DEPARTMENT OF INFORMATION SCIENCE AND ENGINEERING

MASTER OF TECHNOLOGY

in

Computer Network Engineering

VISION

The Department will provide quality and value-based education to produce innovative world-class computing engineers and will enhance quality research for the betterment of society

MISSION

- To impart high quality training, education and competence in information science domain through best-in class faculty and facilities
- To produce globally acceptable information science graduates who can contribute professionally to the industry and research activities by offering courses on emerging technologies.
- To provide platforms to work effectively and innovatively in multi-disciplinary domain.

PROGRAM EDUCATIONAL OBJECTIVES

PEO – 1: Graduates will have an understanding of computer networks and related skills necessary for successful careers.

PEO – 2: Graduate will be able to engage in higher studies or conduct research.

PROGRAM SPECIFIC OUTCOMES

PSO – 1: Problem Solving Skills: Design and implement solutions for solving problems in Computer networks.

PSO – 2: Professional Skills: Ability to demonstrate professional competence in communication skills, projects and involve in life-long learning

PROGRAM OUTCOMES

PO – 1: An ability to independently carry out research / investigation and development work to solve practical problems in computer networks.

PO – 2: An ability to write and present a substantial technical report/document.

PO – 3: An ability to demonstrate a degree of mastery over the area with respect to Computer networking.

PO – 4: An ability to use and apply software tools in networking, handling project management with social and economic factors into consideration.

PO – 5: An ability to demonstrate in life-long learning and assess outcome, based on knowledge and engineering skills in computer networks.

CORE – Theory

AMT1C01	Applied Engineering Mathematics	(4-0-0) 4
MCN1C02	Wireless Adhoc Network	(4-2-0) 5
MCN1C03	Advances in Computer Networks	(4-0-0) 4
MCN1C04	Information and Network Security	(4-2-0) 5
MCN1CRM	Research Methodology	(2-0-0) 2
MCN2C01	Cyber Crime and Digital forensic	(4-2-0) 5
MCN2C02	Cloud Computing	(4-2-0) 5
MCN2C03	Protocol Engineering	(4-0-0) 4
MCN2C04	Network Management	(3-0-2) 4

CORE – Lab

MCN1L01	Advance Computer Networks lab	(0-0-2) 1
MCN2L01	Cryptography and Network security lab	(0-0-2) 1

DEPT. ELECTIVE – I

MCN1E101	Multi core Architecture and programming	(3-0-0) 3
MCN1E102	Multimedia Communications	(3-0-0) 3
MCN1E103	Intrusion Detection and Prevention Systems	(3-0-0) 3
MCN1E104	Client server Programming	(3-0-0) 3
MCN1E105	Information Storage	(3-0-0) 3

DEPT. ELECTIVE – 2

MCN1E201	System Modeling and Simulation	(3-0-0) 3
MCN1E202	Principles of Information Security	(3-0-0) 3
MCN1E203	Distributed systems	(3-0-0) 3
MCN1E204	Artificial Intelligence	(3-0-0) 3
MCN1E205	Wireless Sensor Networks	(3-0-0) 3

DEPT. ELECTIVE – 3

MCN2E301	Optical Network	(3-0-0) 3
MCN2E302	Computer System performance Analysis	(3-0-0) 3
MCN2E303	Web Engineering	(3-0-0) 3
MCN2E304	Advances in Storage Area Network	(3-0-0) 3
MCN2E305	Real Time Systems	(3-0-0) 3
MCN2E306	Social Networks	(3-0-0) 3

DEPT. ELECTIVE – 4

MCN2E401	Big Data Analytics	(3-0-0) 3
MCN2E402	Computer forensics	(3-0-0) 3
MCN2E403	Human Computer Interface	(3-0-0) 3
MCN2E404	Information retrieval systems	(3-0-0) 3
MCN2E405	Advanced Digital Communication	(3-0-0) 3

INDUSTRY DRIVEN ELECTIVE

MCN2I01	Internet of Things	(2-0-0) 2
MCN2I02	Introduction to Machine Learning	(2-0-0) 2

MOOC ELECTIVE

MCN3Mxx	Management Department (12 Weeks)	(3-0-0) 3
MCN3Mxx	Open Elective (Other Department) (8 Weeks)	(2-0-0) 2

PROJECT & SEMINAR

MCN3C01	Seminar	(0-0-2) 1
MCN3C02	Internship	(0-0-10)5
MCN3C03	Project Phase-I	(0-0-14)8
MCN4C01	Project Phase – 2	(0-0-30)15

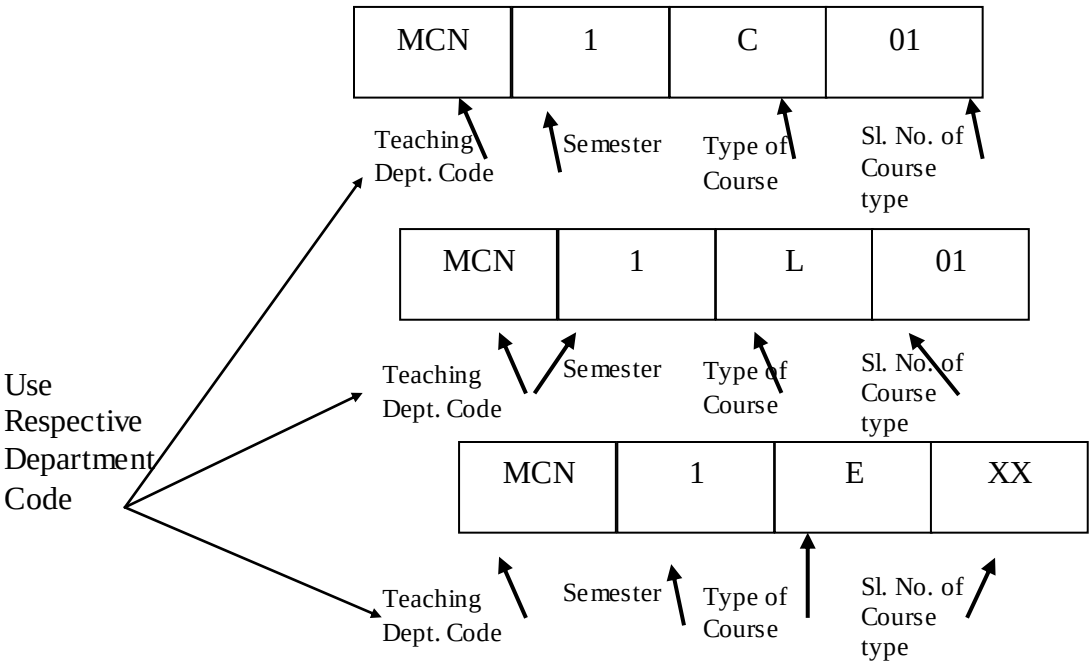
SUGGESTED PLAN OF STUDY FOR REGULAR STUDENTS
(88 Credits)

Semester / Sl. No.	I	II	III	IV
1	AMT1C01	MCN2C01	MCN3Mxx	MCN4C01
2	MCN1C02	MCN2C02	MCN3Mxx	
3	MCN1C03	MCN2C03	MCN3C01	
4	MCN1C04	MCN2C04	MCN3C02	
5	MCN1E1XX	MCN2E3XX	MCN3C03	
6	MCN1E2XX	MCN2E4XX		
7	MCN1CRM	MCN2IXX		
8	MCN1L01	MCN2L01		
Total Cr.	27	27	19	15

DEGREE REQUIREMENT

Engineering Science Core	04
Department Core	42
Department Elective	12
Industry Driven Elective	02
MOOC &Open Elective	05
Project Phase 1 & 2	23
Total	**88**

Course Numbering Scheme



SCHEME OF TEACHING AND EXAMINATION
M. TECH COMPUTER NETWORK ENGINEERING

DEPARTMENT OF INFORMATION SCIENCE AND ENGINEERING

SCHEME OF TEACHING AND EXAMINATION
I SEMESTER M. Tech.

