DEPARTMENT OF INFORMATION SCIENCE & ENGINEERING

Syllabus and Scheme of Examination

M.Tech. in Computer Network Engineering

2017-18

Institution

Vision - Pursuing Excellence, Empowering people, Partnering in Community Development.

Mission - To develop NMAM Institute of Technology, Nitte, as Center of Excellence by imparting Quality Education to generate Competent, Skilled and Humane Manpower to face emerging Scientific, Technological, Managerial and Social Challenges with Credibility, Integrity, Ethics and Social Concern.

Department:

Vision Statement:

To uniquely position the Department as a leader in innovation and excellence in information science and engineering through education, research and scholarship in a professional framework by addressing evolving global needs. Also the Department aims at creating top quality successful and sustainable programs and curricula for the students to address the emerging educational challenges and market demands.

Mission Statement:

- To provide outstanding education and research training to the students for their productive careers in industry, academia and government.
- To provide a learning environment that promotes excellence and innovation, ethical practice and responsibility towards society.
- To prepare the students to practice their professions competently to meet the ever- changing needs of society and to continue learning their discipline, allowing them to move into other related fields.
- To promote active learning, critical thinking, and engineering judgment coupled with business and entrepreneurial skills.

Programme Educational Objectives

PEO1: Post Graduates must gain both theoretical and practical knowledge to identify, formulate & solve challenges in Computer Network Engineering problems.

PEO2: Post Graduates must communicate effectively, recognize and incorporate societal needs and constraints in their professional endeavour, and practice their profession with high regard to legal and ethical responsibilities.

Programme Outcomes:

1. *Scholarship of Knowledge*: Acquire in-depth knowledge of specific discipline or professional area, including wider and global perspective, with an ability to discriminate, evaluate, analyse and synthesise existing and new knowledge, and integration of the same for enhancement of knowledge.
2. *Critical Thinking*: Analyse complex engineering problems critically, apply independent judgement for synthesising information to make intellectual and/or creative advances for conducting research in a wider theoretical, practical and policy context.
3. *Problem Solving*: Think laterally and originally, conceptualise and solve engineering problems, evaluate a wide range of potential solutions for those problems and arrive at feasible, optimal solutions after considering public health and safety, cultural, societal and environmental factors

in the core areas of expertise.

4. *Research Skill*: Extract information pertinent to unfamiliar problems through literature survey and experiments, apply appropriate research methodologies, techniques and tools, design, conduct experiments, analyse and interpret data, demonstrate higher order skill and view things in a broader perspective, contribute individually/in group(s) to the development of scientific/technological knowledge in one or more domains of engineering.
5. *Usage of modern tools*: Create, select, learn and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling, to complex engineering activities with an understanding of the limitations.
6. *Collaborative and Multidisciplinary work*: Possess knowledge and understanding of group dynamics, recognise opportunities and contribute positively to collaborative-multidisciplinary scientific research, demonstrate a capacity for self-management and teamwork, decision-making based on open-mindedness, objectivity and rational analysis in order to achieve common goals and further the learning of themselves as well as others.
7. *Project Management and Finance*: Demonstrate knowledge and understanding of engineering and management principles and apply the same to one's own work, as a member and leader in a team, manage projects efficiently in respective disciplines and multidisciplinary environments after consideration of economical and financial factors.
8. *Communication*: Communicate with the engineering community, and with society at large, regarding complex engineering activities confidently and effectively, such as, being able to comprehend and write effective reports and design documentation by adhering to appropriate standards, make effective presentations, and give and receive clear instructions.
9. *Life-long Learning*: Recognise the need for, and have the preparation and ability to engage in life-long learning independently, with a high level of enthusiasm and commitment to improve knowledge and competence continuously.
10. *Ethical Practices and Social Responsibility*: Acquire professional and intellectual integrity, professional code of conduct, ethics of research and scholarship, consideration of the impact of research outcomes on professional practices and an understanding of responsibility to contribute to the community for sustainable development of society.
11. *Independent and Reflective Learning*: Observe and examine critically the outcomes of one's actions and make corrective measures subsequently, and learn from mistakes without depending on external feedback.
12. An ability to strengthen the knowledge and understanding in the areas of computer networking, Security and Wireless Communication for infrastructure or non-infrastructure based networks-Programme Specific Criteria

NMAM INSTITUTE OF TECHNOLOGY, NITTE
SCHEME OF TEACHING AND EXAMINATION FOR M. TECH. COMPUTER NETWORK ENGINEERING
(AUTONOMOUS SCHEME)

Revised at the BOS meeting on 13th May, 2017

I SEMESTER

Sub. Code	Name of the Subject	Contact hours/week	Duration of Sem. End Exam in hours	Marks for		Total Credits
		L/T/P/S		CIE	SEE	
17CNE101	Wireless Network	4/0/2/0	3	50	50	5
17CNE102	Cryptography and Network Security	4/0/0/2	3	50	50	5
17CNE103	Cloud Infrastructure and Services	4/2/0/0	3	50	50	5
17CNE11X	Elective - I	4/0/0/0	3	50	50	4
17CNE12X	Elective -II	4/0/0/0	3	50	50	4
17CNE104	Research Experience through Practice-I	0/0/4/0	0	100	--	2
TOTAL			15	350	250	25

ELECTIVE –I		ELECTIVE-II	
17CNE111	Probability Statistics and Queuing Theory	17CNE121	Web Technologies
17CNE112	Network Flow Algorithms	17CNE122	Advanced Topics in Graph Theory
17CNE113	Network Management	17CNE123	Ad-Hoc Wireless Networks
17CNE114	Computer Systems Performance Analysis	17CNE124	Mobile Computing
17CNE115	Protocol Engineering	17CNE125	Switching and Statistical Multiplexing
17CNE116	Artificial Intelligence	17CNE126	Multicore Architecture and Programming

M.TECH. COMPUTER NETWORK ENGINEERING
(AUTONOMOUS SCHEME)

II SEMESTER

Sub. Code	Name of the Subject	Teaching hours/week	Duration of Sem. End Exam in hours	Marks for		Total Credits
		L/T/P/S		CIE	SEE	
17CNE201	Cellular Networks	4/0/2/0	3	50	50	5
17CNE202	Advanced Computer Networks	4/2/0/0	3	50	50	5
17CNE203	Optical Networks	4/2/0/0	3	50	50	5
17CNE21X	Elective - III	4/0/0/0	3	50	50	4
17CNE22X	Elective -IV	4/0/0/0	3	50	50	4
17CNE204	Research Experience through Practice-II	0/0/4/0	0	100	--	2
TOTAL			15	350	250	25

ELECTIVE –III

17CNE211	Information Theory and Coding
17CNE212	Advanced Digital Communication
17CNE213	Internet Routing Design Principles
17CNE214	Topics in Analysis of Computer Network
17CNE215	Advanced Network Security
17CNE216	Machine Learning

ELECTIVE - IV

17CNE221	Multimedia Communication
17CNE222	Wireless Sensor Networks
15CNE223	Wireless MIMO Communication
17CNE224	Digital Forensics for Networks
17CNE225	Wireless Broadband Networks
17CNE226	Cyber Security and Cyber Law

List of Audit courses currently offered:
Security in Cloud

M.TECH. COMPUTER NETWORK ENGINEERING
(AUTONOMOUS SCHEME)

III SEMESTER

Revised at the BOS meeting on 13th May, 2017

Sub. Code	Name of the Subject	Duration	Marks for		Total Credits
		Practical/Field Work/Assignment	CIE	SEE	
17CNE301	Industrial Training Mini-Project	Full time 8 weeks	50 (report) 50 (presentation)	--	8
17CNE302	Seminar on special topics	----	100	--	2
17CNE303	Project-Part I	Full time 10 weeks	100 (report) 100(presentation)	--	10
TOTAL			400		20

IV SEMESTER

Sub. Code	Name of the Subject	Duration	Duration of Exam in Hrs.	Marks for		Total Credits
		Practical Field work		CIE	SEE	
17CNE401	Project -Part II	Full time 20 weeks		200 [PPE*-I – 100 PPE-II – 100]	200	30
			TOTAL	400		30
GRAND TOTAL From 1st to 4th semester: 100 credits (2000 marks)						

PPE – Project Progress Evaluation

DETAILED COURSE CONTENTS

Wireless Networks

Subject Code: 17CNE101 **Credits: 05**
Hrs /week: 4+0+2+0 **Total Hours: 52**

Course Learning Objectives
This Course will enable students to

- Understand different wireless networks and understand basic medium access mechanism.
- Identify requirements of different control, management and data frames.
- Evaluate the security risks involved and different security mechanisms adopted with wireless networks.
- Explain the working principles of FH and DS spread spectrum transmission.
- Differentiate various wireless standards and implication of TCP protocols with wireless networks.

Prerequisites:
Student must have fundamental knowledge of computer networks.

Unit I **10 Hours**

Applications and Requirements of Wireless Services: Introduction; Types of Services: Broadcast, Paging, Cellular Telephony, Wireless Local Area Networks, Personal Area Networks, Fixed Wireless Access, Ad hoc Networks and Sensor Networks; Requirements for the Services; Technical Challenges of Wireless Communications: Multipath Propagation; Spectrum Limitations; Limited Energy; User Mobility. Hidden node and exposed node problems. Basics of CSMA/CA, Backoff procedure. MAC Access Modes and Timing, Contention-Based Access Using the DCF, Fragmentation and Reassembly, Frame Format, Contention-Based Data Service, Frame Processing and Bridging.

Unit II **08 Hours**

802.11 Framing: Generic Data Frame. Control Frames: Generic Structure, RTS, CTS, ACK, PSPoll. Management Frames: Generic Structure, Fixed-length components, Information elements: Beacon, SSID, TIM, ERP, and RSN. Management Operations: Management Architecture, Scanning, Authentication, Association, Power Conservation, Timer Synchronization.

Unit III **12 Hours**

Security: Wired Equivalent Privacy: Operations, Problems with WEP. 802.1 xs: The Extensible Authentication Protocol, EAP Methods, 802.1x Network Port Authentication, 802.1X on Wireless LANs. 802.11i: Robust Security Networks, Temporal Key Integrity Protocol (TKIP), Counter Mode with CBC-MAC (CCMP), Robust Security Network (RSN) Operations.

Unit IV **12 Hours**

802.11 Physical Layer: Overview, the Radio Link, RF propagation. Frequency-Hopping (FH) PHY: Frequency-Hopping Transmission, GFSK, PLCP frame format. Direct Sequence PHYs: Direct Sequence Transmission, DPSK, PLCP frame format, Complementary Code Keying, HR/DSSS PLCP

framing.

Unit V **10 Hours**

Wireless WAN/MAN: Cellular Concept: Capacity enhancement, Channel Allocation, Handoffs. Wireless Internet: Mobile IP: Basics, Route Optimization, Variations, handoffs, IPv6 Advancements. TCP in Wireless domain: Traditional TCP, Link layer solutions, Split approach based solutions, end-to-end solutions.

Course Outcomes:

At the end of the course the student will be able to

Sl. No.	Course Outcome (CO)	Bloom's Taxonomy Level (BTL)
C101.1	Comprehend technical challenges of wireless communications and solutions available.	4
C101.2	Detailed understanding of structure of the frames used with 802.11 wireless networks.	2
C101.3	Evaluate the security risks involved and different security mechanisms adopted with wireless networks.	4
C101.4	Explain the working principles of FH and DS spread spectrum transmission.	3
C101.5	Differentiate various wireless standards and implication of TCP protocols with wireless networks.	4

Mapping Course Outcomes with Programme Outcomes:

Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
C101.1	**M**	**L**	**L**								**L**	**H**
C101.2	**H**											**H**
C101.3	**M**	**M**					**L**					**H**
C101.4	**M**											**H**
C101.5	**M**	**L**	**H**	**M**			**L**				**M**	**H**

(L = Low 30%-49%, M = Medium 50%-69%, H = High >70%)

Textbooks:

1. 802.11 Wireless Networks: The definitive guide, 2nd Edition, Matthew Gast, O'Reilly Publisher, 2005. (Chapter 2, 3, 4, 5, 6, 7, 8, 10, 11, 12)
2. Ad Hoc Wireless Networks: Architectures and Protocols, 2nd edition, C. Siva Ram Murthy and B S Manoj, Pearson Education, 2005. (Chapter 2, 3, 4)
3. Wireless Communications, 2nd Edition Andreas F. Molisch, John Wiley & Sons, 2011.

LABORATORY WORK

1. Design, develop, and execute a program in C under UNIX / LINUX environment to implement a simple echo server and demonstrate its working. Both the server and client are to be connection- oriented and use TCP. The system works as follows: Client reads a line from the standard input and writes the line to the server; the server reads a line from its network input and echoes the line back to the client; the client reads the echoed line and prints it on its standard output.
2. Repeat the above experiment using UDP instead of TCP.
3. Repeat the Experiment 1 using JAVA network programming facilities.
4. Modify the above program such that the client sends an integer value supposed to represent the radius of a circle and the server is to compute and return the corresponding area.
5. Extend the above program such that the server responds to multiple clients.

Mini Project: Design, develop, and execute a program in C under UNIX / LINUX environment to implement any utility in TCP/IP suite like PING, TFTP etc.

Cryptography & Network Security

Subject Code: 17CNE102 **Credits: 05**
Hrs /week: 4+0+0+2 **Total Hours: 52**

Course Learning Objectives (CLOs):

This course will enable student to

- Exploring the requirement of cryptography, its application to network security, threats/vulnerabilities to networks and countermeasures.
- Study various approaches to encryption techniques, strengths of Traffic Confidentiality, Message Authentication Codes.
- Know Digital Signature Standard and provide solutions for their issues.
- Be familiar with cryptographic techniques for secure (confidential) communication of two parties over an insecure (public) channel; verification of the authenticity of the source of a message.
- Examine the issues and structures of network security, internet security and system level security protocols.

Prerequisites: NIL

Course Content:

UNIT-I **11 Hours**

Introduction to Cryptography and Network Security Concepts: Security Trends, OSI Security Architecture, Classical Encryption Techniques, Cipher Principles, Data Encryption Standard, Triple DES, Block Cipher Design Principles and Modes of Operation, Evaluation criteria for AES, AES Cipher.

UNIT-II **11 Hours**

Encryption Algorithms and Mathematical Concepts: Introduction to Number Theory, Placement of Encryption Function, Traffic Confidentiality, Key Distribution, Random Number Generation, Public Key Cryptography and RSA, Key Management, Diffie-Hellman Key Exchange, Elliptic Curve Cryptography.

UNIT-III **10 Hours**

Authentication functions-MAC & HASH: Authentication Requirements, Authentication Functions, Message Authentication Codes, Hash Functions, Security of Hash Functions and

MACs, MD5 message Digest Algorithm, Secure Hash Algorithm (SHA-1), HMAC Digital Signatures, Authentication Protocols, Digital Signature Standard.

UNIT-IV **10 Hours**

Network Security: Authentication Applications: Kerberos, X.509 Authentication Service, PGP, S/MIME, IP Security, And Web Security.

UNIT-V **10Hours**

Internet Security Protocols and System Level Security:

System Level Security: Intrusion Detection, Password Management, Viruses and Related Threats, Virus Counter Measures, Firewall Design Principles, Trusted Systems. Internet Security Protocols: SSL, SHTTP, TSP, SET, SSL versus SET, 3D Secure Protocol, Electronic Money, WAP Security, Security in GSM.

