR-WPAN Device architecture: Physical Layer, Data Link Layer, The Network Layer, Applications; IEEE 802.15.3a Ultra wideband.

**TEXT BOOKS:**

1. Carlos de Moraes Cordeiro and Dharma Prakash Agrawal, "Ad Hoc and Sensor Networks", World Scientific, 2011.
2. Vijay K. Garg, "Wireless Communications and Networking", Morgan Kaufmann Publishers, 2009.

**REFERENCE BOOKS:**

1. Kaveh Pahlaram, Prashant Krishnamurthy, "Wireless Networks", PHI, 2002.
2. Marks Ciampor, George Olenewa, "Wireless Communication", Cengage Learning, 2007.

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**OPTICAL COMMUNICATIONS & NETWORKS (PE - 4)**

**UNIT - I**

**Optical Fibers: Structures, waveguiding and Fabrication-** Nature of Light, Basic optical laws and definitions, Single mode fibers, Graded index fiber structure, Attenuation, Signal Dispersion in fibers.

**Optical Sources** - LEDs, Laser Diodes, Line Coding.

**UNIT - II**

**Photodetectors:** Photodetector Noise, Detector Response Time, Avalanche Multiplication Noise.

**Optical Receiver Operation:** Fundamental receiver operation, Digital receiver performance, Eye diagrams. **WDM Concepts and Components-** Passive optical Couplers, Isolators and Circulators

**UNIT - III**

**Digital Links:** Point to point links, power penalties, error control, Coherent detection, Differential Quadrature Phase Shift Keying.

**Analog Links:** Carrier to noise ration, Multichannel Transmission Techniques, RF over Fiber, Radio over fiber links, Microwave Photonics.

**UNIT - IV**

**Optical Networks:** Network Concepts, Network Topologies, SONET/SDH, High speed lightwave links, Optical add/ Drop Multiplexing, Optical Switching, WDM Network, Passive Optical Networks, IP Over DWDM, Optical Ethernet, Mitigation of Transmission Impairments

**UNIT - V**

**Performance Measurement and Monitoring:** Measurement standards, Basic Test Equipment, Optical power measurement, Optical fiber characterization, Eye diagram tests, optical time domain reflectometer, optical performance monitoring, optical fiber system performance measurements.

**TEXTBOOK:**

1. Gerd Keiser, "Optical Fiber Communications", 5<sup>th</sup> Edition, McGraw Hill.

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**WIRELESS SENSOR NETWORKS (PE - 4)**

**UNIT – I**

**Introduction:** Components of a wireless sensor node, Motivation for a Network of Wireless Sensor Nodes, Classification of sensor networks, Characteristics of wireless sensor networks, Challenges of wireless sensor networks, Comparison between wireless sensor networks and wireless mesh networks, Limitations in wireless sensor networks, Design challenges, Hardware architecture, Applications : Structural Health Monitoring, Traffic Control, Health Care, .Pipeline Monitoring, Precision Agriculture, Active Volcano, Underground Mining.

**Node Architecture:** The Sensing Subsystem, The Processor Subsystem , Communication Interfaces, Prototypes. **Operating Systems:** Functional Aspects, Nonfunctional Aspects, Prototypes, Evaluation

**UNIT – II**

**Basic Architectural Framework:** Physical Layer, Basic Components, Source Encoding, Channel Encoding, Modulation.

**Medium Access Control:** Wireless MAC Protocols, Characteristics of MAC Protocols in Sensor Networks, Contention-Free MAC Protocols, Contention-Based MAC Protocols, Hybrid MAC Protocols

**UNIT – III**

**Network Layer:** Routing Metrics, Flooding and Gossiping, Data-Centric Routing, Proactive Routing, On-Demand Routing, Hierarchical Routing, Location-Based Routing, QoS-Based Routing Protocols

**Node and Network Management:** Power Management, Local Power Management aspects, Dynamic Power Management, Conceptual Architecture