Sl.No.	Code	Subject	Dept./Board	Hrs/week			Credits
				L	T	P	
1	AMT1C01	Applied Engineering Mathematics	Mathematics	4	0	0	4
2	MCN1C02	Wireless Adhoc Network	ISE	4	2	0	5
3	MCN1C03	Advances in Computer Networks	ISE	4	0	0	4
4	MCN1C04	Information and Network Security	ISE	4	2	0	5
5	MCN1E1XX	Department Elective-1	ISE	3	0	0	3
6	MCN1E2XX	Department Elective-2	ISE	3	0	0	3
7	MCN1CRM	Research Methodology	ISE	2	0	0	2
8	MCN1L01	Advance Computer Networks lab	ISE	0	0	2	1
			Total	**31**			**27**

Sl. No	Subject Code	Subject	Teaching Hours/ Week			Credits
			L	T	P	
Department Elective-1						
1	MCN1E101	Multi core Architecture and programming	3	0	0	3
2	MCN1E102	Multimedia Communications	3	0	0	3
3	MCN1E103	Intrusion Detection and Prevention Systems	3	0	0	3
4	MCN1E104	Client server Programming	3	0	0	3
5	MCN1E105	Information Storage	3	0	0	3

Sl. No	Subject Code	Subject	Teaching Hours/ Week			Credits
			L	T	P	
Department Elective – 2						
1	MCN1E201	System Modeling and Simulation	3	0	0	3
2	MCN1E202	Principles of Information Security	3	0	0	3
3	MCN1E203	Distributed systems	3	0	0	3
4	MCN1E204	Artificial Intelligence	3	0	0	3
5	MCN1E205	Wireless Sensor Networks	3	0	0	3

SCHEME OF TEACHING AND EXAMINATION
II SEMESTER M.Tech

Sl. No.	Code	Subject	Dept./Board	Hrs/week			Credits
				L	T	P	
1	MCN2C01	Cyber Crime and Digital forensic	ISE	4	2	0	5
2	MCN2C02	Cloud Computing	ISE	4	2	0	5
3	MCN2C03	Protocol Engineering	ISE	4	0	0	4
4	MCN2C04	Network Management	ISE	3	0	2	4
5	MCN2E3XX	Department Elective-3	ISE	3	0	0	3
6	MCN2E4XX	Department Elective-4	ISE	3	0	0	3
7	MCN2IXX	Industry Driven Elective	ISE	2	0	0	2
8	MCN2L01	Cryptography and Network security lab	ISE	0	0	2	1
			Total	**31**			**27**

Sl. No	Subject Code	Subject	Teaching Hours/ Week			Credits
			L	T	P	
Department Elective –3						
1	MCN2E301	Optical Network	3	0	0	3
2	MCN2E302	Computer System performance Analysis	3	0	0	3
3	MCN2E303	Web Engineering	3	0	0	3
4	MCN2E304	Advances in Storage Area Network	3	0	0	3
5	MCN2E305	Real Time Systems	3	0	0	3
6	MCN2E306	Social Networks	3	0	0	3

Sl. No	Subject Code	Subject	Teaching Hours/ Week			Credits
			L	T	P	
Department Elective – 4						
1	MCN2E401	Big Data Analytics	3	0	0	3
2	MCN2E402	Computer forensics	3	0	0	3
3	MCN2E403	Human Computer Interface	3	0	0	3
4	MCN2E404	Information retrieval systems	3	0	0	3
5	MCN2E405	Advanced Digital Communication	3	0	0	3

Sl. No	Subject Code	Subject	Teaching Hours/ Week			Credits
			L	T	P	
Industry Driven Electives						
1	MCN2I01	Internet of Things	2	0	0	2
2	MCN2I02	Introduction to Machine Learning	2	0	0	2

SCHEME OF TEACHING AND EXAMINATION
III SEMESTER M.Tech.

Sl. No.	Subject Code	Subject	L	T	P	Credits
1	MCN3Mxx	Management Department (12 Weeks)	3	0	0	3
2	MCN3Mxx	Open Elective (Other Department) (8 Weeks)	2	0	0	2
3	MCN3C01	Seminar	0	0	0	1
4	MCN3C02	Internship	0	0	0	5
5	MCN3C03	Project Phase-I	0	0	0	8
	Total Credits					**19**

SCHEME OF TEACHING AND EXAMINATION
IV SEMESTER M.Tech

Sl.No.	Subject Code	Subject	L	T	P	Credits
1	MCN4C01	Project- Phase-2	0	0	0	15
	Total Credits					**15**

APPLIED ENGINEERING MATHEMATICS (4-0-0) (Core)

Sub Code: AMT1C01 **CIE:50 Marks**

Hrs / Week: 04 **SEE: 50% Marks**

SEE Hrs: 03 Hours **Max Marks: 100**

***Course Outcomes*:**

On successful completion of the course, the students will be able to:

1. Construct the matrix, digraphs of relations and explain some results on different types of relations and solve problems associated with equivalence relations.
2. Identify different types of functions, compute composition and inverse of a function and solve problems using pigeon-hole principle.
3. Apply Euclidean algorithm, Chinese remainder, Fermat's and Wilsons theorems to solve the problems in Number Theory.
4. Solve problems associated with discrete & continuous probability distributions.
5. Compute measures of central tendency, dispersion, skewness and kurtosis for a given statistical data.
6. Solve problems on joint distribution, Markov chain using transition probability matrix and also problems on queuing theory.

Module 1 **9 Hours**

Relations Binary relations, Matrix and Digraph representation of a relation, Operations on binary relations, Properties of relations, Equivalence relations

Self Learning Exercise: Composition of relations.

Module 2 **8 Hours**

Functions Function, Types of functions, Composition of functions, Invertible functions, Recursive function, The Pigeonhole-principle

Self Learning Exercise: Hash function.

Module 3 **9 Hours**

Number Theory Euclidean Algorithm, Chinese Remainder theorem, Generalized Chinese Remainder theorem, Fermat's little theorem, Euler's theorem (no proof), Pseudo primes, Fermat's pseudo primes

Self Learning Exercise: Primality Testing.