Course Outcomes:

Sl. No.	Course Outcome (CO)	Bloom's Taxonomy Level (BTL
C102.1	Demonstrate cryptography and network security concepts and applications	2
C102.2	Apply mathematical concepts in encryption/decryption algorithms	3
C102.3	Analyse and investigate authentication functions	4
C102.4	Evaluate network security protocols	5
C102.5	Design solutions to Internet Security Protocols and System level security issues	6

Mapping Course Outcomes with Programme Outcomes:

Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	**H**		**L**	**M**					**M**	**L**		**M**
CO 2	**M**	**L**	**H**									**H**
CO 3	**L**	**H**	**M**	**M**								**L**
CO 4		**H**		**H**								**M**
CO 5	**H**	**H**	**H**	**M**	**M**				**L**			**H**

(L = Low 30%-49%, M = Medium 50%-69%, H = High >70%)

Text books:

1. William Stallings, "Cryptography and Network Security – Principles and Practice", Prentice Hall of India, Fifth Edition, 2011.
2. AtulKahate, "Cryptography and Network Security", Tata McGraw-Hill, 2003.

Reference Books:

1. Bruce Schneier, "Applied Cryptography", John Wiley & Sons Inc
2. Charles B. Pfleeger, Shari Lawrence Pfleeger, "Security in Computing", Fourth Edition, Pearson Education
3. Eric Maiwald, "Fundamentals of Network Security", TATA McGraw-Hill,2010

Cloud Infrastructure and Services

Subject Code: 17CNE103 **Credits: 05**
Hrs /week: 4+2+0+0 **Total Hours: 52**

Course Learning Objectives
This Course will enable students to

- Explain the concept of securing the storage infrastructure
- Learn the basic concepts of cloud computing and its benefits, limitations.
- Get the applications of various cloud computing technologies.
- Compare Software as a Service and Software plus services.
- Managing desktop and devices in the cloud.

Prerequisites:
Student must have fundamental knowledge of Storage technologies.

UNIT I **10 Hours**

The History of Cloud Computing: Cloud Computing Basics, Organization and Cloud Computing-when to use cloud and when not to use cloud, benefits, limitations, Cloud Computing with the Titans (Google, Microsoft, Amazon, and Salesforce.com), The Business Case for going Cloud –cloud services, operational-economic-staffing benefits, deleting data centre, Thomson Reuters

UNIT II **10 Hours**

Cloud Computing Technology: Hardware and Infrastructure-client, security, network and services, Accessing the Cloud (basics to APIs)-platform, web application, web API's and web browser, Cloud Storage-overview and cloud storage providers, standards-Application, client, infrastructure and service.

UNIT III **10 Hours**

Cloud Computing at Work-Software as a Service, Software plus Services, Developing Applications-Google, Microsoft, cast iron cloud, bungee connect, Local Clouds and Thin Clients- virtualization in your organization, Migrating to the Cloud-which applications do you need, sending existing data and use the wave approach , Best Practices- finding right vendor, phased-in vs flash-cut approach and be creative in your approach.

UNIT IV **10 Hours**

Cloud Applications and Security Issues: Understanding cloud based security issues and threats (SQL query injections, common hacking efforts), SSL, encrypted query strings, using encryption in the database. Authentication and identity. Use of oAuthOpenID; Understanding QA and Support: Common support issues with cloud apps: user names and passwords, automated emails and spam, browser variants and configurations. Role of developers in QA cycle. QA techniques and technologies. Use of support forums, trouble ticketing. Planning a Cloud Computing Based IT Strategy: Develop an IT strategy to deliver on strategic business objectives in the business strategy. IT Project planning in the areas of ITaaS, SaaS, PaaS and IaaS are essential in delivering a successful strategic IT Plan.

UNIT V **12 Hours**

Governing the cloud-deciding on a governor, knowing risk, measurement methods, making it work. **Virtualization and the cloud**-s/w, h/w provisioning, security issues **Managing desktop and devices in the cloud**-Virtualizing desktop, putting desktop in cloud, managing desktop **SOA and cloud**-SOA characteristics, caching enterprise service bus, serving business with SOA and cloud.

Course Outcomes:

At the end of the course the student will be able to

Sl. No.	Course Outcome (CO)	Bloom's Taxonomy Level (BTL)
C103.1	Comprehend service-oriented and web services architecture	2
C103.2	Describe benefits and limitations of Cloud Computing.	2
C103.3	Illustrate cloud computing and storage technology.	4
C103.4	Explain migrating to the cloud.	3
C103.5	Discuss governing and managing desktop and devices in the cloud.	4

Mapping Course Outcomes with Programme Outcomes:

Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
C103.1	**M**				**M**			**H**			**L**	
C103.2		**M**			**H**					**L**		
C103.3	**H**							**M**		**L**		
C103.4	**M**	**H**			**L**							
C103.5			**H**			**M**		**L**				

(L = Low 30%-49%, M = Medium 50%-69%, H = High >70%)

TEXT BOOKS:

1. Cloud Computing, A Practical Approach, Toby Velte, Anthony Velte, RoberElsenpeter, Tata McGraw-Hill Publishers.
2. Cloud Computing for Dummies- Judith Hurwitz, Robin Bloor.
3. Arnold J Cummins, Easiest Ever Guide to Strategic IT Planning.

REFERENCE BOOK:

1. Storage Networks Explained by Ulf Troppen, Rainer Erkens, Wolfgang Muller.
2. Cloud Computing –Implementation, management and security- John Rittinghouse, 1st Edition, 2009.
3. Tim Mather, SubraKumaraswamy, ShahedLatif, Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance.

Probability Statistics and Queuing Theory

Subject Code: 17CNE111 **Credits: 04**
Hrs /week: 4+0+0+0 **Total Hours: 52**

Course objectives
This course will enable students to

- Develop analytical capability and to impart knowledge of Probability, Statistics and Queuing.
- Apply above concepts in Engineering and Technology.
- Acquire knowledge of Hypothesis testing and queuing methods and their applications so as to enable them to apply them for solving real world problems.

Prerequisites: NIL

UNIT 1 **11 Hours**

Axioms of probability, Conditional probability, Total probability, Baye's theorem, Discrete Random variable, Probability mass function, Continuous Random variable. Probability density function, Cumulative Distribution Function, and its properties, Two-dimensional Random variables, Joint pdf / cdf and their properties

UNIT 2 **10 Hours**

Probability Distributions / Discrete distributions: Binomial, Poisson Geometric and Hyper geometric distributions and their properties. Continuous distributions: Uniform, Normal, exponential distributions and their properties.

UNIT 3 **10 Hours**

Random Processes: Classification, Methods of description, Special classes, Average values of Random Processes, Analytical representation of Random Process, Autocorrelation Function, Cross-correlation function and their properties, Ergodicity, Poisson process, Markov Process, Markov chain.

UNIT 4 **10 Hours**

Testing Hypothesis: Testing of Hypothesis: Formulation of Null hypothesis, critical region, level of significance, errors in testing, Tests of significance for Large and Small Samples, t-distribution, its properties and uses, F-distribution, its properties and uses, Chi-square distribution, its properties and uses, $\chi 2$ – test for goodness of fit, $\chi 2$ test for Independence

UNIT 5 **11 Hours**

Symbolic Representation of a Queuing Model, Poisson Queue system, Little Law, Types of Stochastic Processes, Birth-Death Process, The M/M/1 Queuing System, The M/M/s Queuing System, The M/M/s Queuing with Finite buffers.

Course Outcomes

The students should be able to:

Sl. No.	Course Outcome (CO)	Bloom's Taxonomy Level (BTL)
C111.1	Demonstrate use of probability and characterize probability models using probability mass (Density) functions & cumulative distribution functions..	3
C111.2	Explain the techniques of developing discrete & continuous probability distributions and its applications.	2
C111.3	Describe a random process in terms of its mean and correlation functions.	2
C111.4	Evaluate methods of Hypothesis testing for goodness of it	5
C111.5	Define the terminology &nomenclature appropriate queuing theory and also distinguish various queuing models.	1

Mapping Course Outcomes with Programme Outcomes:

Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
C112.1	**H**	**M**	**H**	**H**					**M**			
C112.2	**M**								**H**			
C112.3		**H**	**H**						**H**			
C112.4				**H**					**H**			
C112.5	**H**		**L**	**M**					**L**			

1. **(L = Low 30%-49%, M = Medium 50%-69%, H = High >70%)**

Text Books:

1. Probability, Statistics and Queuing Theory, V. Sundarapandian, Eastern Economy Edition, PHI Learning Pvt. Ltd, 2009.

Reference Books:

1. Probability & Statistics with Reliability, Queuing and Computer Applications, 2 nd Edition By Kishor. S. Trivedi , Prentice Hall of India ,2004.
2. Probability, Statistics and Random Processes, 1 st Edition by P Kausalya, PearsonEducation,2013.

Network Flow Algorithms

Subject Code: 17CNE112 **Credits: 04**
Hrs /week: 4+0+0+0 **Total Hours: 52**

Course Learning Objectives

This Course will enable students to

- Understand algorithmic aspects and network flow problems.
- Explore different shortest path algorithms.
- Evaluate flow algorithms and their applications towards networks.
- Explain various flow algorithms based on cost as a evaluating parameter.
- Evaluate algorithms designed to deal multiple networks.

Prerequisites:

Student must have fundamental knowledge of Graph theory and algorithms.

Unit I **8 Hours**

Introduction: Network Flow Problems, Network Representations, Network Transformations, Complexity Analysis, Developing Polynomial Time Algorithms, Search Algorithms, Flow Decomposition Algorithms.

Unit II **12 Hours**

Shortest Path Algorithms: Shortest Paths: Label Setting Algorithms – Dijstra's Algorithm, Dial's Implementation, Heap Implementation, Radix Heap Implementation. Shortest Paths: Label Correcting Algorithms – Generic Label Correcting Algorithms, Special Implementations of the Modified Label Correcting Algorithm, Detecting Negative Cycles, All Pairs Shortest Path Problem, Minimum Cost–to–Time Ratio Cycle Problem.

Unit III **10 Hours**

Maximum and Minimum Flow Algorithms

Maximum Flows: Generic Augmenting Path Algorithm, Labeling Algorithm and Max- Flow Min–Cut Theorem, Capacity Scaling Algorithm, Distance Labels and Layered Networks, Generic Pre Flow Push Algorithm, FIFO Pre Flow Push Algorithm, Flows in Unit Capacity Networks, Flows in Bipartite Networks, Flows in Planar Undirected Networks.

Unit IV **10 Hours**

Minimum Cost Flows: Optimality Conditions, Cycle Canceling Algorithm and the Integrity Property, Successive Shortest Path Algorithm, Primal–Dual Algorithm, Out–of Kilter Algorithm, Capacity Scaling Algorithm, Cost Scaling Algorithm, Minimum Mean Cycle Canceling Algorithm.

Unit V **12 Hours**

Trees and Forest: Minimum Spanning Trees, Kruskal's Algorithm, Prim's Algorithm, Sollin's Algorithm, Convex Cost Flows, Pseudo Polynomial Time Algorithm, Polynomial

Time Algorithm Generalized Flows, Augmented Forest Structures, Determining Potentials and Flows for an Augmented Forest Structure, Generalized Network Simplex Algorithm.

Course Outcomes:

At the end of the course the student will be able to

Sl. No.	Course Outcome (CO)	Bloom's Taxonomy Level (BTL)
C112.1	Understand algorithmic aspects and network flow problems.	2
C112.2	Explore different shortest path algorithms	3
C112.3	Evaluate flow algorithms and their applications towards networks	5
C112.4	Explain various flow algorithms based on cost as a evaluating parameter	4
C112.5	Evaluate algorithms designed to deal multiple networks	4

Mapping Course Outcomes with Programme Outcomes:

Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
C112.1	**M**	**L**	**M**									**L**
C112.2	**M**	**M**	**M**	**L**	**L**						**L**	**M**
C112.3	**M**	**H**	**M**	**M**		**L**					**L**	**M**
C112.4	**M**	**H**	**M**	**M**	**L**		**L**				**L**	**M**
C112.5	**M**	**M**	**M**	**M**	**L**						**L**	**M**

(L = Low 30%-49%, M = Medium 50%-69%, H = High >70%)

Text Books:

1. Ravindra K. Ahuja, Thomas L. Magnanti, James B.Orlin, "Network Flows Theory, Algorithms and Applications", 1st Edition, Prentice Hall, 1993.
2. Mokhtar S. Bazaraa, John J. Jarvis, Hanif D. Sherali, "Linear Programming and Network Flows", 4th Edition, John Wiley & Sons, 2009.
3. Gunther Ruhe, Kluwer, "Algorithmic Aspects of Flows in Networks", Academic 6. Publishers Group, 1991.

Reference Books:

1. Michael W. Lucas, "Network Flow Analysis", No Starch Press, 2010.
2. Alexander Engau, VdmVerlag Dr. Muller, "Semi-Simultaneous Flows in Multiple Networks", Aktiengesellschaft& Co. Kg, 2008.
3. Wai-kaiChe, "Theory of Nets: Flows In Networks", John Wiley & Sons, 1990.
4. Ulrich Derigs, "Programming in Networks and Graphs: On the CombinatorialBackground
and Near-Equivalence of Network Flow and Matching Algorithms", 1st

Edition, Springer, 1988.
5. Ford L. R. Jr., Robert G. Bland, Fulkerson D. R, “Flows In Networks”, Princeton University Press, 2010.
6. Alexander Hall, “Scheduling And Flow-Related Problems In NEtworks”, VDM VerlagDr. Mueller E. K, 2007.
7. Pioro M, Routing, Flow and Capacity Design in Communication and Computer Networks, Elsevier India Private Limited, 2004.

Network Management

Subject Code: 17CNE113 **Credits: 04**
Hrs /week: 4+0+0+0 **Total Hours: 52**

Course Learning Objectives
This Course will enable students to

- Know about general concepts and architecture behind standards based network management
- Understand concepts and terminology associated with organizing SNMP and various models
- Understand various communication and functional models based on SNMP, remote monitoring concepts and go through various case studies.
- Get to know about broadband network management

Prerequisites:
Student must have fundamental knowledge of computer networks.

UNIT-I **10 Hours**

Data Communications and Network Management Overview

Analogy of telephone network, Data and telecommunication network, Distributed computing environment, Internet, Protocols and standards, IT management, Network and system management, Current status and future of network management

UNIT-II **10 Hours**

Basic Foundations: Standards, Models, and Language

Network Management Standards, Network Management Model, Organizational Model, Information Model, Communication Model, Abstract Syntax Notation One,TLV Encoding, Functional Model.

UNIT-III **10 Hours**

SNMPv1 Network management: Organization and Information Models

Managed Network, The history of SNMP management, Internet Organizations and Standards, The SNMP model, The Organization Model, System Overview, The information model

UNIT-IV **12 Hours**

SNMPv1 Network management: Communication and Functional Models

Communication and Functional Models, Administrative Model,SNMP Community, Administration Model, Generalized Administration Model, Get and Set PDU,Trap PDU, SNMP Operations,MIB for Get-Next-Request,MIB Lexicographic Order,Get-Next-Request Operation, Sniffer Data,SNMP MIB

SNMP Management: RMON

What is Remote Monitoring? RMON SMI and MIB, RMON1, RMON2, ATM Remote Monitoring, Case Study, Case Study Results

UNIT-V **10 Hours**

Broadband Network management

ATM Technology, ATM Network management, HFC Management, DSL Technology and ADSL Management, Network management applications

Course Outcomes:

At the end of the course the student will be able to

Sl. No.	Course Outcome (CO)	Bloom's Taxonomy Level (BTL)
C113.1	Have knowledge on data communications and network management basics	2
C113.2	Should know about the basic standards, models and the languages used in the network management	3
C113.3	Get to know how to manage and organize the SNMP and various models	2
C113.4	Should know about various communication and functional models and have knowledge on how case studies are implemented.	2
C113.5	Should know how to implement the technologies based on broadband network management	4

Mapping Course Outcomes with Programme Outcomes:

Course Outcomes	PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
C113.1	**M**											**M**
C113.2	**M**											**H**
C113.3	**M**		**M**								**L**	**H**
C113.4	**H**	**L**	**M**	**L**	**M**		**M**				**L**	**M**
C113.5	**M**	**L**	**M**		**M**							**H**

(L = Low 30%-49%, M = Medium 50%-69%, H = High >70%)

Text Book:

1. Network Management- Principles and Practice, Mani Subramanian, Pearson Education, 2003

Computer Systems Performance Analysis

Subject Code: 17CNE114 **Credits: 04**
Hrs /week: 4+0+0+0 **Total Hours: 52**

Course Learning Objectives

This Course will enable students to

- Understand the concept and requirement of computer systems performance evaluation
- Know about general concepts behind workloads, workload selection and characterization
- Understand concepts and terminology associated with monitors, program execution monitors and accounting logs
- Explain various models available for capacity planning and benchmarking
- Evaluate different queuing models available for performance analysis.