**UNIT – IV**

**Time Synchronization:** Clocks and the Synchronization Problem, Time Synchronization in Wireless Sensor Networks, Basics of Time Synchronization, Time Synchronization Protocols

**Localization:** Ranging Techniques, Range-Based Localization, Range-Free Localization, Event-Driven Localization

**UNIT – V**

**Security:** Fundamentals of Network Security, Challenges of Security in Wireless Sensor Networks , Security Attacks in Sensor Networks, Protocols and Mechanisms for Security, IEEE 802.15.4 and Zig Bee Security

**TEXT BOOKS:**

1. Waltenegus Dargie, Christian Poellabauer, “ Fundamentals of Wireless Sensor Networks: Theory and Practice”, Wiley 2010
2. Mohammad S. Obaidat, Sudip Misra, “ Principles of Wireless Sensor Networks”, Cambridge, 2014

**REFERENCES:**

1. Ian F. Akyildiz, Mehmet Can Vuran , “Wireless Sensor Networks”, Wiley 2010
2. C S Raghavendra, K M Sivalingam, Taieb Znati, “Wireless Sensor Networks”, Springer, 2010
3. C. Sivarmurthy & B.S. Manoj, “ Adhoc Wireless Networks”, PHI-2004
4. FEI HU., XIAOJUN CAO, “Wireless Sensor Networks”, CRC Press, 2013
5. Feng ZHAO, Leonidas GUIBAS, “Wireless Sensor Networks”, ELSEVIER , 2004

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**QoS IN PACKET NETWORKS (PE - 4)**

**UNIT - I**

**Introduction:** Need For QoS , Definition of QoS, Review of Probability Theory, Statistical Characterization of a Stochastic Process, Stationarity, Strict Sense Stationarity (SSS), Wide Sense Stationarity (WSS) Queuing Theory Basics, Real-Life Examples of Queuing, Definition of Queuing System, Birth-Death Process Model, Arrival Rate, Definition Empirical Determination of Arrival Rate, Stationarity , Ergodicity , The Poisson Arrival Markov Modulated Poisson Process (MMPP), Service Rate, Utilization Factor, Queuing System Performance Metrics, Little's Theorem , M/M/1 Queue.

**UNIT - II**

**QoS Metrics:** Network Types, Connection-Oriented Packet Network Services, Connectionless Packet Network, Digital Communications System, Source Coding, Waveform Coding, Linear Predictive Coding, packetization, Voice Over IP, Packetization, Channel Coding, Interleaving, Error Correction, Modulation, QoS of Real Time Services.

**Delay:** Frame Delay, Packetization Delay, Interleaving Delay, Error Correction Coding Delay, Jitter Buffer Delay, Packet Queuing Delay, Propagation Delay, Effect of Delay, End-To-End Delay, Objectives, Delay Variation , Source of Delay Variation, Packet Loss Probability.

**Blocking Probability:** Trunked Channel Systems, Offered Traffic Load, Units of Traffic Load, Trunk Utilization Factor, Erlang B System, Erlang C System.

**UNIT - III**

**IP QoS Generic Functional Requirements:** Introduction, Packet Marking, Packet Classification, Traffic Policing, Traffic Rates, Line Rate, Peak Information Rate (PIR) Committed Informationrate (CIR),Burst Sizes, Traffic Metering And Coloring, Single Rate Three Color Marker (SRTCM),Two Rate Three Color Marker (TRTCM), Active Queue Management, Tail Drop Method And TCP Global Synchronization

Random Early Discarding (RED),Weighted Random Early Discarding (WRED),Explicit Congestion Notification (ECN),General Concept, ECN Marking in the IP Header, ECN Marking in The TCP Header, ECN Handshaking And Operation.