Module 4 **9 Hours**

Probability Random variables – Discrete and continuous random variables, Binomial, Poisson's, Exponential and Normal Distributions

Self Learning Exercise: Basic probability upto Baye's Theorem.

Module 5 **8 Hours**

Statistics Moments, Skewness – test of skewness, uses of skewness, measure of skewness by Karl pearson's, Bowley's methods and skewness based on third moment, Kurtosis

Self Learning Exercise: Measures of central tendency, Measures of dispersion

Module 6 **9 Hours**

Joint Distribution and Markov Chains

Concept of joint probability: Joint probability distribution, (discrete) Independent random variables, Expectation, Covariance, Correlation Coefficient. Probability vectors, Stochastic matrices, Regular stochastic matrices, Markov chains, Transition Probability Matrix. Concept of a queue, the M/G/I and M/M/I queuing systems

Self Learning Exercise: Continuous joint probability distributions.

Books for Reference:

1. Discrete Mathematics and its Applications – Kenneth.H.Rosen V edition
2. Elements of Discrete Mathematics – C.L. Liu, D.P. Mohapatra.
3. "Elementary Number Theory With Applications", Thomas Koshy,ISBN-13:9788131218594, 2008, Reed Elsevier India Pvt.Ltd..
4. Probability and Statistics – Schaum Series **(**All latest editions**)**
5. Probability, Statistics and Random Processes-3rd Edition,TataMcGraw-Hill Publishing Company Limited, New Delhi,2008 - T.Veerarajan

WIRELESS ADHOC NETWORK (4-2-0) (Core)

Sub Code: MCN1C02 **CIE:50 Marks**

Hrs / Week: 06 **SEE: 50% Marks**

SEE Hrs: 03 Hours **Max Marks: 100**

***Course Outcomes*:**

On successful completion of the course, the students will be able to:
1.Explain wireless sensor networks and MAC Protocols.
2.Discuss the working of routing protocols.
3.Apply the knowledge of Multicast Routing in Ad hoc Wireless Networks.
4.Compare different Transport Layer and Security Protocols for Adhoc Networks.
5.Describe the necessary of QoS and QoS Protocols.
6. Discuss Energy Management issues.

Module-1 10 Hours

Ad hoc Wireless 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, Design Goals of MAC Protocols, Classification of MAC protocols, Contention-Based Protocols, Contention-Based Protocols with Reservation Mechanisms, Contention-Based Protocols with Scheduling Mechanisms,

***Self Learning Exercise*:** MAC Protocols that Use Directional Antennas

Module-2 10 Hours

Routing Protocols for Ad Hoc Wireless Networks: Introduction, Issues in Designing a Routing Protocol for Ad hoc Wireless Networks; Classification of Routing Protocols; Table Driven Routing Protocols: Destination Sequenced Distance-Vector Routing Protocol, Cluster- Head Gateway Switch Routing Protocol; On-Demand Routing Protocols: Dynamic Source Routing Protocol, Ad Hoc On-Demand Distance-Vector Routing Protocol, Location-Aided Routing, Associativity-Based Routing, Hybrid Routing Protocols: Zone Routing Protocol, Hierarchical Routing Protocols: Hierarchical State Routing Protocol

***Self Learning Exercise*:**Power-Aware Routing Protocols

Module-3 9 Hours

Multicast Routing in Ad hoc Wireless Networks: Issues in Designing a Multicast Routing Protocol, Operation of Multicast Routing Protocols, An Architecture Reference Model for Multicast Routing Protocols, Classifications of Multicast Routing Protocols, Tree-Based Multicast Routing Protocols: Bandwidth-Efficient Multicast Routing Protocol, Preferred Link- Based Multicast Protocol,

***Self Learning Exercise*:** Mesh-Based Multicast Routing Protocols: On-Demand Multicast Routing Protocol.

Module-4 **9 Hours**

Transport Layer and Security Protocols for Ad hoc Networks: Introduction, Issues in Designing a Transport Layer Protocol; Design Goals of a Transport Layer Protocol; Classification of Transport Layer Solutions; TCP over Transport Layer Solutions: Why Does TCP Not Perform Well in Ad Hoc Wireless, TCP with Explicit Link Failure Notification, TCP- Bus, Split TCP, A Comparison of TCP Solutions for Ad Hoc Wireless Networks; Security in Ad hoc Wireless Networks, Issues and Challenges in Security Provisioning, Network Security Attacks: Transport Layer Attacks, Application Layer Attacks, Other Attacks; Key Management: Symmetric Key Algorithms, Asymmetric Key Algorithms, Key Management Approaches.

***Self Learning Exercise*:** Security-Aware Ad Hoc Routing Protocol.

Module-5 **7 Hours**

Quality of Service Introduction, Issues and Challenges in Providing QoS in Ad hoc Wireless Networks, Classification of QoS Solutions, MAC Layer Solutions: IEEE 802.11e, DBASE, Network Layer Solutions: Ticket- Based QoS Routing Protocol, Bandwidth Routing Protocol, On-Demand QoS Routing Protocol ;

***Self Learning Exercise*:**Casestudy on QoS.

Module-6 **7 Hours**

Energy Management in Ad hoc Wireless Networks: Introduction, Need for Energy Management in Ad hoc Wireless Networks, Classification of Energy Management Schemes, Battery Management Schemes, Transmission Management Schemes,

***Self Learning Exercise*:**System Power Management Schemes.

TUTORIALCOMPONENT:

Note: Standard Network Parameters and supporting protocols may be assumed for simulation. Any suitable network simulator may be used. (Preferably NS2 or NS3 Simulator)

1. Develop unicast routing protocols using any suitable Network Simulator for (Mobile Ad hoc Networks) MANET to find the best route using the any one of routing protocols from each category from table-driven (e.g., link state or DSDV) on demand (e.g., DSR, AODV, TORA), hybrid (e.g., ZRP, contact-based architectures) and hierarchical (e.g., cluster based.) The efficient path/route should be established for source and destination data transmission using routing protocols. Understand the advantages and disadvantages of each routing protocol types by observing the performance metrics of the routing protocol. In that way the best application/environment suitable routing protocol can be identified in each category.

2. Develop multicast routing protocols using any suitable Network Simulator for MANET in which session nodes are connecting through either tree(MAODV, MCEDAR) or mesh (ODMRP,CAMP, FGMP) structure. Analyze the performance metrics of multicast routing protocols with unicast routing protocols.

3. Develop MAC Protocol using any suitable Network Simulator for MANETs to send the packet without any contention through wireless link using the following MAC protocols; (CSMA/CA (802.11), MACA, MACAW, PAMAS, SMAC). Analyze its performance with increasing node density and mobility.

4. Analyze the performance of TCP connection when it is used for wireless networks. You will find performance of TCP decreases dramatically when a TCP connection traverses a wireless link on which packets may be lost due to wireless transmission errors. Make use of Active Queue Management Technique to control congestion on Wireless Networks. Evaluate the performance of FIFO, RED and WFQ over wireless networks using suitable Network Simulator.

5. Simulate MANET environment using suitable Network Simulator and test with various mobility model such as Random way point, group mobility, highway model, Manhattan model, hybrid models) (Spatial correlation, temporal correlation, relative speed, link durations). Analyze throughput, PDR and delay with respect to different mobility models.