Prerequisites:

Student must have fundamental knowledge of computer networks.

Unit I **8 Hours**

The art of Performance Evaluation; Common Mistakes in Performance Evaluation, A Systematic Approach to Performance Evaluation, Selecting an Evaluation Technique, Selecting Performance Metrics, Commonly used Performance Metrics, Utility Classification of Performance Metrics, Setting Performance Requirements.

Unit II **8 Hours**

Workloads, Workload Selection and Characterization: Types of Workloads, addition instructions, Instruction mixes, Kernels; Synthetic programs, Application benchmarks, Popular benchmarks. Work load Selection: Services exercised, level of detail; Representativeness; Timeliness, Other considerations in workload selection. Work load characterization Techniques: Terminology; Averaging, Specifying dispersion, Single Parameter Histograms, Multi Parameter Histograms, Principle Component Analysis, Markov Models, Clustering.

Unit III **12 Hours**

Monitors, Program Execution Monitors and Accounting Logs: Monitors: Terminology and classification; Software and hardware monitors, Software versus hardware monitors, Firmware and hybrid monitors, Distributed System Monitors, Program Execution Monitors and Accounting Logs, Program Execution Monitors, Techniques for Improving Program Performance, Accounting Logs, Analysis and Interpretation of Accounting log data, Using accounting logs to answer commonly asked questions.

Capacity Planning and Benchmarking: Steps in capacity planning and management; Problems in Capacity Planning; Common Mistakes in Benchmarking; Benchmarking Games; Load Drivers; Remote-Terminal Emulation; Components of an RTE; Limitations of RTEs.

Unit IV **10 Hours**

Experimental Design and Analysis: Introduction: Terminology, Common mistakes in experiments, Types of experimental designs, 2^k Factorial Designs, Concepts,

Computation of effects, Sign table method for computing effects; Allocation of variance; General 2^k Factorial Designs, General full factorial designs with k factors: Model, Analysis of a General Design, Informal Methods.

Unit V **14 Hours**

Queuing Models: Introduction: Queuing Notation; Rules for all Queues; Little's Law, Types of Stochastic Process. Analysis of Single Queue: Birth-Death Processes; M/M/1 Queue; M/M/m Queue; M/M/m/B Queue with finite buffers; Results for other M/M/1 Queuing Systems. Queuing Networks: Open and Closed Queuing Networks; Product form networks, queuing Network models of Computer Systems. Operational Laws: Utilization Law; Forced Flow Law; Little's Law; General Response Time Law; Interactive Response Time Law; Bottleneck Analysis; Mean Value Analysis and Related Techniques; Analysis of Open Queuing Networks; Mean Value Analysis; Approximate MVA; Balanced Job Bounds; Convolution Algorithm, Distribution of Jobs in a System, Convolution Algorithm for Computing G(N), Computing Performance using G(N), Timesharing Systems, Hierarchical Decomposition of Large Queuing Networks: Load Dependent Service Centers, Hierarchical Decomposition, Limitations of Queuing Theory.

Course Outcomes:

At the end of the course the student will be able to

Sl. No.	Course Outcome (CO)	Bloom's Taxonomy Level (BTL)
C114.1	Understand commonly used performance evaluation metrics.	2
C114.2	Identify different benchmarking available for workload selection and characterization	3
C114.3	Understand concepts associated with monitors, program execution monitors and accounting logs	2
C114.4	Explain the experimental designs for the performance evaluation	2
C114.5	Explain various statistical queuing models.	2

Mapping Course Outcomes with Programme Outcomes:

Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
C114.1	**M**											**M**
C114.2	**M**	**L**	**L**									**L**
C114.3	**M**		**M**		**L**							**L**
C114.4	**M**		**H**		**L**							**M**
C114.5	**M**	**L**	**H**									**M**

(L = Low 30%-49%, M = Medium 50%-69%, H = High >70%)

Text Book:

1. Raj Jain: The Art of Computer Systems Performance Analysis, John Wiley and Sons, 1991.

Reference Books:

1. Paul J Fortier, Howard E Michel: Computer Systems Performance Evaluation and Prediction, Elsevier, 2003.
2. Trivedi K S: Probability and Statistics with Reliability, Queuing and Computer Science Applications, PHI, 1990.Computer Systems Performance Analysis

Protocol Engineering

Subject Code: 17CNE115 **Credits: 04**
Hrs /week: 4+0+0+0 **Total Hours: 52**

Course Learning Objectives

This Course will enable students to

- Understand protocol development methods and phases.
- Identify the protocol functions in the designing protocol specification.
- Understand the protocol specification language and validation functions.
- Analyse protocol conformance and performance testing methods.
- Evaluate requirements of protocol implementation.

UNIT I **10 Hours**

Introduction: Communication model, Communication Software, Communication, Subsystems, Communication Protocol Definition/Representation, Formal and Informal Protocol Development Methods, Protocol Engineering Phases; Architecture, Network Services and Interfaces

UNIT II **12 Hours**

Protocol Specification: Protocol Functions: Encapsulation, Segmentation, Reassembly, Multiplexing, Addressing Components of specification, Service specification, Communication Service Specification Protocol entity specification: Sender, Receiver and Channel specification, Interface specifications, Interactions, Multimedia specifications, Alternating Bit Protocol Specification, RSVP specification.

UNIT III **12 Hours**

Protocol Specification Language (SDL): Salient Features. Communication System Description Using SDL, Structure of SDL. Data types and communication paths, Examples of SDL based Protocol Specifications: Question and answer protocol, X-on-Xoff protocol, Alternating bit protocol, Sliding window protocol specification, TCP protocol specification, SDL based platform for network, OSPF, BGP Multi-Protocol Label Switching SDL components. Protocol Verification / Validation: Protocol Verification using FSM, ABP Verification, Protocol Design Errors, Deadlocks, Unspecified Reception, Non-executable Interactions, State Ambiguities, Protocol Validation Approaches: Perturbation Technique, Reachability Analysis, Fair Reachability Graphs, Process Algebra based Validation, SDL Based Protocol Verification: ABP Verification, Liveness Properties, SDL Based Protocol Validation: ABP Validation.

UNIT IV **10 Hours**

Protocol Conformance and Performance Testing: Conformance Testing Methodology and Framework, Local and Distributed Conformance Test Architectures, Test Sequence Generation Methods: T, U, D and W methods, Distributed Architecture by Local Methods, Synchronizable Test Sequence, Conformance testing with Tree and Tabular Combined Notation (TTCN), Testing Multimedia Systems, quality of service test architecture(QOS), Performance Test methods, Interoperability testing, Scalability testing

UNIT V **08Hours**

Protocol Synthesis & Implementation: Synthesis methods, Interactive Synthesis Algorithm, Automatic Synthesis Algorithm, Automatic Synthesis of SDL from MSC, Protocol Re-synthesis,

Requirements of Protocol Implementation, Objects Based Approach To Protocol implementation, Protocol Compilers, Code generation from Estelle, LOTOS, SDL and CVOPS.

Case Studies: Example (Simple) protocols to be chosen to give equivalent FSM specification & develop SDL charts and perform verification and validation for the same.

Course Outcomes:

At the end of the course the student will be able to

Sl. No.	Course Outcome (CO)	Bloom's Taxonomy Level (BTL)
C115.1	Understand protocol development methods and phases.	2
C115.2	Identify the protocol functions in the designing protocol specification.	4
C115.3	Understand the protocol specification language and validation functions.	2
C115.4	Analyze protocol conformance and performance testing methods.	4
C115.5	Evaluate requirements of protocol implementation.	4

Mapping Course Outcomes with Programme Outcomes:

Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
C115.1	**M**											**M**
C115.2	**M**	**L**	**L**									**L**
C115.3	**M**		**M**									**L**
C115.4	**M**		**H**									**M**
C115.5	**M**	**L**	**H**									**M**

(L = Low 30%-49%, M = Medium 50%-69%, H = High >70%)

TEXT BOOKS:

1. PallapaVenkataram and Sunilkumar S. Manvi: Communication Protocol Engineering, PHI, 2004.

REFERENCE BOOK:

1. Mohammed G. Gouda: Elements of Protocol Design, Wiley Student Edition, 2004.

Artificial Intelligence

Subject Code: 17CNE116 **Credits: 04**
Hrs /week: 4+0+0+0 **Total Hours: 52**

Course objectives:
This course will enable students to

- Apply a given AI technique to a given concrete problem
- Implement non-trivial AI techniques in a relatively large system
- Explain uncertainty and Problem solving techniques.
- Illustrate various symbolic knowledge representations to specify domains and reasoning tasks of a situated software agent.
- Contrast different logical systems for inference over formal domain representations, and trace how a particular inference algorithm works on a given problem specification.
- Compare various learning techniques and agent technology.

Prerequisites: NIL

UNIT I **10 Hours**

What is Artificial Intelligence: The AI Problems, The Underlying assumption, what is an AI Technique? The Level of the model, Criteria for success, some general references, one final word and beyond. Problems, problem spaces, and search: Defining, the problem as a state space search, Production systems, Problem characteristics, Production system characteristics, Issues in the design of search programs, Additional Problems. Intelligent Agents: Agents and Environments, The nature of environments, the structure of agents.

UNIT II **11 Hours**

Heuristic search techniques: Generate-and-test, Hill climbing, best-first search, Problem reduction, Constraint satisfaction, Mean-ends analysis. Knowledge representation issues: Representations and mappings, Approaches to knowledge representation, Issues in knowledge representation, the frame problem. Using predicate logic: Representing simple facts in logic, representing instance and ISA relationships, Computable functions and predicates, Resolution, Natural Deduction. Logical Agents: Knowledge –based agents, the Wumpus world, Logic-Propositional logic, Propositional theorem proving, Effective propositional model checking, Agents based on propositional logic.

UNIT III **10 Hours**

Symbolic Reasoning under Uncertainty: Introduction to non-monotonic reasoning, Logic for non-monotonic reasoning, Implementation Issues, Augmenting a problem-solver, Implementation: Depth-first search, Implementation: Breadth-first search. Statistical Reasoning: Probability and Bayes Theorem, Certainty factors and rule-based systems, Bayesian Networks, Dempster-Shafer Theory, Fuzzy logic. Quantifying Uncertainty: Acting under uncertainty, Basic probability notation, Inference using full joint distributions, Independence, Bayes' rule and its use, The Wumpus world

UNIT IV **11Hours**

Weak Slot-and-filter structures: Semantic Nets, Frames. Strong slot-and –filler structures: Conceptual dependency, scripts, CYC. Adversarial Search: Games, Optimal Decision in Games, Alpha-Beta Pruning, Imperfect Real-Time Decisions, Stochastic Games, Partially Observable Games, State-Of-The-Art Game Programs, Alternative Approaches, Summary

UNIT V **10 Hours**

Learning From examples: Forms of learning, Supervised learning, Learning decision trees, Evaluating and choosing the best hypothesis, The theory of learning ,PAC, Regression and Classification with linear models, Nonparametric models, Support vector machines, Ensemble learning. Learning Probabilistic Models: Statistical learning, learning with complete data, learning with hidden variables: The EM algorithm.

Course Outcomes:

At the end of the course the student will be able to

Sl. No.	Course Outcome (CO)	Bloom's Taxonomy Level (BTL)
C116.1	Understand Artificial Intelligence	1
C116.2	Design intelligent agents for problem solving, reasoning, planning, and decision making, and learning.	5
C116.3	Specific design and performance constraints, and when needed, design variants of existing algorithms	5
C116.4	Apply AI technique on current applications.	3
C116.5	Problem solving, knowledge representation, reasoning, and learning.	4

Mapping Course Outcomes with Programme Outcomes:

Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
C116.1	**M**			**M**			**L**		**M**		**H**	
C116.2		**M**	**H**	**H**	**M**							
C116.3		**H**	**H**	**M**	**H**							
C116.4	**M**	**H**	**M**	**M**	**L**							
C116.5	**H**	**H**	**H**	**H**							**H**	

Text Books:

1. Elaine Rich,Kevin Knight, Shivashanka B Nair:Artificial Intelligence, Tata CGraw Hill 3rd Edition. 2013

2. Stuart Russel, Peter Norvig: Artificial Intelligence A Modern Approach, Pearson 3rd edition 2013.

Reference Book:

1. Nils J. Nilsson: "Principles of Artificial Intelligence", Elsevier, ISBN-13: 9780934613101

Web Technologies

Subject Code: 17CNE121 **Credits: 04**
Hrs /week: 4+0+0+0 **Total Hours: 52**

Course Learning Objectives

This Course will enable students to

- Design web pages with rich and dynamic content.
- Gain the programming knowledge with Swing, JSP and Servlets
- Design web based server applications with database connectivity.

Prerequisites: NIL

Unit I **10 Hours**

XML: Document type definition, XML Schemas, Document Object model, Presenting XML, Using XML Processors: DOM and SAX Review of Applets, Class, Event Handling, AWT Programming.
Introduction to Swing: Applet, Handling Swing Controls like Icons – Labels – Buttons – Text Boxes – Combo – Boxes – Tabbed Pains – Scroll Pains – Trees – Tables Differences between AWT Controls & Swing Controls Developing a Home page using Applet & Swing.

Unit II **10 Hours**

PHP (HYPERTEXT PREPROCESSOR)

Introduction, syntax, variables, strings, operators, if-else, loop, switch, array, function, form, mail, file upload, session, error, exception, filter, PHP-ODBC.

Unit III **10 Hours**

Java Beans: Introduction to Java Beans, Advantages of Java Beans, BDK Introspection, Using Bound properties, Bean Info Interface, Constrained properties Persistence, Customizes, Java Beans API.
Web servers: Tomcat Server installation & Testing.
Introduction to Servlets: Lifecycle of a Servlet, JSDK The Servlet API, The javax.servelet Package, Reading Servlet parameters, Reading Initialization parameters.

Unit IV **10 Hours**

More on Servlets: The javax.servlet HTTP package, Handling HTTP Request & Responses, Using Cookies-Session Tracking, Security Issues.
Introduction to JSP: The Problem with Servlet. The Anatomy of a JSP Page, JSP Processing. JSP Application Design with MVC architecture. AJAX.