**Packet Scheduling:** FIFO, Priority Queuing (PQ),Fair Queuing (FQ),Weighted Round Robin (WRR),Weighted Fair Queuing (WFQ), Class-Based WFQ (CB WFQ), Traffic Shaping, Pure Traffic Shaper, Token Bucket Traffic Shaper.

**UNIT - IV****IP Integrated Services And Differentiated Services :**

**Integrated Services:** Intserv Basic Functional Requirements Resource Reservation Protocol (RSVP) Overview Of RSVP, RSVP Operation, RSVP Reservation Styles, RSVP Message Format Path Message RESV Message.

**Differentiated Services:** Diffserv Overview, Diffserv Architecture Diffserv Packet Marking, Packet Marking In Conventional Routers, Diffserv (DS) Field Diffserv Code Points (DSCP's) Per-Hop Behaviors (PHB's) Expedited Forwarding (EF) Phb Assured Forwarding (AF) PHB.

**UNIT - V**

**QoS in ATM Networks :** Genesis of ATM ATM Network Interfaces , ATM Protocols ATM Cell Layer, ATM Adaptation Layer (AAL) , ATM Virtual Connections, Virtual Channel and Virtual Path ,Virtual Links Virtual Connections Virtual Path connection (VPC) Virtual Channel Connection (VC), Permanent Virtual Connection (PVC), Switched Virtual Connection (SVC) ATM QoS Parameters, Information Transfer Performance, End-To-End Performance, Performance Management Information Base (MIB),

ATM Service Categories, ATM Service Categories, Traffic Descriptors, AAL Types , ATM Connection Admission Control, A Model of ATM Switch, Logical Port Bandwidth Allocation, CAC For CBR Traffic, CAC For VBR Traffic

**MPLS** : Why Use MPLS, Conventional IP Packet Forwarding, MPLS Advantages, MPLS Architecture, Label Encoding, MPLS Shim Header , Label Encoding Over ATM, ATM SVC Encoding, ATM SVP Encoding, ATM SVP Multipoint Encoding , MPLS Implementation, MPLS Operation, Label Mapping, Incoming Label Map (ILM), FEC-To-NHLFE (FTN) Map Label Swapping.

**TEXT BOOKS:**

1. Kun I. Par, "QoS in Packet Networks", Springer, 2010
2. Tim Szigeti, Christina Hattingh, "End-to-End QoS Network Design: Quality of Service for Rich-Media & Cloud Networks", Cisco.

**REFERENCES:**

1. Miguel Barreiros, Peter Lundqvist, "QOS-Enabled Networks: Tools and Foundations", Wiley.
2. William Stallings, "High-speed networks and Internets", 2nd Edition - Pearson education
3. Mahbub Hasan Raj Jain, "High performance TCP/IP Networking", PHI -2004

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**ADVANCED COMMUNICATIONS AND NETWORKS LAB**

**Note:**

- Minimum of 10 Experiments have to be conducted
- All the Experiments may be Conducted using Network Simulation software like NS-2/ NSG-2.1/ Wire SHARK/ SDR etc.

Note: For Experiments 1 to 7 Performance may be evaluated through simulation by using the parameters Throughput, Packet Delivery Ratio, Delay etc.

1. Evaluate the performance of various LAN Topologies
2. Evaluate the performance of Drop Tail and RED queue management schemes
3. Evaluate the performance of CBQ and FQ Scheduling Mechanisms
4. Evaluate the performance of TCP and UDP Protocols
5. Evaluate the performance of TCP, New Reno and Vegas
6. Evaluate the performance of AODV, DSR and DSDV routing protocols
7. Evaluate the performance of IEEE 802.11 and IEEE 802.15.4
8. Capturing and Analysis of TCP and IP Packets
9. Simulation and Analysis of ICMP and IGMP Packets
10. Analyze the Protocols SCTP, ARP, NetBIOS, IPX VINES
11. Analysis of HTTP, DNS and DHCP Protocols
12. Analysis of OFDM Spectrum
13. Analysis CDMA Downlink

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