Text Book:

1. C. Siva Ram Murthy & B. S. Manoj: Ad hoc Wireless Networks, 2nd Edition, Pearson Education, 2011

References:

1. Ozan K. Tonguz and Gianguigi Ferrari: Ad hoc Wireless Networks, John Wiley,2007.
2. Xiuzhen Cheng, Xiao Hung, Ding- Zhu Du: Ad hoc Wireless Networking, Kluwer Academic Publishers,2004

ADVANCES IN COMPUTER NETWORKS (4-0-0) (Core)

Sub Code: MCN1C03 **CIE:50 Marks**

Hrs / Week: 04 **SEE: 50% Marks**

SEE Hrs: 03 Hours **Max Marks: 100**

***Course Outcomes*:**

On successful completion of the course, the students will be able to:

1. Describe the effect of performance in network
2. Explain the network addressing and subnetting in design of networks.
3. Differentiate between RIP and OSPF
4. Discuss the performance of sliding window protocol
5. Compare FIFO and fair queueing
6. Distinguish DEC bit and RED.

Module-1 Foundation **9 Hours**

Building a Network, Requirements, Perspectives, Scalable Connectivity, Cost-Effective Resource sharing, Support for Common Services, Manageability, Protocol layering, Performance, Bandwidth and Latency, Delay X Bandwidth Product, Perspectives on Connecting,

Classes of Links, Reliable Transmission, Stop-and-Wait, Sliding Window

***Self Learning Exercise*: ConcurrentLogical Channels.**

Module 2: Internetworking- I **9 Hours**

Switching and Bridging, Datagrams, Virtual Circuit Switching, Source Routing, Bridges and LAN Switches, Basic Internetworking (IP), What is an Internetwork? Service Model, Global Addresses, Datagram Forwarding in IP, subnetting and classless addressing, Address Translation(ARP), Host Configuration(DHCP), Error Reporting (ICMP).

***Self Learning Exercise*: Virtual Networksand Tunnels.**

Module-3Internetworking- II **10 Hours**

Network as a Graph, Distance Vector(RIP), Link State(OSPF), Metrics, The Global Internet, Routing Areas, Routing among Autonomous systems(BGP), IP Version 6(IPv6), Mobility

***Self Learning Exercise*:Mobile IP**

Module-4End-to-End Protocols **10 Hours**

Simple Demultiplexer (UDP), Reliable Byte Stream(TCP), End-to-End Issues, Segment Format, Connecting Establishment and Termination, Sliding Window Revisited, Triggering Transmission, Adaptive Retransmission, Record Boundaries.

***Self Learning Exercise*:TCP Extensions**

Module-5 Queuing **7 Hours**

Queuing Disciplines, FIFO, Fair Queuing, TCP Congestion Control, Additive Increase / Multiplicative Decrease, Slow Start, Fast Retransmit

***Self Learning Exercise*:FastRecovery.**

Module -6Congestion Control and Resource Allocation 7 Hours

Congestion-Avoidance Mechanisms, DEC bit, Random Early Detection (RED), Source-Based Congestion Avoidance. The Domain Name System (DNS), Electronic Mail (SMTP,POP,IMAP,MIME), World Wide Web (HTTP)

***Self Learning Exercise*: Network Management (SNMP)**

Text books:

1. **T1**: **Larry Peterson and Bruce S Davis** "Computer Networks :A SystemApproach" 5th Edition,Elsevier-2014

2. **T2: Douglas E Come r, "**Internetworking with TCP/IP, Principles, Protocols and Architecture" 6th Edition, PHI -2014

References:

1. Uyless Black "Computer Networks, Protocols, Standards and Interfaces" 2nd Edition -PHI Behrouz A Forouzan "TCP/IP Protocol Suite" 4t h Edition – T

INFORMATION AND NETWORK SECURITY (4-2-0) (Core)

Sub Code: MCN1C04 **CIE:50 Marks**

Hrs / Week: 06 **SEE: 50% Marks**

SEE Hrs: 03 Hours **Max Marks: 100**

***Course Outcomes*:**

On successful completion of the course, the students will be able to:

1. Explain classical encryption technique.
2. Discuss various data encryption.
3. Describe the various Public-Key Cryptosystems.
4. Explain Key Management and distribution methods.
5. Discuss Wireless Network security.
6. Explain Web and Transport-level security.

Module -1 8 Hours

Classical Encryption Techniques:

Symmetric Cipher Model, Substitution Techniques, Transposition techniques, Steganography.

Block Ciphers and the data encryption standard: Traditional block Cipher structure, The Data Encryption Standard, A DES example, The strength of DES.

***Self Learning Exercise*: Block cipher design principles**

Module -2 8 Hours

Advanced Encryption Standard: AES Structure,AES Transformation Functions, AES Key Expansion,An AES Example, AES Implementation.

Block Cipher Operation: Multiple Encryption and Triple DES,Electronic Codebook,Cipher Block Chaining Mode,Cipher Feedback Mode.

***Self Learning Exercise*: Output Feedback Mode, Counter Mode.**

Module -3 9 Hours

Public-Key Cryptography and RSA: Principles of Public-Key Cryptosystems. The RSA Algorithm, Diffie-Hellman Key Exchange.

Other Public-Key Cryptosystems: Elgamal Cryptographic Systems, Elliptic Curve Arithmetic, Elliptic Curve Cryptography,

***Self Learning Exercise*: Pseudorandom number generation based on an asymmetric cipher.**

Module-4 10 Hours

Cryptographic Hash Functions: Applications of Cryptographic Hash Functions, Secure Hash Algorithm (SHA).

Message Authentication Codes: Message Authentication Requirements, MACs Based on Hash Functions: HMAC.

Digital Signatures: Digital Signatures, Elgamal Digital Signature Scheme.

Key Management and Distribution: Symmetric key distribution using Symmetricencryption, Symmetric key distribution using asymmetric encryption, Distribution of public keys.

User Authentication: Remote user Authentication principles, Kerberos.

***Self Learning Exercise*: X.509 Certificates , Public-Key Infrastructure**

Module -5 **9 Hours**

Network Access Control and Cloud Security: Network Access Control,Extensible Authentication Protocol, IEEE 802.1X Port-Based Network Access Control, Cloud Computing, Cloud Security Risks and Countermeasures, Data Protection in the Cloud

***Self Learning Exercise*: : Cloud Security as a Service.**

Module-6 **8 Hours**

Transport-Level Security: Web Security Considerations, Transport Layer Security, **HTTPS** Connection Initiation, Connection Closure. **Secure Shell (SSH)**

Wireless network security: Wireless security, mobile device security, IEEE 802.11 Wireless LAN overview.

IP Security: IP Security Overview, IP Security Policy.