Unit V **12 Hours**

JSP Application Development: Generating Dynamic Content, Using Scripting Elements Implicit JSP Objects, Conditional Processing – Displaying Values Using an Expression to Set an Attribute, Declaring Variables and Methods Error Handling and Debugging Sharing Data Between JSP pages, Requests, and Users Passing Control and Date between Pages – Sharing Session and Application Data – Memory Usage Considerations Database Access Database Programming using JDBC Studying Javax.sql.* package Accessing a Database from a JSP Page Application – Specific Database Actions Deploying JAVA Beans in a JSP Page

Course Outcomes:

At the end of the course the student will be able to

Sl. No.	Course Outcome (CO)	Bloom's Taxonomy Level (BTL)
C121.1	Use HTML tags effectively in web pages	6
C121.2	Design web pages with Swing and understand the utilization of XML	6
C121.3	Install a web server.	3
C121.4	Understand JSP architecture and usage.	3
C121.5	Design server web app with JDBC connectivity.	6

Mapping Course Outcomes with Programme Outcomes:

Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
C121.1	**M**	**L**	**L**		**L**			**M**				**L**
C121.2	**H**	**M**	**M**		**L**		**L**	**M**				**L**
C121.3	**H**	**L**	**L**		**M**		**M**	**L**				**M**
C121.4	**H**	**M**	**M**		**M**	**L**	**M**	**L**				**M**
C121.5	**H**	**H**	**M**		**M**	**M**	**M**	**M**				**H**

(L = Low 30%-49%, M = Medium 50%-69%, H = High >70%)

TEXT BOOKS:

1. Web Programming, building internet applications, Chris Bates 2nd edition, WILEY Dreamtech (UNIT 1)
2. The complete Reference Java 2 Fifth Edition, Patrick Naughton and Herbert Schildt., TMH (Chapters: 25) (UNIT 1, 3)
3. Java Server Pages –Hans Bergsten, SPD O'Reilly (UNITs 3,4,5)
4. Ullman, "PHP for the Web: Visual QuickStart Guide", Pearson Education(UNIT 2)

REFERENCE BOOKS:

1. Programming world wide web-Sebesta,PearsonCore Servlets And Java Server Pages Volume 1: Core Technologies, Marty Hall and Larry Brown Pearson
2. Internet and World Wide Web – How to program, Dietel and Nieto PHI/Pearson.
3. Jakarta Struts Cookbook, Bill Siggelkow, S P D O'Reilly for chap 8.
4. Murach's beginning JAVA JDK 5, Murach, SPD
5. An Introduction to web Design and Programming –Wang-Thomson
6. Professional JavaServer Programming, S.Allamarajuan.
7. Java Server Programming, Ivan Bayross and others,The X Team,SPD 9. Web Warrior Guide to Web Programmming-Bai/Ekedaw-Thomas
8. Beginning Web Programming-Jon Duckett WROX.
9. Java Server Pages, Pekowsky, Pearson.
10. Java Script,D.Flanagan,O'Reilly,SPD.

Advanced Topics in Graph Theory

Subject Code: 17CNE122 **Credits: 04**
Hrs /week: 4+0+0+0 **Total Hours: 52**

Course Learning Objectives

This Course will enable students to

- Distinguish planar graphs, digraphs and understand few graph theoretic concept with these.
- Understand the theory of network flows.
- Explain few algorithms associated with network flows.
- Understand graph colouring and associated methods.

Prerequisites:
Student must have fundamental knowledge of Graph theory.

Unit I **8 Hours**

Planar Graphs: Plane and Planar Graphs, Different Representations of a Planar Graph, Euler's Formula, Kuratowski's Theorem, Dual of Planar Graph- Geometric Dual and Combinatorial Dual.

Unit II **10 Hours**

Directed Graphs: Directed Graphs, Types of Digraphs, Digraphs and Binary Relations, In Degree and Out Degree, Bruijn Sequence, Tournaments, Traffic Flow-The Hopcroft and Tarjan Algorithm.

Unit III **12 Hours**

Network Theory and Algorithms: Network Theory, Flows and Cuts, The Max-Flow and Min-Cut Theorem, The Ford and Fulkerson Algorithm, Separating Sets, Menger's Theorem.

Unit IV **12 Hours**

Coloring Algorithms: Vertex Colouring, Coloring Algorithms- The Simple Sequential Colouring Algorithm, The Largest-First Sequential Algorithm, The Smallest-Last Sequential Algorithm, Critical Graphs, Edge Colouring.

Unit V **10 Hours**

Trees definitions and properties, rooted trees, Trees and sorting, weighted trees and prefix codes, bi connected components and articulation points, kruskal's and Prim's algorithms for minimal spanning trees

Course Outcomes:

At the end of the course the student will be able to

Sl. No.	Course Outcome (CO)	Bloom's Taxonomy Level (BTL)
C122.1	Understand different representations of a planar graph	2
C122.2	Understand digraphs and its application.	3

C122.3	Evaluate few algorithms associated with network flows.	4
C122.4	Understand graph coloring and associated methods	2

Mapping Course Outcomes with Programme Outcomes:

Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
C122.1	**L**											
C122.2	**L**		**L**									**L**
C122.3	**M**	**M**	**H**	**L**		**L**					**M**	**M**
C122.4	**M**	**M**	**M**	**L**		**L**					**M**	**L**
C122.5												

(L = Low 30%-49%, M = Medium 50%-69%, H = High >70%)

References:

1. John Clark & Derek Allan Holton, "A first look at Graph Theory", World Scientific Publishing Company, 1991.
2. Gary, Chartrand, Ping, Zhang, "Chromatic graph theory", CRC Press, 2008.
3. John Adrian Bondy, Murty U S R, "Graph theory with Applications", American Elsevier, 1976.
4. NarshingDeo, "Graph Theory with Applications to Engineering and Computer Science", Prentice-Hall of India, 2004.

Ad hoc Wireless Networks

Subject Code: 17CNE123 **Credits: 04**

Hrs /week: 4+0+0+0 **Total Hours: 52**

Course Learning Objectives

This Course will enable students to

- Understand issues in adhoc networks.
- Classify the adhoc MAC and routing protocols.
- Compare and evaluate the performance of a few adhoc routing protocols
- Understand different approches adopted by various algorithms to address the basic characteristic problems with adhoc networks.

Prerequisites:

Student must have fundamental knowledge of wireless networks

Unit I **10 Hours**

Review of Wireless Networks: IEEE802.11 Standard, Basic MAC layer mechanisms, CSMA/CA mechanisms and other MAC layer functionality. Ad hoc Networks: Introduction, Issues in Ad Hoc wireless networks, Ad hoc wireless internet. MAC Protocols for Ad hoc wireless Networks: Introduction, Issues in designing a MAC Protocol for Ad hoc wireless Networks, Design goals of a MAC protocol for Ad hoc wireless Networks.

Unit II **10 Hours**

Classification of MAC Protocols, Contention based protocols: MACAW, busy tone protocols. Contention based protocols with reservation mechanisms: DPRMA, HRMA, FPRP. Contention-based MAC protocols with scheduling mechanism: DPS&MA. *Routing protocols for* Ad hoc wireless Networks: Introduction, Issues in designing a routing Protocol for Ad hoc wireless Networks, Classification of routing Protocols.

Unit III **10 Hours**

Table drive routing protocol: DSDV, WRP, CHGWS. On-demand routing protocol: DSR, AODDV, LAR, FORP. Hybrid routing protocol: CEDAR, ZRP. Routing protocols with effective flooding mechanisms: PLBR. Hierarchical routing protocols: FSR. Metrics used by power aware routing protocols.

Unit IV **12 Hours**

Multicast routing protocols in Ad hoc wireless Network: Issues and operations. Reference model for multicast routing protocols. Classifications of multicast routing protocols. MAODV,AM Route, CAMP. Transport layer protocols for Ad hoc wireless Networks: 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: TCP-F, TCP-Bus, ATCP, Split TCP. Other transport layer protocols for Ad hoc wireless Networks: ACTP, ATP.

Unit V **10 Hours**

Security in wireless Ad hoc wireless Networks, Network Security requirements, Issues & Challenges in security provisioning, Network security attacks, Key Management, Secure

routing in Ad hoc wireless Networks: SAR, SEAD, Security-Aware AODV. Quality of service in Ad hoc wireless Networks: Introduction, Issues & challenges in providing QoS in Ad hoc wireless Networks, Classification of QoS solutions, MAC layer solutions, network layer solutions.

Course Outcomes:

At the end of the course the student will be able to

Sl. No.	Course Outcome (CO)	Bloom's Taxonomy Level (BTL)
C123.1	List and explain the issues in designing a MAC Protocol for Adhoc wireless Networks	2
C123.2	Classify adhoc MAC protocols based on contention and scheduling mechanisms	4
C123.3	Classify adhoc routing protocols based on the routing information storage and management	4
C123.4	Compare the issues and implication of adhoc networks while using transport layer protocols designed for wired networks	5
C123.5	Understand requirements, issues and solution for security and QoS for adhoc wireless networks	4

Mapping Course Outcomes with Programme Outcomes:

Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
C123.1	**M**	**M**	**L**									**H**
C123.2	**M**	**M**	**M**	**L**								**H**
C123.3	**M**	**M**	**M**	**L**								**H**
C123.4	**M**	**M**	**M**	**M**			**L**		**L**		**M**	**H**
C123.5	**H**	**H**	**M**	**M**			**L**		**L**		**L**	**H**

(L = Low 30%-49%, M = Medium 50%-69%, H = High >70%)

Textbooks:

1. *Ad Hoc Wireless Networks: Architectures and Protocols*, 2nd edition, C. Siva Ram Murthy and B S Manoj, Pearson Education, 2005.

Reference Books:

1. Ad Hoc Networks: Technologies and Protocols, PrasantMohapatra and Srikanth Krishnamurthy, Springer Science, 2005.
2. Ad Hoc Mobile Wireless Networks: Principles, Protocols, and Applications, Subir Kumar Sarkar, T G Basavaraju and C Puttamadappa, Auerbach Publications, 2007.
3. Guide to Wireless Ad Hoc Networks, SudipMisra, Isaac Woungang, Subhas Chandra Misra, Springer-Verlag, 2009.
4. The Handbook of Ad Hoc Wireless Networks, Editor Mohammad Ilyas, CRC Press, 2003.
5. Ad hoc Mobile Wireless Networks: Protocols&Systems, C. K. Toh, Prentice-Hall PTR, 2002.

Mobile Computing

Subject Code: 17CNE124 **Credits: 04**
Hrs /week: 4+0+0+0 **Total Hours: 52**

Course Learning Objectives

This Course will enable students to

- Identify basic protocols of mobile networks
- Explain the computing concepts of mobile networks
- Know to perform performance comparison of mobile networks

Prerequisites: NIL

UNIT I **10 Hours**

Introduction to mobile computing: Mobile Technologies, Anatomy of a Mobile Device, Survey of Mobile Devices Applications of Mobile Computing
Types of Mobility: Mobility in cellular based wireless network: channel allocation, interferences, handoffs and location management. IP mobility: Mobile IP and IDMP

UNIT II **12 Hours**

Impacts of mobility and portability in computational model and algorithms for mobile environment: Disconnected operation. Analysis of algorithms and termination detection.

Data delivery models: push and pull. Data dissemination in wireless channels. Broadcast disks. Effects of caching.

UNIT III **12 Hours**

Application Design: Context, Information Architecture, Design Elements, Mobile Web vs Native Applications
The User Experience: The Small Screen Problem, The Unified Look and Feel
Paradigm, The iPhone Human Interface Guidelines, The Blackberry User Interface Guidelines, Common User Interface Guidelines

UNIT IV **10 Hours**

Mobile Databases and Handover Management: Indexing in Air, Mobile Databases and transaction. Handover management, location management, registration, tunnelling and encapsulation, route optimization, dynamic host configuration. Logical mobility: Migrating processes, mobile agents

UNIT V **08 Hours**

Upcoming Technologies: Convergence of Media and Communication Devices, Security Issues. Next era: Cloud Computing

Course Outcomes:

At the end of the course the student will be able to

Sl. No.	Course Outcome (CO)	Bloom's Taxonomy Level (BTL)

C124.1	Explain the mobility in cellular based wireless network	2
C124.2	Understand the impacts of mobility and portability in computational model and algorithms for mobile environment	2
C124.3	Formulate designs based on user experience.	6
C124.4	Understand mobile databases and handover management	2
C124.5	Assess convergence of media and communication devices, security Issues.	5

Mapping Course Outcomes with Programme Outcomes:

Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
C124.1	**L**											**L**
C124.2	**M**	**L**										**M**
C124.3	**M**	**M**	**M**	**L**	**M**		**M**					**M**
C124.4	**M**		**M**						**L**			**M**
C124.5	**L**	**M**		**L**					**M**			**M**

(L = Low 30%-49%, M = Medium 50%-69%, H = High >70%)

TEXTBOOKS:

1. KumkumGarg, Mobile Computing, First Edition, Pearson Education, 2010
2. Rajkamal, Mobile Computing, Second Edition, Oxford University Press, 2012

REFERENCE BOOKS:

1. T. Mikkonen, Programming Mobile Devices: An Introduction for Practitioners, Wiley, 2007.
2. S. Hashimi, S. Komatineni, D. MacLean, Pro Android 2, Apress (2010).
3. D. Mark and J. LaMarche, Beginning iPhone 3 Development: Exploring the iPhone SDK, Apress (2009).
4. A. Rizk, Beginning BlackBerry Development, Apress, (2009).

Switching & Statistical Multiplexing in Telecommunications

Subject Code: 17CNE125 **Credits: 04**
Hrs /week: 4+0+0+0 **Total Hours: 52**

Course Learning Objectives

This Course will enable students to

- Understand the switching principles of telecommunication networks.
- Understand the principles crossbar switching technology.
- Illustrate stored program control architecture.
- Summarize digital transmission and multiplexing techniques and traffic engineering

Prerequisites:
Student must have fundamental knowledge of communication networks

Unit I **10 Hours**

Evolution of Telecommunication, Simple Telephone Communication, Basics of a Switching System, Manual Switching System, Major Telecommunication Networks Advantages of Digital Voice Networks, Digital Signal Processing, Disadvantages of Digital Voice Networks.

Unit II **10 Hours**

Switching: Crossbar Switching, Principles of Common Control, Touch Tone Dial Telephone, Principles of Crossbar Switching, Crossbar Switch Configurations, Cross point Technology, Crossbar Exchange Organization

Unit III **10 Hours**

Electronic Space Division Switching: Stored Program Control, Centralized SPC, Distributed SPC, Software Architecture, Application Software, Enhanced Services, Two stage, Three-stage and n-stage Networks.

Unit IV **12 Hours**

Digital Transmission and Multiplexing: Sampling, Quantization and Binary Coding, Quantization Noise, Compounding, Differential Coding, Vocoders, Pulse Transmission, Line Coding, Time Division Multiplexing.
Time Division Switching: Basic Division Space and Time Switching, Time Multiplexed Space and Time Switching, Combination Switching, Three-stage and n-stage Combination Switching.

Unit V **10 Hours**

Traffic Engineering: Network Traffic Load and Parameters, Grade of Service and Blocking Probability, Modelling Switching Systems, Incoming Traffic and Service Time Characterization, Blocking Models and Loss Estimates, Delay Systems.

Course Outcomes:

At the end of the course the student will be able to

Sl. No.	Course Outcome (CO)	Bloom's Taxonomy Level (BTL)
C125.1	Illustrate switching principles of telecommunication networks	2
C125.2	Demonstrate principles crossbar switching technology	2
C125.3	Illustrate stored program control architecture and configuration	3
C125.4	Summarize digital transmission and multiplexing techniques	2
C125.5	Compare network load traffic engineering systems	4

Mapping Course Outcomes with Programme Outcomes:

Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
C125.1	**M**											**M**
C125.2	**M**											**M**
C125.3	**H**	**L**	**M**									**H**
C125.4	**H**	**M**	**M**	**L**	**L**		**M**					**H**
C125.5	**H**	**M**		**M**	**L**		**L**					**H**

(L = Low 30%-49%, M = Medium 50%-69%, H = High >70%)

TEXT BOOKS:

1. ThiagarajanViswanathan: Telecommunication Switching Systems and Networks, PHI, 1992.
2. John.C.Bellamy: Digital Telephony, 3rd Edition, John Wiley and Sons Inc., 2002.