***Self Learning Exercise*: Encapsulating Security Payload**

Tutorial Component:

Module-1:

- Encrypt and decrypt a file with composite data using the following Traditional symmetric key Ciphers: Caesar Cipher, Playfair Cipher, Hill Cipher, Vigenere Cipher, Rail fence and Row-Column transformation cipher.
- For a given input with alpha-numeric data, encrypt using Data Encryption Standard (DES) algorithm and Decrypt using DES

Module-2:

- Consider an alpha-numeric data, encrypt it using Advanced Encryption Standard (AES) algorithm and Decrypt using AES

Module-3:

- Implement RSA and ElGamal cryptosystems to sign and verify a given message.

Module-4:

- Implement the Diffie-Hellman key exchange algorithm
- Implement SHA algorithm

Text Books:

1. Cryptography and Network Security Principles and Practice, 7th Edition, Global Edition, by William Stallings.

References:

1. Cryptography and Network Security, 3rd Edition, by Behrouz Forouzan and Debdeep Mukhyopadhyay.
2. Cryptography and Network Security, 4th Edition, by Atul Kahate.

E-Books:

1. Cryptography And Network Security Principles And Practice https://dl.hiva-network.com/Library/security/Cryptography-and-network-security-principles-and-practice.pdf
2. A Course in Number Theory and Cryptography Second Edition, by Neal Koblitz http://almuhammadi.com/sultan/crypto_books/Koblitz.2ndEd.pdf

MOOC:

1. Cryptography and Network Security, by Pro. Sourav Mukhopadhyay, IIT Kharagpur https://swayam.gov.in/nd1_noc20_cs21/preview
2. Cryptography 1, by Stanford https://www.coursera.org/learn/crypto

RESEARCH METHODOLOGY (2:0:0) (Core)

Sub code	**: MCN1CRM**	**CIE**	**: 50 Marks**
Hrs/week	**: 02**	**SEE**	**: 50 Marks**
SEEHrs	:02	Max. Marks:50	

***Course Outcomes*:**

On Successful completion of the course, the students will be able to:

1. Explain the basic framework of research process, research design andtechniques
2. Discuss the processes of quantitative data collection, analysis, interpretation andpresentation
3. Describe the components of scholarly writing and ethical issues inresearch

MODULE1: 10 Hrs

OVERVIEW OF RESEARCH:

Introduction to research, Objectives and motivations for research, Significance of research, Research Methods v/s Methodology, Types of research, Quantitative Research Methods, Variables, Conjecture, Hypothesis. Research Process, Steps in research process, Criteria of good Research,

Importance of literature review in defining a problem - Survey of literature - Primary and secondary sources - Reviews, - web as a source - searching the web - Identifying gap areas from literature review - Development of working hypothesis.

Research problem-definition, selection and formulation of a research problem selection, criteria of a good research problem**.** Introduction to research design, Characteristics of good researchdesign.

***Self Learning Exercise*:** Developing a research plan , Department/program specific research problem discussions

MODULE2: 12 Hrs

DATA COLLECTION, PROCESSING AND ANALYSIS:

Sources of data, collection of data, Primary and secondary Data, Collection of Data through various methods, Measurement and scaling, Sources of error in measurement. Modeling, Mathematical Models for research (brief introduction only)

Sampling: Concepts of Statistical Population, Sample, Sampling Frame, Sampling Error, Sample Size, Probability and Non Probability sampling- types and criteria for selection, Hypothesis Testing, Level of Significance and Confidence Interval, Type I and Type II errors , t-test, z-test, Correlation, Regression Analysis (brief introduction only)

***Self Learning Exercise*:** Tools for data processing, Graphical representation of Data.

MODULE3: 10 Hrs

REPORT WRITING AND ETHICS IN RESEARCH:

Writing Research Report: Format and style. Review of related literature its implications at various stages of research. (Formulation of research problem, hypothesis, interpretation and discussion of results. Major findings, Conclusions and suggestions.) Layout of a Research Paper, Research proposal, Citation of references, Reference Management Software like Zotero/Mendeley, Software for paper formatting like LaTeX/MS Office, effective technical presentation inseminars/workshops/symposiums (oral/paper/poster), articleindexing

Significance of ethical conduct in research, Ethical issues related to publishing, Plagiarism & latest regulations. Software for detection of Plagiarism

***Self Learning Exercise*:** Intellectual property rights, importance and protection, copyrights, patents, Impact factor of Journals

TEXT BOOKS:

1. Chawla, Deepak & Sondhi, Neena (2011). Research methodology: Concepts and Cases, Vikas Publishing House Pvt. Ltd.Delhi.
2. Kothari, C.R., (2014), Research Methodology, New Age International second revisededition
3. Ranjit Kumar, (2011). Research Methodology a step by step guide for beginners, Sage Publications

REFERENCE BOOKS:

1. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., (2002). An Introduction to Research Methodology, RBSAPublishers.
2. Sinha S.C. and Dhiman AK, (2002). Research Methodology, Ess, EssPublications
3. Fink A, (2009). Conducting Research Literature Reviews: From the Internet to Paper, Sage Publications
4. Donald R. Cooper and Pamela S. Schindler, (2013). Business Research Methods, TMH, New Delhi, 12thEdition.
5. John W. Creswell, (2003). Research Design, Qualitative, Quantitative and Mixed Approaches, 2ndEdition, SagePublication.
6. William G. Zikmund, Jon C. Carr, Barry Babin, Mitch Griffin, (2013). Business Research Methods, CengageLearning.

ADVANCE COMPUTER NETWORKS LAB (0-0-2) (Core)

Sub Code: MCN1L01 **CIE:25 Marks**

Hrs / Week: 04 **SET: 25 Marks**

SET Hrs: 03 Hours **Max Marks: 50**

***Course Outcomes*:**

On successful completion of the course, the students will be able to:

CO1 : Implement basic computer network algorithms

CO2 : Implementation of client server applications using Socket Programming

CO3: Simulate basic protocols using simulators.

PART A : Implement the following using C/C++ :

1. Write a program to transfer the contents of a requested file from server to the client using TCP/IP Sockets (using TCP/IP Socketprogramming).
2. Write a program to archive Traffic management at Flow level by implementing Closed Loop Control technique. (Leaky BucketAlgorithm)
3. Write a program to implement dynamic routing strategy in finding optimal path for data transmission. (Bellman fordalgorithm).
4. Write a program to implement Link State Routing (DijkstraAlgorithm).
5. Write a program for implementing the error detection technique while data transfer in unreliable network code using CRC (16-bits)Technique.
6. Write a program for providing security for transfer of data in the network. (RSAAlgorithm)
7. Write a program for encrypting 64 bit playing text using DESalgorithm.

PART B: Simulation Programs using OPNET /NS2 or any other equivalent software

1. Simulate a 3 node point to point network with duplex links between them. Set the Queue size andvary the bandwidth and find the number of packetsdropped.

2. Simulate a four-node point-to-point network, and connect the links as follows: n0->n2, n1->n2 and n2->n3. Apply TCP agent changing the parameters and determine the number of packets sent/received by TCP/UDP

3. Simulate the different types of internet traffic such as FTP and TELNET over network and analyze the throughput.

DEPARTMENT ELECTIVE-1

MULTI CORE ARCHITECTURE AND PROGRAMMING (3-0-0) (Elective)

Sub Code: MCN1E101 **CIE:50 Marks**

Hrs / Week: 03 **SEE: 50% Marks**

SEE Hrs: 03 Hours **Max Marks: 100**

***Course Outcomes*:**

On successful completion of the course, the students will be able to:

1. Explain the recent trends in the field of Computer Architecture and identify performance related parameters.
2. Discuss on system overview of threading.
3. Describe the fundamental concepts of Parallel Programming.
4. Discuss the threading and parallel programming constructs.
5. Use OpenMP for threading.

Module-1 **7 Hours**

Introduction to Multi-core Architecture: Motivation for Concurrency in software, Parallel Computing Platforms, Parallel Computing in Microprocessors, Differentiating Multi-core Architectures from Hyper-Threading Technology, Multi-threading on Single-Core versus Multi-Core Platforms Understanding Performance, Amdahl's Law

***Self Learning Exercise*:** GrowingReturns : Gustafson's Law.

Module-2 **7 Hours**

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 ThreadIs Created, Application Programming Models and Threading, Virtual Environment: VMs and Platforms, Runtime Virtualization.

***Self Learning Exercise*:**System Virtualization.

Module-3 **8 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,

***Self Learning Exercise*:** Other Alternatives of Error Diffusion.

Module-4 **8 Hours**

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.

Threading APIs : Threading APIs for Microsoft Windows, Win32/MFC Thread APIs,Threading APIs for Microsoft. NET Framework, Creating Threads, Managing Threads, Thread Pools, Thread Synchronization, POSIX Threads, Creating Threads, Managing Threads,

***Self Learning Exercise*:** Thread Synchronization, Signaling.

Module-5 **9 Hours**

Open MP: A Portable Solution for Threading: Challenges in Threading a Loop, Loop-carried 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 Multithread Execution, Data Copy- in and Copy-out,Protecting Updates of Shared Variables, Intel Taskqueuing Extension to OpenMP, OpenMP Library Functions.
***Self Learning Exercise*:**OpenMP Environment.

Text Book

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

Reference Books

1. Multicore and GPU Programming: An Integrated Approach by Gerassimos Barlas, 2015.

E-Books:

1. Multicore Programming , Increased Performance through Software Multi- threading https://mcai.github.io/resources/ebooks/Multi-Core_Programming.pdf
2. Multicore and GPU Programming: An Integrated Approach http://digilib.stmik-banjarbaru.ac.id/data.bc/18.%20Programming/18.%20Programming/2015%20Multicore%20and%20GPU%20Programming%20An%20Integrated%20Approach.pdf

MULTIMEDIA COMMUNICATIONS (3-0-0) (Elective)

Sub Code: MCN1E102 **CIE:50 Marks**

Hrs / Week: 03 **SEE: 50% Marks**

SEE Hrs: 03 Hours **Max Marks: 100**

***Course Outcomes*:**
On successful completion of the course, the students will be able to:

1. Explain the Multimedia Communication Models
2. Describe Multimedia Frame work for Standardization (2 & 3)
3. Explain different Multimedia Applications and Services
4. Discuss middleware layer for multimedia

Module-1 **8 Hours**

Introduction to Multimedia Communications: Introduction, Human communication model, Evolution and convergence, Technology framework
***Self Learning Exercise*:**Standardization framework.

Module-2 **7 Hours**

Frame work for Multimedia Standardization: Introduction, Standardization activities, Standards to build a new global information infrastructure, Standardization processes on multimedia communications
***Self Learning Exercise*:**ITU-Tmediacom2004

Module -3 **7 Hours**

Framework for multimedia, ISO/IEC MPEG-21 multimedia framework
***Self Learning Exercise*:** IETF multimedia Internet standards.

Module – 4 **8 Hours**

Application Layer: Introduction, ITU applications, MPEG applications, Mobile servers and applications.
***Self Learning Exercise*:** Universal multimedia access.

Module-5 **9 Hours**

Middleware Layer: Introduction to middleware for multimedia, Media coding, Media Streaming,
***Self Learning Exercise*:** Infrastructure for multimedia content distribution.

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, andStandards, Pearson, 2001.
2. Nalin K Sharad : Multimedia information Networking, PHI,2002.
3. Ralf Steinmetz, Klara Narstedt : Multimedia Fundamentals: Volume 1-Media Coding andContent Processing, 2nd Edition, Pearson,2003.
4. Prabhat K. Andleigh, Kiran Thakrar: Multimedia Systems Design, PHI,2003.

INTRUSION DETECTION AND PREVENTION SYSTEMS (3-0-0) (Elective)

Sub Code: MCN1E103 **CIE:50 Marks**

Hrs / Week: 03 **SEE: 50% Marks**

SEE Hrs: 03 Hours **Max Marks: 100**

***Course Outcomes*:**

On successful completion of the course, the students will be able to:

1. Explain intrusion detection and prevention concepts.
2. Analyze network protocol abuses.
3. Use of TCP dump for traffic analysis.
4. Explain Tiered Architectures.
5. Explain IDS and IPS Internals

Module – 1 **8 Hours**

Understanding Intrusion Detection:

Intrusion-Detection and Intrusion-Prevention Basics-Why IDSs and IPSs are Important – IDSand IPS Analysis Schemes- IDSIPS

***Self Learning Exercise*:**IDS and IPS Pros and Cons

MODULE - 2 **8 Hours**

Unauthorized Activity I:

General IDS Limitations -Network Protocol Abuses: ARP, IP, UDP,TCP

***Self Learning Exercise*:**ICMP.

Module - 3 **8 Hours**

Tcpdump:

Tcp dump Command Line Options-Tcp dump Output Format-Tcp dump Expressions-Bulk Capture-How Many Bytes Were Transferred in That Connection?-Tcp dump as Intrusion Detection?

***Self Learning Exercise*:**Tcpslice, Tcpflow,and Tcpjoin.

Module–4 **7 Hours**

Architecture:IDS and IPS Architecture- Tiered Architectures.

***Self Learning Exercise*:**FutureIDS

Module - 5 **8 Hours**

IDS AND IPS INTERNALS:

Information Flow in IDS and IPS-Detection of Exploits-Malicious Code Detection-OutputRoutines

***Self Learning Exercise*:**DefendingIDS/IPS.

Text Book:

1. **"Intrusion detection and Prevention"**, Carl Enrolf, Eugene Schultz, Jim Mellander, McGraw Hill, 2004

References:

1. **"Network Intrusion Detection and Prevention: Concepts and Techniques",** Ali A. Ghorbani, Wei Lu, Springer,2010.
2. **"The Practical Intrusion Detection Handbook ",** Paul E. Proctor, Prentice Hall,2001.
3. **"Intrusion Alert",** Ankit Fadia and Mnu Zacharia, Vikas Publishing house Pvt., Ltd,2007.
4. **"Intrusion Prevention Fundamentals",** Earl Carter, Jonathan Hogue, Pearson Education,2006.