Multi-Core Architecture and Programming

Subject Code: 17CNE126 **Credits: 04**
Hrs /week: 4+0+0+0 **Total Hours: 52**

Course objectives:
This course will enable students to

- Define technologies of multicore architecture and performance measures
- Demonstrate problems related to multiprocessing
- Illustrate windows threading, posix threads, openmp programming
- Analyze the common problems in parallel programming

Prerequisites: NIL

Unit I **10 Hours**

Introduction to Multi-core Architecture: Motivation for Concurrency in software, Parallel Computing Platforms, Parallel Computing in Microprocessors, and Differentiating Multi-core Architectures from Hyper- Threading Technology, Multi-threading on Single-Core versus Multi-Core Platforms Understanding Performance, Amdahl's Law, and Growing Returns: Gustafson's Law. System Overview of Threading: Defining Threads, System View of Threads, Threading above the Operating System, Threads inside the OS, Threads inside the Hardware, What Happens When a Thread Is Created, Application Programming Models and Threading, Virtual Environment: VMs and Platforms, Runtime Virtualization, System Virtualization.

Unit II **10 Hours**

Fundamental Concepts of Parallel Programming: Designing for Threads, Task Decomposition, Data Decomposition, Data Flow Decomposition, Implications of Different Decompositions, Challenges You'll Face, Parallel Programming Patterns, A Motivating Problem: Error Diffusion, Analysis of the Error Diffusion Algorithm, An Alternate Approach: Parallel Error Diffusion, Other Alternatives. Threading and Parallel Programming Constructs: Synchronization, Critical Sections, Deadlock, Synchronization Primitives, Semaphores, Locks, Condition Variables, Messages, Flow Control- based Concepts, Fence, Barrier, Implementation-dependent Threading Features

Unit III **10 Hours**

Threading APIs: ThreadingAPls for Microsoft Windows, Win32/MFC Thread APls,Threading APls for Microsoft. NET Framework, Creating Threads, Managing Threads, Thread Pools, Thread Synchronization, POSIX Threads, Creating Threads, Managing Threads, Thread Synchronization, Signaling, Compilation and Linking.

Unit IV **10 Hours**

OpenMP: A Portable Solution for Threading: Challenges in Threading a Loop, Loopcarried Dependence, Data-race Conditions, Managing Shared and Private Data, Loop Scheduling and Portioning, Effective Use of Reductions, Minimizing Threading Overhead, Work-sharing Sections, Performance-oriented Programming, Using Barrier and No wait, Interleaving Single-thread and Multi-thread Execution, Data Copy-in and Copy-out, Protecting Updates of

Shared Variables, Intel Task queuing Extension to OpenMP, OpenMP Library Functions, OpenMP Environment Variables, Compilation, Debugging, performance

Unit V **12Hours**

Solutions to Common Parallel Programming Problems: Too Many Threads, Data Races, Deadlocks, and Live Locks, Deadlock, Heavily Contended Locks, Priority Inversion, Solutions for Heavily Contended Locks, Non-blocking Algorithms, ABA Problem, Cache Line Ping-ponging, Memory Reclamation Problem, Recommendations, Thread-safe Functions and Libraries, Memory Issues, Bandwidth, Working in the Cache, Memory Contention, Cache-related Issues, False Sharing, Memory Consistency, Current IA-32Architecture, Itanium Architecture, High-level Languages, Avoiding Pipeline Stalls onIA-32,Data Organization for High Performance.

At the end of the course the student will be able to

Sl. No.	Course Outcome (CO)	Bloom's Taxonomy Level (BTL)
C126.1	Identify the limitations of ILP and the need for multicore architectures	3
C126.2	Define fundamental concepts of parallel programming and its design issues	1
C126.3	Solve the issues related to multiprocessing and suggest solutions	3
C126.4	Make out the salient features of different multicore architectures and how they exploit parallelism	1
C126.5	Demonstrate the role of OpenMP and programming concept	2

Mapping Course Outcomes with Programme Outcomes:

Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
C126.1	**M**											
C126.2	**M**											
C126.3	**H**	**L**	**M**									
C126.4	**H**	**M**		**L**	**L**		**M**					
C126.5	**H**	**M**		**M**	**L**		**L**					

(L = Low 30%-49%, M = Medium 50%-69%, H = High >70%)

Text Books:

1. Multicore Programming , Increased Performance through Software Multi-threading by Shameem Akhter and Jason Roberts, Intel Press, 2006

Cellular Networks

Subject Code: 17CNE201 **Credits: 05**
Hrs /week: 4+0+2+0 **Total Hours: 52**

Course Learning Objectives
This Course will enable students to

- The concepts that enable traditional cellular radio and wireless data networks.
- The design trade-offs and methods of improving system performance.
- Various modulation techniques available and when to use them.
- To differentiate multiple access techniques for wireless communications.
- Identify various standards in modern wireless communication systems.

Prerequisites:
Student must have fundamental knowledge of wireless networks.

UNIT I **10Hours**

Introduction to Wireless Communication Systems: Evolution of Mobile Radio Communications Mobil Radio Systems around the world examples of Wireless Communication Systems, Paging System, Cordless Telephone System. Cellular Telephone Systems, Comparison of Common Wireless Communications Systems Modern Wireless Communications Systems: Second generation (2G), Cellular Networks, evolution of2.5G, TDMA Standards, Third Generation (3G) Wireless Networks, Wireless Local Loop (WLL) and LMDS, Wireless Local Area Networks (WLANs), Bluetooth and Personal Area Networks (PANS)

UNIT II **10 Hours**

The Cellular Concept: System Design Fundamentals, Introduction, Frequency reuse, channel assignment strategies, handoff strategies – prioritizing handoffs, Practical Handoff considerations, Interference and system capacity, co-channel interference and system capacity, channel planning for wireless systems, adjacent channel interference, power control for reducing interference Mobile Radio Propagation: Introduction to radio wave propagation, free space propagation model, Relating power to electric field, Reflection, Diffraction, Scattering.

UNIT III **10 Hours**

Modulation Techniques for Mobile Radio: Frequency modulation Vs amplitude modulation, Amplitude modulation, Angle modulation, Digital Modulation, Linear Modulation techniques –Binary phases shift keying (BPSK), Differential Phase Shift Keying (DPSK), Quadrature Phase Shift Keying (QPSK), Constant envelope modulation – Binary Frequency Shift Keying, Minimum Shift Keying (MSK), Gaussian Minimum Shift Keying (GMSK).

UNIT IV **10 Hours**

Multiple Access Techniques for Wireless Communications: Introduction to Multiple access, Frequency Division Multiple Access (FDMA), Time Division Multiple Access (TDMA), Spread Spectrum Multiple Access, Space Division Multiple Access (SDMA), Packet Radio. Protocols, Reservation Protocols – Reservation ALOHA, Packet Reservation Multiple Access (PRMA), Capacity of cellular systems

UNIT V **12Hours**

3G – The Universal Mobile Telecommunication System (UMTS) - UMTS Network Architecture –Release 99, UMTS Interfaces, UMTS Network Evolution UMTS Release 5, UMTS FDD and TDD, UMTS Channels, Logical Channels, UMTS downlink transport and physical channels, UMTS uplink transport and physical channels UMTS Time Slots, UMTS Network Protocol Architecture, Mobility Management for UMTS Network Overview Mobile Internet Protocol-Basic Mobile IP, Mobile IP Type-MIPV4 and MIPv6, Mobile IP: Concept, Four basic entities for MIPv4, Mobile IPv4 Operations, Registration, Tunnelling, MIPv4 Reverse Tunnelling, MIPv4 Triangular Routing, Problems and Limitations of MIP, MIPv4 Route Optimization. Cellular and WLAN Integration: Heterogeneous Network Architecture, Step towards 4G Networks - Why Integration, Benefits of Integration, Internetworking Network Architecture: Point of Integration, Overview of UMTS Network, IEEE 802.11 Overview Integration Architecture: Tight coupling Integration, Loose Coupling Integration, and Handoff in integrated network architecture.

Course Outcomes:

At the end of the course the student will be able to

Sl. No.	Course Outcome (CO)	Bloom's Taxonomy Level (BTL)
C201.1	Understand the evolution path of cellular communication networks	2
C201.2	Evaluate the technique for planning and prioritize handoffs.	3
C201.3	Explain modulation techniques available and when to use them.	2
C201.4	Differentiate multiple access techniques for wireless communications.	2
C201.5	Identify various standards in modern wireless communication systems.	2

Mapping Course Outcomes with Programme Outcomes:

Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
C201.1	**M**											**M**
C201.2	**H**	**M**	**H**	**M**	**L**		**M**	**L**	**L**	**L**	**L**	**H**
C201.3	**M**											**M**
C201.4	**M**	**L**										**M**
C201.5	**H**		**M**	**L**								**M**

(L = Low 30%-49%, M = Medium 50%-69%, H = High >70%)

TEXT BOOKS:

1. Theodore S Rappaport: Wireless Communications, Principles and Practice, 2nd Edition, Pearson Education Asia, 2002.

REFERENCE BOOKS:

1. William C Y Lee: Mobile Communications Engineering Theory and Applications, 2nd Edition, McGraw Hill Telecommunications 1998.
2. William Stallings: Wireless Communications and Networks, Pearson Education Asia, 2002

LABORATORY WORK

- Using any package like MATLAB or using any programming language of your choice, implement the BPSK algorithm and study its performance.
- Repeat the above experiment for QPSK algorithm and compare its performance with that of BPSK.
- Using any Network simulation package or using any programming language of your choice, implement and study the performance of PRMA. Mini Project: Using any platform like ANDROID, J2ME etc, implement any mobile application like Location Based Services, Emergency Services, Remote Monitoring etc. Students are also encouraged to take-up design project using integrating sensors and network components on an Aurdino / Intel Galileo boards.

ADVANCED COMPUTER NETWORKS

Course Code: 17CNE202 **Credits: 05**
Hrs /week: 4+2+0+0 **Total Hours: 52**

Course Learning Objectives (CLOs):
This course will enable student to

- Apply knowledge of the TCP/IP &OSI layering model to intelligently debug networking problems.
- Analyzing why networks need security and control, what errors might occur, and how to control network errors.
- Design and engineer routes to create interconnect of nodes
- Evaluate demultiplexing services and simple byte stream protocol 5. Explore and engineer most popular applications

Prerequisites:
NIL

Course Content:

UNIT-I **8 Hours**

Foundation: Requirements: Connectivity, Cost-Effective Resource Sharing, Support for Common Services, Network Architecture: Layering and Protocols, OSI Architecture, Internet Architecture, Implementing Network Software: Application Programming Interface (Sockets), Example Application, Protocol Implementation Issues, Performance: Bandwidth and Latency, Delay × Bandwidth Product, High- Speed Networks, Application Performance Needs.

UNIT-II **12 Hours**

Direct Link Networks: Physically Connecting Hosts, Hardware Building Blocks: Nodes, Links, Encoding: (NRZ, NRZI, Manchester, 4B/5B), Framing: Byte-Oriented Protocols (PPP), Bit-Oriented Protocols (HDLC), Clock-Based Framing (SONET), Error Detection: Two-Dimensional Parity, Internet Checksum Algorithm, Cyclic Redundancy Check, Reliable Transmission: Stop-and-Wait, Sliding Window, Concurrent Logical Channels, Token Rings: (802.5, FDDI, RPR), Token Ring Media Access Control, Token Ring Maintenance, FDDI , Resilient Packet Ring (802.17), Wireless(802.11), Bluetooth (802.15.1), Wi-Fi (802.11), WiMax (802.16), Cell Phone Technologies.

UNIT-III **12 Hours**

Packet Switching: Switching and Forwarding: Datagrams, Virtual Circuit Switching, Source Routing, Bridges and LAN Switches: Learning Bridges, Spanning Tree Algorithm, Broadcast and Multicast, Limitations of Bridges, Cell Switching (ATM): Cells, Segmentation and Reassembly, Virtual Paths, Physical Layers for ATM, Implementation and Performance: Ports, Fabrics.
Internetworking: Simple Internetworking (IP), What Is an Internetwork?, Service Model, Global Addresses, Datagram Forwarding in IP, Address Translation (ARP), Host

Configuration (DHCP), Error Reporting (ICMP) Virtual Networks and Tunnels, Routing, Network as a Graph, Distance Vector (RIP), Link State (OSPF) ,Metrics, Routing for Mobile Hosts, Router Implementation, Global Internet

UNIT-IV **12 Hours**

End-to-End Protocols: Simple Demultiplexer (UDP), Reliable Byte Stream (TCP), Endto-End Issues, Segment Format, Connection Establishment and Termination, Sliding Window Revisited, Triggering Transmission, Adaptive Retransmission, Record Boundaries, TCP Extensions, Alternative Design Choices, Remote Procedure Call, RPC Fundamentals, RPC Implementations (SUNRPC, DCE), Transport for Real-Time Applications (RTP), Requirements, RTP Details, Control Protocol, Performance, Open Issue: Application-Specific Protocols.

UNIT-V **8 Hours**

Data Compression: Lossless Compression Algorithms, Image Compression (JPEG), Video Compression (MPEG), Transmitting MPEG over a Network, Audio Compression (MP3).

Applications: Name Service (DNS)**,** Traditional Applications: Electronic Mail (SMTP, MIME, IMAP), World Wide Web (HTTP), Network Management (SNMP).

Course Outcomes:

Sl. No.	Course Outcome (CO)	Bloom's Taxonomy Level (BTL
C202.1	Interpret the terminology and concepts of the OSI & TCP/IP reference model and network foundations	L2
C202.2	Analyze the issues of making the link reliable in spite of transmission problems in wired and wireless communication	L4
C202.3	Apply IP for interconnecting networks	L3
C202.4	Evaluate end to end protocols like TCP,UDP,RTP,RPC etc	L5
C202.5	Design data compression techniques and conduct research in various applications	L6

Mapping Course Outcomes with Programme Outcomes:

Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	**H**	**L**	**H**						**L**			**M**
CO2	**M**	**H**	**H**				**L**					**M**
CO3	**H**		**H**	**M**								**H**
CO4		**H**	**M**	**M**								**H**
CO5	**H**	**L**		**H**	**M**				**L**		**M**	**H**

(L = Low 30%-49%, M = Medium 50%-69%, H = High >70%)

Text Books:

1. Computer Networks: A systems Approach, Larry L. Peterson & Bruce S. Davie, Elsevier Inc.
2. Computer Networking: A Top-Down Approach Featuring the Internet, James Kurose, Kieth W. Ross, Addison Wesley

Reference Books:

1. Protocol Management in Computer Networking, Phillippe Byrnes, Artech House Publishers.
2. Computer Networks, A. Tanenbaumand David Wetherall, Pearson Prentice-Hall.
3. High performance browser networking by IlyaGrigorik, O'reilly Publications.

Optical Networks

Subject Code: 17CNE203 **Credits: 05**
Hrs /week : 4+2+0+0 **Total Hours: 52**

Course Learning Objectives

This Course will enable students to

- Understand the importance of timing and synchronization of signals in optical networks.
- Explain the frame structure and architecture of Sonet/SDH 3. Discuss suitability of network topologies to the optical networks.
- Understand the architecture of IP and MPLS-Based OTNs
- Compare and analyze ATM versus IP in Optical Internets

Prerequisites:

Student must have fundamental knowledge of Data Communication and Networks.

UNIT I **14 Hours**

Introduction: Three generations of Digital Transport Networks; Key Optical Nodes; Other Key Terms; Key attributes of Optical Fiber: Attenuation; Amplifier Spontaneous Emission; Chromatic Dispersion; Lasers.

Timing and Synchronization: Timing and Synchronization in Digital Networks; Effect of a Timing error; The Clocking Signal; Types of Timing in Networks; Timing Variations; Methods of Clock Exchange; Distribution of Timing Using SONET and DS1; Timing Downstream Devices; Building Integrated Timing Supply; Synchronization Status Messages and Timing Loops.

UNIT II **08 Hours**

SONET and SDH: Introduction; The SONET / SDH Frame Structure; SONET and SDH Functional Components; SONET and SDH Problem Detection; Locating and Adjusting Payload with Pointers; The Overhead Bytes; SONET and SDH Concatenation.

Architecture of Optical Transport Networks: The Digital Wrapper; Control Planes; InBand and Out-Band Control Signalling; The OTN Layered Model; Encapsulation and Decapsulation Operations; Generic Framing Procedure

UNIT III **12 Hours**

WDM: The WDM Operation; DWDM, TDM and WDM Topologies; Relationship of WDM to SONET / SDH; EDF; WDM Amplifiers; Add-Drop Multiplexers; WDM Cross Connects; Wavelength Continuity Property; Examples of DWDM Wavelength Plan; Higher Dispersion for DWDM; Tunable DWDM Lasers.

Network Topologies and Protection Schemes: The Non-Negotiable Requirement Robust Networks; Diversity in the Network; Line and Path Protection Switching; Types of Topologies; Working and Protection Fibers; Point-to-Point Topology; BLSR; Protection Switching on Four-Fiber BLSR; Meshed Topologies; PONs; Ethernet in the Wide Area Backbone? Metro Optical Networking

UNIT IV **12 Hours**

Architecture of IP and MPLS-Based OTNs: IP, MPLS, and Optical Control Planes; Interworking the three Control Planes; Management of the Planes; A Framework for the IP

over Optical Networks; The Link Management Protocol (LMP)**:**Basic functions of LMP; Control Channel Management; Link Property Correlation; Fault Management; Extending LMP operations for Optical Link Systems.

Optical Routers: Optical Switching; Evolution of Switching Networks; Optical Router; Optical Switching Technologies; Optical Resources; Protecting The Label Switched Paths; Protection of the OSP; Wavelength OSP and MPLS LSP; Nesting the LSPs and OSPs; Topologies for a Node Failure; Plane Coupling and De-Coupling; Approach to the Problem of LSP and OSP Interworking; MEMS and Optical Switching; Thermo-Optic Switches.

UNIT V **06 Hours**

ATM versus IP in Optical Internets: IP over ATM over SONET; The OSI and Internet Layered Models; ATM in the SONET / SDH Payload Envelope; PPP in the SONET Payload Envelope; Encapsulation / Framing Rules; The PPP Packet; The ATM versus IP; Overhead of IP and ATM; Three encapsulation methods. ASON Operation at the UNI and NNI: Objectives of ASON; UNI and NNI; Types of Connections; NNI; UNI and NNI Signalling Services. Evolving to 3G Architecture: Migration of IP Optical Networking; IP and the Optical Backbones; Placing MPLS into the Picture; putting it together

Course Outcomes:

At the end of the course the student will be able to

Sl. No.	Course Outcome (CO)	Bloom's Taxonomy Level (BTL)
C203.1	Understand the importance of timing and synchronization of signals in optical networks.	2
C203.2	Explain the frame structure and architecture of Sonet /SDH	2
C203.3	Discuss suitability of network topologies to the optical networks.	4
C203.4	Understand the architecture of IP and MPLS-Based OTNs	2
C203.5	Compare and analyze ATM versus IP in Optical Internets	4

Mapping Course Outcomes with Programme Outcomes:

Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
C203.1	**H**	**L**	**L**									**H**
C203.2	**H**	**M**										**H**
C203.3	**H**	**M**	**M**	**L**								**H**
C203.4	**H**	**M**		**L**	**L**			**L**			**L**	**H**
C203.5	**H**	**M**	**M**	**M**	**L**		**L**	**M**	**L**	**L**	**M**	**H**

(L = Low 30%-49%, M = Medium 50%-69%, H = High >70%)

TEXT BOOKS:

1. Uyless Black: Optical Networks, Pearson Education Asia, 2002

REFERENCES:

1. Rajiv Ramaswami and Kumar N.Sivaranjan: Optical Networks - A Practical Perspective, Morgan Kaufuann, 2000.
2. Paul E.Green Jr.: Fiber Optic Network, Prentice Hall, 1993.
3. Jeff Hecht: Understanding Fiber Optics, 4th Edition, PHI 1999.

Information Theory and Coding

Subject Code: 17CNE211 **Credits: 04**
Hrs /week: 4+0+0+0 **Total Hours: 52**

Course Learning Objectives
This Course will enable students to

- Understand the basics of information theory and channel capacity
- Explain coding techniques used.
- Compare a few liner error control coding mechanisms.
- Analyse error correction and coding techniques

Prerequisites:
Student must have fundamental knowledge of Data Communication and Networks.

UNIT – I **10 Hours**

INFORMATION THEORY AND CHANNEL CAPACITY: Introduction, Measure of Information, Average Information Content of Symbols in Long Independent Sequences, Average Information Content of Symbols in Long Dependent Sequences, Mark-off Statistical Model for Information Sources. Entropy and Information Rate of Mark-Off Sources.

UNIT – II **10 Hours**

Encoding of the Source Output, Shannon's Encoding Algorithm, Communication Channels, discrete Communication Channels, Rate of Information Transmission over a Discrete Channel, Capacity of a Discrete Memory Less Channel, discrete Channels with Memory Continuous Channels, Shannon Hartely Law and its Implications.

(Text 1: Chapter 4: Section 4.1)

UNIT – III **10 Hours**

FUNDAMENTAL LIMITS ON PERFORMANCE: Some Properties of Entropy, Extension of a DMS, Prefix Coding, Source Coding Theorem, Huffman Coding, Mutual Information, Properties of Mutual Information, Differential Entropy and Mutual Information for Continuous Ensembles. (Text 2, Chapter 2: Section 2.1 to 2.9)

UNIT – IV **10 Hours**

ERROR CONTROL CODING: Rationale for Coding and Types of Code, Discrete Memory less channels, Examples of Error Control Coding, Methods of Controlling Errors, Types of Errors, Types of Codes, Linear Block Codes, Error Detection and Error Correction Capabilities of Linear block codes. Single Error Correcting Hamming Codes, Lookup Table (or Syndrome) Decoding using Standard Array, Binary Cyclic Codes,
Algebraic Structures of Cyclic Codes.

UNIT– V **12 Hours**

Encoding using an (n-k) Bit Shift Register, Syndrome Calculation, Error Detection and Error Correction, BCH Codes, RS Codes, Golay Codes, Shortened Cyclic Codes, Burst Error

Correcting Codes, Shortened Cyclic Codes, Burst Error Correcting Codes. (Text 1, Chapter 9, Section 9.1 to 9.4) Convolution Codes, Time Domain Approach, Transfer Domain Approach, State, Tree and Trellis diagrams, Encoders and Decoders (using Viterbi algorithm only) for (n,k,l) Convolution Codes. (Text 2, Chapter 8: Section 8.5 to 8.6)

Course Outcomes:

At the end of the course the student will be able to

Sl. No.	Course Outcome (CO)	Bloom's Taxonomy Level (BTL)
C211.1	Understand the basics of information theory and channel capacity	2
C211.2	Understand the discrete channels and encoding	2
C211.3	Explain coding techniques used.	2
C211.4	Compare a few liner error control coding mechanisms.	4
C211.5	Differentiate error correction and error detection mechanisms	5

Mapping Course Outcomes with Programme Outcomes:

Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
C211.1	**L**											**L**
C211.2	**L**		**M**									
C211.3	**M**	**L**	**M**									**M**
C211.4	**M**		**M**	**M**	**L**						**L**	**M**
C211.5	**M**											**M**

(L = Low 30%-49%, M = Medium 50%-69%, H = High >70%)

TEXT BOOKS:

1. Digital and Analog Communication Systems – K Sam Shanmugam, John Wiley, 1996.
2. Digital Communication – Simon Haykin, John Wiley, 2003

REFERENCE BOOKS:

1. Digital Communication Fundamental and Applications Bernard Skla, 2e, Pearson Education, 2002.
2. Concepts of Information Theory and Coding – P.S. Sathyanarayana, 2e, Dynaram, 2004.

Advanced Digital Communication

Subject Code: 17CNE212 **Credits: 04**
Hrs /week: 4+0+0+0 **Total Hours: 52**

Course Learning Objectives

This Course will enable students to

- Understand the basics of digital transmission.
- Explain the digital modulation techniques and the error detection and correction methods utilized.
- Understand few waveform coding techniques
- Differentiate baseband transmission techniques

Prerequisites:

Student must have fundamental knowledge of Data Communication and Networks.

UNIT I **12Hours**

Digital Transmission Fundamentals: Digital Representation of Information: Block-Oriented Information, Stream Information; Why Digital Communications? Comparison of Analog and Digital Transmission, Basic properties of Digital Transmission Systems; Digital Representation of Analog Signals: Bandwidth of Analog Signals, Sampling of An Analog Signal, Digital Transmission of Analog Signals; Characterization of Communication Channels: Frequency Domain Characterization, Time Domain Characterization; Fundamental Limits in Digital Transmission.

UNIT II **10 Hours**

Digital Transmission Fundamentals Contd: The Nyquist Signalling Rate, The Shannon Channel Capacity; Line Coding; Modems and Digital Modulation: Binary Phase Modulation, QAM and Signal Constellations, Telephone Modem Standards; Properties of Media and Digital Transmission Systems: Twisted Pair, Coaxial Cable, Optical Fiber, Radio Transmission, Infrared Light; Error Detection and Correction: Error Detection, Two Dimensional Parity Checks, Internet Checksum, Polynomial Codes, Standardized Polynomial Codes, Error Detecting Capability of a Polynomial Code.

UNIT III **10 Hours**

Brief Review of digital communication systems: Elements of Digital communication systems; Communication channels and their characteristics; Historical perspective in the development of digital communication; Review of the features of a decreases memory less channel and the channel capacity theorem.

UNIT IV **10 Hours**

Waveform Coding Techniques: PCM, Channel. Noise and error probability, DPCM, DM, coding speech at low bit rates, Applications.

UNIT V **10 Hours**

Baseband Shaping for data transmission: Discrete PAM signals, Inter symbol interference (ISI) Nyquist criterion for distortion-less Baseband binary transmission, correlative coding, Eypattern, transmission, correlative coding, Eypatterns Based and M-ary PAM system, Adoptive Equalization, The zero forcing algorithm, The LMA algorithm

Course Outcomes:

At the end of the course the student will be able to

Sl. No.	Course Outcome (CO)	Bloom's Taxonomy Level (BTL)
C212.1	Compare digital and analog transmission techniques	4
C212.2	Explain the digital modulation techniques and the error detection and correction methods utilized.	2
C212.3	Historical perspective in the development of digital communication	2
C212.4	Understand few waveform coding techniques	2
C212.5	Differentiate baseband transmission techniques	4

Mapping Course Outcomes with Programme Outcomes:

Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
C212.1	**M**											**L**
C212.2	**M**	**L**	**L**					**M**				**M**
C212.3	**L**							**L**				**L**
C212.4	**L**							**L**				**M**
C212.5	**L**											**M**

(L = Low 30%-49%, M = Medium 50%-69%, H = High >70%)

TEXTBOOKS:

1. Alberto Leon– Garcia and Indra Widjaja: Communication Networks Fundamental Concepts and Key architectures, 2nd Edition, Tata McGraw Hill, 2006.
2. Simon Haykin: Digital Communication, Wiley India, 2007.

REFERENCEBOOKS:

1. John G Proakis: Digital Communications, 3rd Edition, McGrawHill, 2008.
2. Leon W Couch: Analog/Digital Communication, 5th Edition, PHI, 2008.

Internet Routing Design Principles

Subject Code: 17CNE213 **Credits: 04**
Hrs /week: 4+0+0+0 **Total Hours: 52**

Course Learning Objectives

This Course will enable students to

- Understand internet addressing and architecture.
- Illustrate various routing algorithm and compare and evaluate their futures
- Explain traffic engineering and packet processing

Prerequisites:

Student must have fundamental knowledge of Computer Networks.

Unit I **10 Hours**

Networking and Network Routing: An Introduction, Addressing and Internet Service: An Overview, Network Routing, IP Addressing, Service Architecture, Protocol Stack Architecture, Router Architecture, Network Topology, Architecture, Network Management Architecture, Public Switched Telephone Network.

Unit II **10 Hours**

Routing Algorithms: Shortest Path and Widest Path: Bellman–Ford Algorithm and the Distance Vector Approach, Dijkstra's Algorithm, Widest Path Algorithm, Dijkstra-Based Approach, Bellman–Ford-Based Approach, *k*-Shortest Paths Algorithm. OSPF and Integrated IS-IS: OSPF: Protocol Features, OSPF Packet Format, Integrated IS-IS, Key Features, comparison. BGP: Features, Operations, Configuration Initialization, phases, Message Format, IP Routing and Distance Vector Protocol Family**:** RIPv1 and RIPv2.

Unit III **10 Hours**

Routing Protocols: Framework and Principles: Routing Protocol, Routing Algorithm, and Routing Table, Routing Information Representation and Protocol Messages, Distance Vector Routing Protocol, Link State Routing Protocol, Path Vector Routing, Protocol, Link Cost.

Unit IV **10 Hours**

Internet Routing and Router Architectures: Architectural View of the Internet, Allocation of IP Prefixes and AS Number, Policy-Based Routing, Point of Presence, Traffic Engineering Implications, Internet Routing Instability. Router Architectures: Functions, Types, Elements of a Router, Packet Flow, Packet Processing: Fast Path versus Slow Path, Router Architectures

Unit V **12 Hours**

Routing and Traffic Engineering: Traffic Engineering of IP/MPLS Networks, VPN Traffic Engineering, Problem Illustration: Layer 3 VPN, LSP Path Determination: Constrained Shortest Path Approach, LSP Path Determination: Network Flow Modelling Approach, Layer 2 VPN Traffic Engineering, Observations and General Modelling Framework, Routing/Traffic Engineering for Voice Over MPLS.

Course Outcomes:

At the end of the course the student will be able to

Sl. No.	Course Outcome (CO)	Bloom's Taxonomy Level (BTL)
C213.1	Explain network topology, architecture, network management architecture	2
C213.2	Analyse and evaluate route optimization algorithms	4
C213.3	Analyse and evaluate route optimization algorithms	4
C213.4	Evaluate policy based routing and supporting architecture.	5
C213.5	Understand VPN Traffic Engineering	2

Mapping Course Outcomes with Programme Outcomes:

Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
C213.1	**M**											**M**
C213.2	**M**	**L**	**M**									**H**
C213.3	**M**	**M**	**M**	**M**								**H**
C213.4	**H**	**M**	**M**	**L**			**L**				**L**	**H**
C213.5	**H**			**L**			**L**					**H**

(L = Low 30%-49%, M = Medium 50%-69%, H = High >70%)

Text Books:

1. Network Routing: Algorithms, Protocols, and Architectures, Deepankar Medhi and Karthikeyan Ramasamy, Morgan Kaufmann Series in Networking, 2007
2. Network Algorithmic: An Interdisciplinary Approach to Designing Fast Networked Devices, George Varghese, Morgan Kaufmann Series in Networking, 2004

Topics in Analysis of Computer Networks

Subject Code: 17CNE214 **Credits: 04**
Hrs /week: 4+0+0+0 **Total Hours: 52**

Course Learning Objectives

This Course will enable students to

- Understand network analysis issues
- Illustrate network performance and multiplexing characteristics
- Explain deterministic network analysis

Prerequisites: NIL

Unit I **8 Hours**

Introduction: Two examples of analysis: Efficient transport of packet voice calls, Achievable throughput in an input-queuing packet switch; the importance of quantitative modelling in the Engineering of Telecommunication Networks.

Unit II **10 Hours**

Multiplexing: Network performance and source characterization; Stream sessions in a packet network: Delay guarantees; Elastic transfers in a packet network; Packet multiplexing over Wireless networks.

Unit III **10 Hours**

Stream Sessions: Deterministic Network Analysis: Events and processes in packet multiplexer models: Universal concepts; Deterministic traffic models and Network Calculus; Scheduling; Application to a packet voice example; Connection setup: The RSVP approach; Scheduling (continued).