CLIENT SERVER PROGRAMMING (3-0-0) (Elective)

Sub Code: MCN1E104 **CIE:50 Marks**

Hrs / Week: 03 **SEE: 50% Marks**

SEE Hrs: 03 Hours **Max Marks: 100**

***Course Outcomes*:**

On successful completion of the course, the students will be able to:

1. Analyze the requirements of the client and server environment.
2. Explain socket interface in network programming.
3. Demonstrate client/server system technologies.
4. Develop client software.
5. Explain the server software design.

Module 1 **7 Hours**

The Client Server Model and Software Design, Concurrent Processing inClient-Server Software:Introduction,Motivation, Terminology and Concepts,Introduction,Concurrency in Networks, Concurrency in Servers, Terminology and Concepts, An example of Concurrent Process Creation, Executing New Code, Context Switching and Protocol Software Design

***Self Learning Exercise*:**Concurrency andAsynchronous I/O.

Module 2 **7 Hours**

Program Interface to Protocols, the Socket Interface: Introduction, Loosely Specified Protocol Software Interface, Interface Functionality, Conceptual Interface Specification, System Calls, Two Basic Approaches to Network Communication, The Basic I/O Functions available in UNIX, Using UNIXI/O with TCP/IP, Introduction, Berkley Sockets, Specifying a Protocol Interface, The Socket Abstraction, Specifying an End Point Address, A Generic Address Structure, Major System Calls used with Sockets, Utility Routines for Integer Conversion, Using Socket Calls in aProgram.

***Self Learning Exercise*:**Symbolic Constants for SocketCallParameters.

Module 3 **7 Hours**

Algorithms and Issues in Client Software Design: Introduction, Learning Algorithms instead of Details, Client Architecture, Identifying the Location of a Server, Parsing an Address Argument, Looking up a Domain Name, Looking up a well-known Port by name, Port Numbers and Network Byte Order, Looking up a Protocol by Name, The TCP Client Algorithm, Allocating a Socket, Choosing a Local Protocol Port Number, A fundamental Problem in choosing a Local IP Address, Connecting a TCP Socket to a Server, Communicating with the Server using TCP, Reading a response from a TCP Connection, Closing a TCP Connection, Programming a UDP Client, Connected and Unconnected UDP Socket, Using Connect with UDP, Communicating with a Server using UDP, Closing a Socket thatuses UDP

***Self Learning Exercise*:** Partial Close for UDP and A Warning aboutUDPUnreliability.

Module 4 **9 Hours**

Example Client Software: Introduction, The Importance of Small Examples, Hiding Details, An Example Procedure Library for Client Programs, Implementation of Connect TCP, Implementation of Connect UDP, A Procedure that Forms Connections, Using the Example Library, The DAYTIME Service, Implementation of a TCP Client for DAYTIME, Reading from a TCP Connection, The Time Service, Accessing the TIME Service, Accurate Times and Network Delays, A UDP Client for the TIME Service, The ECHO Service, A TCP Client for the ECHO Service,

***Self Learning Exercise*:**A UDP Client for the ECHO Service.

Module 5 **9 Hours**

Algorithms and Issues in Server Software Design: Introduction, The Conceptual Server Algorithm, Concurrent Vs. Iterative Servers, Connection-Oriented Vs. Connectionless Access, Connection-Oriented Servers, Connectionless Servers, Failure, Reliability and Statelessness, Optimizing Stateless Servers, Four Basic Types of Servers, Request Processing Time, Iterative Server Algorithms, An Iterative Connection-Oriented Server Algorithm, Binding to a Well Known Address using INADDR_ANY, Placing the Socket in Passive Mode, Accepting Connections and using them. An Iterative Connectionless Server Algorithm, Forming a Reply Address in a Connectionless Server, Concurrent Server Algorithms, Master and Slave Processes, A Concurrent Connectionless Server Algorithm,Iterative, Connectionless Servers (UDP), Iterative, Connection-Oriented Servers (TCP), Concurrent, Connection-Oriented Servers (TCP):Introduction, Creating a Passive Socket, Process Structure, An example TIME Server, Introduction, Allocating a Passive TCP Socket, A Server for the DAYTIME Service, ProcessStructure, An Example DAYTIME Server, Closing Connections, Connection Termination and Server Vulnerability, Introduction, Concurrent ECHO, Iterative Vs Concurrent Implementations, Process Structure, An example Concurrent ECHO Server,

***Self Learning Exercise*:**Cleaning up Errant Processes**.**

Text Book: DouglasE.Comer, David L. Stevens: Internet working with TCP/IP–Vol. 3, Client-Server Programming and Applications, BSD Socket Version with ANSIC, 2nd Edition, Pearson, 2001.

INFORMATION STORAGE (3-0-0) (Elective)

Sub Code: MCN1E105 **CIE:50 Marks**

Hrs / Week: 03 **SEE: 50% Marks**

SEE Hrs: 03 Hours **Max Marks: 100**

***Course Outcomes*:**

On successful completion of the course, the students will be able to:

1. Explain the design of storage infrastructure.
2. Discuss efficientstorage provisioning technique and RAID.
3. Identify different components of FC SAN and fabric logintypes.
4. Describe IP SAN and NAS.
5. Discuss object-Based and Unified Storage

Module 1 **7 Hours**

Introduction to Information Storage: Information Storage, Evolution of Storage Architecture, Data Center Infrastructure.**Data Center Environment:** Application, Database Management System (DBMS), Host (Compute), Connectivity, Storage, Disk Drive Components, Disk Drive Performance, Host Access to Data, Direct- Attached Storage, Storage Design Based on Application Requirements and Disk Performance, Disk Native Command Queuing

Self LearningExercise : Virtualization and Cloud Computing, Introduction to Flash Drives.

Module 2: **8 Hours**

Data Protection: RAID, RAID Implementation Methods, RAID Array Components, RAID Techniques, RAID Levels, RAID Impact on Disk Performance, RAID Comparison, Hot Spares. **Intelligent Storage Systems:** Components of an Intelligent Storage System, Storage Provisioning

Self LearningExercise: Types of IntelligentStorageSystem.

Module 3: **8 Hours**

Fibre Channel Storage Area Networks: Fibre Channel: Overview, The SAN and Its Evolution, Components of FC SAN, FC Connectivity, Switched Fabric Ports, Fibre Channel Architecture, Fabric Services, Switched Fabric Login Types, Zoning, FC SAN Topologies

Self Learning Exercise: Virtualization inSAN.

Module 4: **8 Hours**

IP SAN and FCoE: iSCSI, FCIP, FCoE

Network-Attached Storage: General-Purpose Servers versus NAS Devices, Benefits of NAS, File Systems and Network File Sharing, Components of NAS, NAS I/O Operation, NAS Implementations, NAS File-Sharing Protocols, Factors Affecting NAS Performance

***Self Learning Exercise*:File-LevelVirtualization.**

Module 5: **8 Hours**

Object-Based and Unifed Storage: Object-Based Storage Devices, Content-Addressed Storage**Unified Storage.** Introduction to Business Continuity: Information Availability, BC Terminology, BC Planning Life Cycle, Failure Analysis, Business Impact Analysis

***Self Learning Exercise*: BCTechnologySolutions**

Text Books:

1. Information Storage and Management, 2nd Edition, Wiley- India 2009, G.Somasundaram, Alok Shrivastava

Reference Books:

1. Storage Networks Explained, Wiley India, 2003. Ulf Troppens, Rainer Erkens and WolfgangMuller
2. Storage Networks, The Complete Reference, Tata McGraw Hill, 2003. RobertSpalding
3. Storage Area Networks Essentials A Complete Guide to Understanding and Implementing SANs, Wiley India, 2002. Richard Barker and PaulMassiglia.