Unit IV **12 Hours**

Stream Sessions: Stochastic Analysis: Deterministic analysis can yield loose bounds; Stochastic traffic models; Additional notation; Performance measures; Little's theorem, Brumelle's theorem, and applications; Multiplexer analysis with stationary and ergodic traffic; The effective bandwidth approach for admission control; Application to the packet voice example; Stochastic analysis with shaped traffic; Multihop networks; Long-Range-Dependent traffic.

Unit V **12 Hours**

Adaptive Bandwidth Sharing for Elastic Traffic: Elastic transfers in a Network; Network parameters and performance objectives; sharing a single link; Rate-Based Control; Window-Based Control: General Principles; TCP: The Internet's Adaptive Window Protocol; Bandwidth sharing in a Network.

Course Outcomes:

At the end of the course the student will be able to

Sl. No.	Course Outcome (CO)	Bloom's Taxonomy Level (BTL)

C214.1	Understand network analysis topics	2
C214.2	Analyse and evaluate network performance using multiplexing	4
C214.3	Analyse deterministic network	4
C214.4	Analyse and evaluate stochastic process of network	5
C214.5	Understand elastic transfer of network	2

Mapping Course Outcomes with Programme Outcomes:

Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
C214.1	**M**											**M**
C214.2	**M**	**L**	**M**									**H**
C214.3	**M**	**M**	**M**	**M**								**H**
C214.4	**H**	**M**	**M**	**L**			**L**				**L**	**H**
C214.5	**H**			**L**			**L**					**H**

(L = Low 30%-49%, M = Medium 50%-69%, H = High >70%)

TEXT BOOKS:

1. Anurag Kumar, D. Manjunath, JoyKuri: Communication Networking: An Analytical Approach, Elsevier, 2004.

REFERENCE BOOKS:

1. M. Schwartz**:** Broadband Integrated Networks, Prentice Hall PTR, 1996.
2. J. Walrand, P. Varaiya: High Performance Communication Networks, 2nd Edition, Morgan Kaufmann, 1999.

Advanced Network Security

Subject Code: 17CNE215 **Credits: 04**

Hrs /week: 4+0+0+0 **Total Hours: 52**

Course Learning Objectives

This Course will enable students to

- Understand network security issues and various attacks and their classification
- Illustrate web services technologies and standards and security in e-services and applications.
- Explain security mechanism for mobile agent systems
- Evaluate cryptographic techniques for network security

Prerequisites:

Student must have fundamental knowledge of Communication Networks and information security.

UNIT I **12Hours**

Computer Network Security: Basic background and Current Issues. Internet Security: Secure Routing: Networking Technologies, Attacks in Networks, State of the Art Designing Firewalls: Firewall Classification, Firewall Deployment: Management, Security in Virtual Private Networks: VPN overview, VPN Benefits, VPN Technology, VPN Taxonomy, IPSec, IP Security(IPSecs): IPSecs Architecture and Components, Benefits and Applications of IPSec, IDs for Networks: Background, Modern NIDSs, Intrusion Detection versus Intrusion Protection: Detections Versus Prevention, Intrusion Prevention Systems: Next Step in Evolution of IDS, Architecture, IPS Deployment, IPS Advantages, IPS Requirements Denial-of-Service Attacks: DoS Attacks, DDoS Attacks, DDoS Defence Mechanism, Secure Architectures with Active Networks: Active Networks, SAVE Test bed, Adaptive VPN Architecture with Active Networks, (SAM) Architecture

UNIT II **10Hours**

Security in E-Services and Applications: What is an E-Service? Security Requirements for E-Services and Applications, Security for future E-Services, Security in Web Services: Web Services Technologies and Standards, Web Services Security Standard, Secure Multicasting: IP Multicast, Application Security Requirements, Multicast Security Issues, Data Authentication, Source Authentication Schemes, Group Key Management, Group Management and Secure Multicast Architectures, Secure IP Multicast Standardization Efforts.

UNIT III **8Hours**

Voice Over IP Security: Security Issues in VoIP, Vulnerability Testing, Intrusion Detection Systems, Grid Security: Security Challenges for Grids, Grid Security Infrastructure, Grid Computing Environments, Grid Network Security, Mobile Agent Security: Taxonomy of Solutions, Security Mechanism for Mobile Agent Systems.

UNIT IV **12Hours**

Mobile terminal Security, IEEE 802.11 Security: Introduction of IEEE 8002.11, Wired Equivalent Privacy, Additional IEEE 8002.11 Security Techniques, Wireless Intrusion Detection Systems, Practical IEEE 8002.11 Security Measures, Bluetooth Security: Bluetooth

wireless Technology, Security Architecture, Security Weaknesses and Countermeasures, Mobile Telecom Networks: Architectures Network, Security Architecture, Security in Mobile Ad Hoc networks: Routing Protocols, Security vulnerabilities, Preventing Attacks in MANETs, Trust in MANETs, Establishing Secure Routes in a MANETs, Cryptography tools for MANETs, Wireless Sensor Networks: Sensor Devices, Sensor Network Security, Trust: What is Trust Model? How Trust Model works? Where Trust can go Wrong? Why is it Difficult to define Trust?

UNIT V **10Hours**

PKI Systems: Origin of Cryptography, Overview of PKI Systems, Components of PKI, Procedure of PKI Systems, Current and Future aspects of PKI Systems, Privacy in Electronic Communications: Protection from Third Party: Confidentiality, Protection from communication Partner, Invasions of Electronic. Private Sphere, Balancing Privacy with other needs, Structure of Privacy, Securing Digital Content: Securing Digital Content: Need and Challenges, Content Protection Techniques, Illustrative Application.

Course Outcomes:

Sl. No.	Course Outcome (CO)	Bloom's Taxonomy Level (BTL
C215.1	Demonstrate internet security concepts and applications	2
C215.2	Apply security in e-services	3
C215.3	Analyse voice over IP security	4
C215.4	Explain mobile terminal security	2
C215.5	Design solutions to PKI systems	6

Mapping Course Outcomes with Programme Outcomes:

Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	**H**		**L**	**M**					**M**	**L**		**M**
CO 2	**M**	**L**	**H**									**H**
CO 3	**L**	**H**	**M**	**M**								**L**
CO 4		**H**		**H**								**M**
CO 5	**H**	**H**	**H**	**M**	**M**				**L**			**H**

(L = Low 30%-49%, M = Medium 50%-69%, H = High >70%)

Text Books:

1. Network security: current status and future directions, Christos Douligeris, Dimitrios N. Serpanos, Wiley-Inderscience.

Machine Learning

Subject Code: 17CNE216 **Credits: 04**
Hrs /week: 4+0+0+0 **Total Hours: 52**

Course objectives

This course will enable students to

- Explain basic concepts of learning and decision trees.
- Compare and contrast neural networks and genetic algorithms
- Apply the Bayesian techniques and instant based learning
- Examine analytical learning and reinforced learning

Prerequisites: NIL

UNIT –I **12 Hours**

INTRODUCTION, CONCEPT LEARNING AND DECISION TREES Learning Problems Designing Learning systems, Perspectives and Issues – Concept Learning – Version Spaces and Candidate Elimination Algorithm – Inductive bias – Decision Tree learning – Representation Algorithm – Heuristic Space Search

UNIT -II **10 Hours**

NEURAL NETWORKS AND GENETIC ALGORITHMS: Neural Network Representation – Problems – Perceptrons – Multilayer Networks and Back Propagation Algorithms – Advanced Topics – Genetic Algorithms – Hypothesis Space Search – Genetic Programming – Models of Evolution and Learning.

UNIT -III **10Hours**

BAYESIAN AND COMPUTATIONAL LEARNINGL Bayes Theorem – Concept Learning – Maximum Likelihood – Minimum Description Length Principle – Bayes Optimal Classifier – Gibbs Algorithm – Naïve Bayes Classifier– Bayesian Belief Network – EM Algorithm – Probably Learning – Sample Complexity for Finite and Infinite Hypothesis Spaces – Mistake Bound Model.

UNIT -IV **10Hours**

INSTANT BASED LEARNING AND LEARNING SET OF RULES: K- Nearest Neighbor Learning – Locally Weighted Regression – Radial Basis Functions –Case- Based Reasoning – Sequential Covering Algorithms – Learning Rule Sets – Learning First Order Rules – Learning Sets of First Order Rules – Induction as Inverted Deduction – Inverting Resolution

UNIT -V **10Hours**

ANALYTICAL LEARNING AND REINFORCED LEARNING: Perfect Domain Theories – Explanation Based Learning – Inductive-Analytical Approaches – FOCL Algorithm – Reinforcement Learning – Task – Q-Learning – Temporal Difference Learning

Course Outcomes:

At the end of the course the student will be able to

Sl. No.	Course Outcome (CO)	Bloom's Taxonomy Level (BTL)
C216.1	Understand the concept of decision tree	1
C216.2	Design neural network and genetic algorithm	5
C216.3	Apply the Bayesian techniques and instant based learning	3
C216.4	Analyse instant based learning and learning set of rules	4
C216.5	Evaluate analytical learning and reinforced learning	5

Mapping Course Outcomes with Programme Outcomes:

Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
C216.1	**M**			**M**			**L**		**M**		**H**	
C216.2		**M**	**H**	**H**	**M**							
C216.3		**H**	**H**	**M**	**H**							
C216.4	**M**	**H**	**M**	**M**	**L**							
C216.5	**H**	**H**	**H**	**H**							**H**	

Text Books:

1. Tom M. Mitchell, "Machine Learning", McGraw-Hill Education (INDIAN EDITION), 2013.

Reference Books:

1. EthemAlpaydin, "Introduction to Machine Learning", 2nd Ed., PHI Learning Pvt. Ltd., 2013.
2. T. Hastie, R. Tibshirani, J. H. Friedman, "The Elements of Statistical Learning", Springer; 1stedition, 2001.

Multimedia Communications

Subject Code: 17CNE221 **Credits: 04**
Hrs /week: 4+0+0+0 **Total Hours: 52**

Course Learning Objectives
This Course will enable students to

- Understand framework for multimedia communication and standardization
- Illustrate functions available at application layer and middleware layer for multimedia communication.
- Discover QoS in Network Multimedia Systems

Prerequisites: NIL

UNIT I **10 Hours**
Introduction to Multimedia Communications: Introduction, Human communication model, Evolution and convergence, Technology framework, Standardization framework.

UNIT II **12 Hours**
Framework for Multimedia Standardization: Introduction, Standardization activities, Standards to build a new global information infrastructure, Standardization processes on multimedia communications, ITU-T mediacom2004 framework for multimedia, ISO/IEC MPEG-21 multimedia framework, IETF multimedia Internet standards.

UNIT III **10 Hours**
Application Layer: Introduction, ITU applications, MPEG applications, Mobile servers and applications, Universal multimedia access.

UNIT IV **10 Hours**
Middleware Layer: Introduction to middleware for multimedia, Media coding, Media Streaming, Infrastructure for multimedia content distribution.

UNIT V **10 Hours**
Network Layer: Introduction, QoS in Network Multimedia Systems.

Course Outcomes:
At the end of the course the student will be able to

Sl. No.	Course Outcome (CO)	Bloom's Taxonomy Level (BTL)
C221.1	Analyse multimedia communication	4
C221.2	Understand framework for multimedia communication and standardization	2
C221.3	Illustrate functions available at application layer and middleware layer for multimedia communication.	2

C221.4	Understand middleware layer	2
C221.5	Evaluate QoS in Network Multimedia Systems	5

Mapping Course Outcomes with Programme Outcomes:

Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
C221.1	**M**											
C221.2	**M**	**L**	**L**					**M**				**M**
C221.3	**L**							**L**				**L**
C221.4	**L**							**L**				**M**
C221.5	**L**											**H**

(L = Low 30%-49%, M = Medium 50%-69%, H = High >70%)

TEXT BOOKS:

1. K.R. Rao, Zoran S. Bojkovic, Dragorad A. Milovanovic: Introduction to Multimedia Communications – Applications, Middleware, Networking, Wiley India, 2006.

REFERENCE BOOKS:

1. Fred Halsall: Multimedia Communications – Applications, Networks, Protocols, and Standards, Pearson, 2001.
2. Nalin K Sharad: Multimedia information Networking, PHI, 2002.
3. Ralf Steinmetz, KlaraNarstedt: Multimedia Fundamentals: Volume 1-Media Coding and Content Processing, 2nd Edition, Pearson, 2003.
4. Prabhat K. Andleigh, KiranThakrar: Multimedia Systems Design, PHI, 2003.

Wireless Sensor Networks

Subject Code: 17CNE222 **Credits: 04**
Hrs /week: 4+0+0+0 **Total Hours: 52**

Course Learning Objectives
This Course will enable students to

- Identify basic architecture of wireless sensor network
- Analyze the issues related to communication in wireless sensor network
- Identify the current and future trends in wireless sensor networks

Prerequisites:
Student must have fundamental knowledge of Wireless Networks.

UNIT I **10 Hours**

Introduction to wireless communication networks and wireless sensor networks: Basics of Wireless communication; signal propagation related issues: fading, multipath propagation, ISI, hidden and exposed terminal issues, susceptibility to errors, solutions applied (abstract only).
Introduction to Sensor Networks: Unique constraints and challenges, Advantage of Sensor Networks, Applications of Sensor Networks, Mobile AdhocNETworks(MANETs) and Wireless Sensor Networks: comparison, Enabling technologies for Wireless Sensor Networks

UNIT II **12 Hours**

Sensor Node Hardware and Network Architecture: Single-node architecture, Hardware components & design constraints, Operating systems and execution environments, introduction to TinyOS and nesC, Network architecture, Optimization goals and figures of merit, Design principles for WSNs, Service interfaces of WSNs, Gateway concepts.
Deployment and Configuration: Localization and positioning, Coverage and connectivity, Single-hop and multihop localization, self configuring localization systems, sensor management. Protocols to be studied from recent research papers for solving localization and positioning issues from recent research papers.

UNIT III **12 Hours**

Link Layer Protocols: Issues in designing the link layer protocols, Selected protocols to be studied from recent research papers
Network Protocols: Issues in designing MAC protocol for WSNs, Why current MAC protocols for wired or wireless scenarios cannot be reused? – A feasibility study. Classification of MAC Protocols, S-MAC Protocol, B-MAC protocol, IEEE 802.15.4 standard and Zig Bee, Dissemination protocol for large sensor network. Selected protocols to be studied from recent research papers

UNIT IV **12 Hours**

Routing protocols: Issues in designing routing protocols, Classification of routing protocols, Energy-efficient routing, Unicast, Broadcast and multicast, Geographic routing.Selected protocols to be studied from recent research papers
Data Storage and Manipulation: Data centric and content based routing, storage and

retrieval in network, compression technologies for WSN, Data aggregation technique. Study of representative data aggregation protocol from each class. Selected protocols to be studied from recent research papers

UNIT V **06 Hours**

Security issues: How security issues of WSN are different from that of other wired or wireless scenarios? Issues in providing security for WSNs. Attacks and countermeasures. Selected protocols to be studied from recent research papers **Recent trends:** Introduction to multimedia sensor networks, architecture, functioning, and applications. Mobile Agents: concepts, and uses and discussion of relevant protocol from research papers

Course Outcomes:

At the end of the course the student will be able to

Sl. No.	Course Outcome (CO)	Bloom's Taxonomy Level (BTL)
C222.1	Identify the wireless sensor network	1
C222.2	Deployment and configuration of sensor node hardware and network architecture	2
C222.3	Analyse the design issues of link layer and network protocol	4
C222.4	Analyse the design issues of link layer and network protocol	4
C222.5	Evaluate security issues in WSN	5

Mapping Course Outcomes with Programme Outcomes:

Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
C222.1	**M**											**L**
C222.2	**M**	**L**	**L**					**M**				**L**
C222.3	**H**	**M**	**M**					**L**				**H**
C222.4	**H**							**L**				**H**
C222.5	**M**	**L**	**M**						**L**	**L**		**M**

(L = Low 30%-49%, M = Medium 50%-69%, H = High >70%)

TEXT BOOKS:

1. Feng Zhao, Leonidas Guibas, "Wireless Sensor Network", Elsevier, 1st Ed. 2004 (ISBN: 13- 978-1-55860-914-3)

REFERENCES:

1. HolgerKerl, Andreas Willig, "Protocols and Architectures for Wireless Sensor Network", John Wiley and Sons, 2005 (ISBN: 978-0-470-09511-9)
2. Raghavendra, Cauligi S, Sivalingam, Krishna M., ZantiTaieb, "Wireless Sensor Network", Springer 1st Ed. 2004 (ISBN: 978-4020-7883-5).
3. Kazem, Sohraby, Daniel Minoli, TaiebZanti, "Wireless Sensor Network: Technology,

Protocols and Application", John Wiley and Sons 1st Ed., 2007 (ISBN: 978-0-471-74300-2).

4. B. Krishnamachari, "Networking Wireless Sensors", Cambridge University Press.
5. N. P. Mahalik, "Sensor Networks and Configuration: Fundamentals, Standards, Platforms, and Applications" Springer Verlag..

Wireless MIMO Communications

Subject Code: 17CNE223 **Credits: 04**
Hrs /week: 4+0+0+0 **Total Hours: 52**

Course Learning Objectives

This Course will enable students to

- Understand MIMO propagation modelling
- Understand space time coding technique
- Understand MIMO multi-antenna systems
- Illustrate high speed communication concepts with MIMO

Prerequisites:

Student must have fundamental knowledge of Wireless Networks.

Unit I **8 Hours**

MIMO Propagation Modeling, Deterministic Propagation Modelling with Ray Tracing, Stochastic Propagation Modeling, The 3GPP MIMO Channel Mode.

Unit II **10 Hours**

Theory and Practice of MIMO Wireless Communication Systems, Information Theory and Electromagnetism: It's Relationship.

Unit III **12 Hours**

Introduction to Space–Time Coding, Feedback Techniques for MIMO Channels, Antenna Selection in MIMO Systems, Performance of Multi-User Spatial Multiplexing.

Unit IV **12 Hours**

Channel Data, Multiuser MIMO for UTRA FDD, Multifunctional Reconfigurable Micro electromechanical Systems, Integrated Antennas for MIMO Systems, Multi Antenna Test beds for Wireless Communications.

Unit V **10 Hours**

Gigabit Mobile Communications Using Real-Time MIMOOFDM Signal Processing, Network Planning and Deployment Issues for MIMO Systems.

Course Outcomes:

At the end of the course the student will be able to

Sl. No.	Course Outcome (CO)	Bloom's Taxonomy Level (BTL)
C223.1	Analyse MIMO propagation modelling	4
C223.2	Understand Theory and Practice of MIMO Wireless Communication Systems	2
C223.3	Understand space time coding technique	2
C223.4	Analyse MIMO multi-antenna systems	4

C223.5	Illustrate high speed communication concepts with MIMO	2

Mapping Course Outcomes with Programme Outcomes:

Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
C223.1	**M**											**L**
C223.2	**M**	**L**	**L**					**M**				**M**
C223.3	**L**							**L**				**L**
C223.4	**L**	**M**						**L**				**M**
C223.5	**L**											**H**

(L = Low 30%-49%, M = Medium 50%-69%, H = High >70%)

Reference Books:

1. "MIMO System Technology for Wireless Communications", George Tsoulos, CRC Press.

Digital Forensics for Networks

Subject Code: 17CNE224 **Credits: 04**
Hrs /week: 4+0+0+0 **Total Hours: 52**

Course Learning Objectives

This Course will enable students to

- Understand the basics of computer forensics and investigations
- Evaluate methods of packet capture and analysis
- Determine methods to incident report planning
- Evaluate commercial applications available for network forensics.
- Understand the legal implications and challenges with digital forensics.

Prerequisites:

Student must have fundamental knowledge of Networks and security.

Unit I **8 Hours**

Computer Forensics and Investigations, Data Acquisition, Working with windows and DOS Systems, Computer Forensics Tools, Forensics Analysis and Validation. Introduction to the Incident Response Process, Investigative and Forensics Methodologies.

Unit II **12 Hours**

Capturing Network Traffic: The Importance of DHCP Logs, Using TCPDump/WinDump, Using Wireshark, Using SPAN Ports or TAPS, Using Fiddler, Firewalls, Placement of Sensors. Using Snort for Network-Based Forensics: ***IDS*** **Overview, Snort Architecture, Snort** Preprocessor Component, Snort Detection Engine Components, Network Forensics Evidence Generated with Snort

Unit III **12 Hours**

Other Network Evidence: Overview of Botnets and Other Network-Aware Malware, Temporal, Relational, and Functional Analyses and Victimology, First Responder Evidence, Dynamic Evidence Capture, Malware Analysis: Using Sandbox Technology. **Deciphering a TCP Header:** OSI and TCP Reference Models, TCP Header, Decipherment of a TCP Segment, TCP Signature Analysis.

Incorporating Network Forensics into Incident Response Plans: Investigation Method, Incident Response, DMCA Violations, Web Site Compromise: Search Engine Spam and Phishing

Unit IV **10 Hours**

Commercial NetFlow Applications: What Is NetFlow?, What Is an FNF?, What Is an sFlow?, Which Is Better: Net Flow or sFlow?, Scrutinizer, Using Flow Analytics to Identify Threats within NetFlow.

NetWitness Investigator: NetWitness Investigator Architecture, Import/LiveCapture Network Traffic, Collections, Parsers, Feeds, and Rules, Navigation Views, Data Analysis, Exporting Captured Data

Unit V **10 Hours**

Legal Implications and Considerations: Internet Forensics, Cloud Forensics, International

Complexities of Internet and Cloud Forensics. Network Forensics Examiner Skills, Network Forensics Investigation Life Cycle. Today's Challenges with Existing Devices for Network Forensics, Network Forensics Quadrants of Focus Network Forensics Analysis Tools.

Course Outcomes:

At the end of the course the student will be able to

Sl. No.	Course Outcome (CO)	Bloom's Taxonomy Level (BTL)
C224.1	Understand the basics of computer forensics and investigations	2
C224.2	Evaluate methods of packet capture and analysis	5
C224.3	Analyse methods to incident report planning	4
C224.4	Evaluate commercial applications available for network forensics	5
C224.5	Understand the legal implications and challenges with digital forensics	2

Mapping Course Outcomes with Programme Outcomes:

Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
C224.1	**M**											
C224.2	**M**	**L**	**L**					**M**				**M**
C224.3	**L**							**L**				**L**
C224.4	**L**	**H**		**L**				**L**				**M**
C224.5	**L**											**H**

(L = Low 30%-49%, M = Medium 50%-69%, H = High >70%)

References:

1. Clint Garrison; Digital Forensics For Network, Internet and Cloud Computing, Syngres.
2. Bill Nelson, Amelia Phillips, Christopher Stuart; Guide to Computer Forensics and Investigations, Fourth Edition.

Wireless Broadband Networks

Subject Code: 17CNE225 **Credits: 04**
Hrs /week: 4+0+0+0 **Total Hours: 52**

Course Learning Objectives

This Course will enable students to

- Understand the basics of Wireless broadband networks
- Evaluate methods of medium access control
- Determine the routing protocol for multihop wireless broadband networks
- Evaluate applications available for wireless local area network

Understand the legal implications and challenges with digital forensics.

Prerequisites:

Student must have fundamental knowledge of Wireless Networks.

UNIT I **12 Hours**

Orthogonal Frequency-division multiplexing and other clock based transmissions; Wireless communication systems, Block-based Transmissions, Orthogonal Frequency division Multiplexing Systems, Single-carrier Cyclic Prefix Systems, Orthogonal Frequency-division Multiple Access, Single-carrier Frequency-division Multiple Access, CP-based Code Division Multiple Access, Receiver Design. Multiple-input, Multiple-output Antenna systems: Introduction, MIMO System Model, channel Capacity, Diversity, Diversity and Spatial Multiplexing Gain, SIMO Systems, MISO Systems, Space-Time Coding, MIMO Transceiver Design, SVD-based Eigen Beam forming, MIMO for Frequency-Selective Fading Channels, Transmitting Diversity for Frequency-Selective Fading Channels, Cyclic Delay Diversity. Ultra wideband: Introduction, Time-Hopping Ultra wideband, Direct-Sequence Ultra wideband, Multiband, Other Types of UWB.

UNIT II **10 Hours**

Medium Access Control: Introduction, Slotted ALOHA MAC, CSMA-CA MAC, Polling MAC, Reservation MAC, Energy-Efficient MAC, Multichannel MAC, Directional-Antenna MAC, Multihop Saturated Throughput of IEEE 802.11 MAC, Multiple Access Control. Mobility Resource Management: Types of Handoffs, Handoff Strategies, Channel Assignment Schemes, Multiclass Channel Assignment Schemes, Location Managements, Mobile IP, Cellular IP, HAWAII.

UNIT III **10 Hours**

Routing Protocols for Multihop Wireless Broadband Networks: Multihop Wireless Broadband Networks: Mesh Networks, Importance of Routing Protocols, Routing Metrics, Classification of Routing Protocols, MANET Routing Protocols. Radio Resource Management for Wireless Broadband Networks: Packet Scheduling, Admission Control.

UNIT IV **8 Hours**

Ad Hoc Wireless Sensor Networks (WSNs), Communication Coverage, Sensing Coverage, Localization Routing, Function Computation, Scheduling, S-MAC, IEEE 802.15.4 (Zigbee)

UNIT V **12 Hours**

Wireless Local Area Network: Network Architectures, Physical Layer of IEEE802.11n.

Medium Access Control, Mobility Resource Management, Quality of Services, Applications. Wireless Personal Area Network: Network Architectures, Physical Layer of IEEE802.11n. Medium Access Control, Mobility Resource Management, Routing Quality of Services, Applications. Convergence of Networks: 3GPP/WLAN Interworking, IEEE 802.11u, Interworking with External Networks, LAN/WLAN/WiMax/3G Interworking based on IEEE 802.22 Media Independent Handoff, Future Cellular/WiMax/WLAN/WPAN Interworking, Analytical Model for Cellular/WLAN Interworking.

Course Outcomes:

At the end of the course the student will be able to

Sl. No.	Course Outcome (CO)	Bloom's Taxonomy Level (BTL)
C225.1	Understand the fundamentals of wireless broadband networks	2
C225.2	Analyse different methods of medium access control	4
C225.3	Apply routing protocol for multihop wireless broadband networks.	3
C225.4	Understand Adhoc wireless sensor network	2
C225.5	Evaluate applications available for wireless local area network	5

Mapping Course Outcomes with Programme Outcomes:

Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
C225.1	**M**											**H**
C225.2	**M**	**L**	**L**					**M**				**M**
C225.3	**L**							**L**				**L**
C225.4	**L**							**L**				**M**
C225.5	**L**	**M**	**M**	**L**								**H**

(L = Low 30%-49%, M = Medium 50%-69%, H = High >70%)

Text Books:

1. Wireless Broadband Networks, David Tung Chong Wong, Peng-yong Kong, YingchangLiang, John Wiley & Sons.

Cyber Security and Cyber Law

Subject Code: 17CNE226 **Credits: 04**

Hrs /week: 4+0+0+0 **Total Hours: 52**

Course objectives

This course will enable students to

- Define the area of cybercrime and forensics.
- Explain the motive and causes for cybercrime, detection and handling.
- Investigate Areas affected by cybercrime.
- Illustrate tools used in cyber forensic
- Infer legal Perspectives in cyber security

UNIT-I **12 Hours**

Introduction to Cybercrime: Cybercrime: Definition and Origins of the Word, Cybercrimeand Information Security, Who are Cybercriminals?,Classifications of Cybercrimes, Cybercrime: The Legal Perspectives, Cybercrimes: An Indian Perspective, Cybercrime and the Indian ITA 2000, A Global Perspective on Cybercrimes, Cybercrime Era: Survival Mantra for the Netizens. Cyberoffenses: How Criminals Plan Them: How Criminals Plan the Attacks, Social Engineering, Cyberstalking, Cyber cafe and Cybercrimes, Botnets: The Fuel for Cybercrime, Attack Vector, Cloud Computing.

UNIT-II **10 Hours**

Cybercrime: Mobile and Wireless Devices: Introduction, Proliferation of Mobile andWireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication Service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for organizations, Organizational Measures for Handling Mobile, Organizational Security Policies and Measures in Mobile Computing Era, Laptops

UNIT-III **10 Hours**

Tools and Methods Used in Cybercrime: Introduction, Proxy Servers and Anonymizers,Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan Horses and Backdoors, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Overflow, Attacks on Wireless Networks. Phishing and Identity Theft: Introduction, Phishing, Identity Theft (ID Theft).

UNIT-IV **10 Hours**

Understanding Computer Forensics: Introduction, Historical Background ofCyberforensics, Digital Forensics Science, The Need for Computer Forensics, Cyberforensics and Digital Evidence, Forensics Analysis of E-Mail, Digital Forensics Life Cycle, Chain of Custody Concept, Network Forensics, Approaching a Computer Forensics Investigation, Setting up a Computer Forensics Laboratory: Understanding the Requirements, Computer Forensics and Steganography, Relevance of the OSI 7 Layer Model to Computer Forensics, Forensics and Social Networking Sites: The Security/Privacy Threats, Computer Forensics from Compliance Perspective, Challenges in Computer Forensics, Special Tools and Techniques, Forensics Auditing, Antiforensics.

UNIT-V **10 Hours**

Introduction to Security Policies and Cyber Laws: Need for An Information SecurityPolicy, Information Security Standards – Iso, Introducing Various Security Policies andTheir Review Process, Introduction to Indian Cyber Law, Objective and Scope of the it Act, 2000, Intellectual Property Issues, Overview of Intellectual - Property – Related Legislation in India, Patent, Copyright, Law Related to Semiconductor Layout and Design, Software License.

Course Outcomes:

At the end of the course the student will be able to

Sl. No.	Course Outcome (CO)	Bloom's Taxonomy Level (BTL)
C226.1	Define cyber security, cyber law and their roles	1
C226.2	Demonstrate cyber security cybercrime and forensics.	2
C226.3	Infer legal issues in cybercrime	3
C226.4	Design tools and methods used in cybercrime and security.	5
C226.5	Illustrate evidence collection and legal challenges	2

Mapping Course Outcomes with Programme Outcomes:

Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
C226.1	**H**		**L**	**M**					**M**	**L**		
C226.2	**M**	**L**	**H**									
C226.3	**L**	**H**	**M**	**M**								
C226.4		**H**		**H**								
C226.5	**H**	**H**	**H**	**M**	**M**				**L**			

(L = Low 30%-49%, M = Medium 50%-69%, H = High >70%)

Text Books:

1. SunitBelapure and Nina Godbole, "Cyber Security: Understanding Cyber Crimes, ComputerForensics And Legal Perspectives", Wiley India Pvt Ltd, ISBN: 978-81-265-21791, PublishDate 2013
2. Dr. Surya PrakashTripathi, RitendraGoyal, Praveen Kumar Shukla, KLSI. "Introduction toinformation security and cyber laws". Dreamtech Press. ISBN: 9789351194736, 2015

Reference Books:

1. Thomas J. Mowbray, "Cybersecurity: Managing Systems, Conducting Testing, andInvestigating Intrusions", Copyright © 2014 by John Wiley & Sons, Inc, ISBN: 978 -1-118 -84965 -1
2. James Graham, Ryan Olson, Rick Howard, "Cyber Security Essentials", CRC Press, 15-Dec 2010