DEPARTMENT ELECTIVE-2

SYSTEM MODELING AND SIMULATION (3-0-0) (Elective)

Sub Code: MCN1E201 **CIE:50 Marks**

Hrs / Week: 03 **SEE: 50% Marks**

SEE Hrs: 03 Hours **Max Marks: 100**

***Course Outcomes*:**

On successful completion of the course, the students will be able to:

1. Identify situations where one should use simulation and where notto.
2. Analyze various probability distribution functions.
3. Illustrate random number generators.
4. Choose suitable data collection methods for simulation methods.
5. Evaluate simulation models.

Module-1 **8 Hours**

Introduction, General Principles: When simulation is the appropriate tool and when it is not appropriate; Advantages and disadvantages of Simulation; Areas of application; Some recent applications of Simulation; Systems and system environment; Components of a system; Discrete and continuous systems; Model of a s ystem; Types of Models; Discrete-Event System Simulation; Steps in a Simulation Study, Concepts in Discrete-Event Simulation,

***Self Learning Exercise*:**List processing.

Module-2 **8 Hours**

Statistical Models in Simulation, Queuing Models Review of terminology and concepts; Useful statistical models; discrete distributions; Continuous distributions; Poisson process; Empirical distributions, Characteristics of queuing systems; Queuing notation; Long-run measures of performance of queuing systems; Steady-state behavior of M/G/1 queue;

***Self Learning Exercise*:**Networksof queues.

Module-3 **8 Hours**

Random-Number Gene ration, Random-Variate Generation: Properties of random numbers; Generation of pseudo-random numbers; Techniques for generating random numbers; Tests for Random Numbers Random- Variate Generation: Inverse transform

technique; Acceptance-Rejection technique;

***Self Learning Exercise*:**Special properties.

Module-4 **8 Hours**

Input Modeling: Data Collection; Identifying the distribution with data; Parameter estimation; Goodness of Fit Tests; Fitting a non-stationary Poisson process; Selecting input models without data; Multivariate

***Self Learning Exercise*:** Time-Seriesinputmodels.

Module-5 **7Hours**

Verification, Calibration, and Validation of Simulation Models: Model building, verification, and validation; Verification of simulation models; Calibration andvalidation of models.

***Self Learning Exercise*:** Optimization viaSimulationA

TEXT BOOKS:

1. Jerry Banks, John S. Carson II, Barry L. Nelson, David M. Nicol: Discrete-Event System Simulation, 5th Edition, Pearson Education, 2010.

Reference Books:

1. Lawrence M. Leemis, Stephen K. Park: "Discrete – Event Simulation: A FirstCourse", Pearson Education,2006.Averill M. "Law: Simulation

PRINCIPALS OF INFORMATION SECURITY (3-0-0) (Elective)

Sub Code: MCN1E202 **CIE:50 Marks**

Hrs / Week: 03 **SEE: 50% Marks**

SEE Hrs: 03 Hours **Max Marks: 100**

***Course Outcomes*:**

On successful completion of the course, the students will be able to:

1. Explain fundamentals of Information Security and its planning.
2. Describe various security technologies essential for Information security.
3. Describe the methods and models of Information Security Maintenance.
4. Discuss underlying foundation, architecture and implementation of modern cryptosystems.
5. Explain the elements critical to implement information security.

Module-1 **8 Hours**

Introduction to Information Security: Introduction; what is security? CNSS security model; Approaches to information security implementation; The Security System Development Life Cycle; Information Security: Is it an Art or Science? Planning for Security: Introduction; Information Security Policy, Standards, and Practices.

***Self Learning Exercise*:**The Information Security Blue Print.

Module-2 **8 Hours**

Security Technology: Firewalls and VPNs: Introduction, Access control, Firewalls,Protecting Remote Connections.

Intrusion Detection, Access control and Other Security Tools: Introduction; Intrusion Detection Systems (IDS); Honey Pots, Honey Nets, and Padded cell systems; Scanning and Analysis Tools;

***Self Learning Exercise*:**Biometric Access Controls.

Module-3 **8 Hours**

Information Security maintenance: Introduction; Security Management Models; The Maintenance Model. Monitoring the External Environment, Monitoring the Internal Environment, Planning and Risk Assessment.

Digital Forensics: The Digital Forensics Team, Affidavits and Search Warrants, Digital Forensics Methodology

***Self Learning Exercise*:**Evidentiary Procedures.

Module-4 **8 Hours**

Cryptography: Cipher Methods: Substitution Cipher, Transposition Cipher, Hash Functions. **Cryptographic Algorithms:** Symmetric Encryption, Asymmetric Encryption. **Cryptographic Tools:** Public-Key Infrastructure (PKI), Digital Signatures, Digital Certificates.

***Self Learning Exercise*:**Protocols for Secure Communications and Attacks on Cryptosystems.

Module-5 **7 Hours**

Implementing Information Security: Introduction, Information Security Project Management , Technical Aspects of Implementation, Nontechnical Aspects of Implementation, Credentials of Information Security Professionals, Employment Policies and Practices.

***Self Learning Exercise*:** Information Systems Security Certification and Accreditation.

Text Books:

1. Principles of Information Security, 4th Edition, Michael E. Whitman and Herbert J. Mattord: Cengage Learning.
2. William Stallings: Network Security Essentials Applications and Standards, Person, 2000.
3. Deven N. Shah: Information Security – Principles and Practice, Wiley India, 2009.

Reference Books:

1. Behrouz A. Forouzan: Cryptography and Network Security, Tata McGraw-Hill, 2007.

E-Books:

1. Principles of Information Security, 4th Edition, Michael E. Whitman and Herbert J. Mattord: Cengage Learning
http://almuhammadi.com/sultan/sec_books/Whitman.pdf

2. William Stallings: Network Security Essentials Applications and Standards, Person, 2000.
http://index-of.es/Hack/Network%20Security%20Essentials%204th%20Edition.pdf

MOOC:

1. Information Security concepts and secure design principles
https://www.udemy.com/course/information-security-concepts-and-secure-design-principles/

2. Basic Principles of Information Security and Cyber attacks
https://www.udemy.com/course/cyber-security-technologies-and-process/

DISTRIBUTED SYSTEMS (3-0-0) (Elective)

Sub Code: MCN1E203	**CIE:50 Marks**
Hrs / Week: 03	**SEE: 50% Marks**
SEE Hrs: 03 Hours	**Max Marks: 100**

***Course Outcomes*:**

On successful completion of the course, the students will be able to:

1. Describe the principles and concepts involved in designing distributedsystems
2. Explain the general properties of networked communication necessary fordistributed systems on theInternet
3. Discuss the characteristics of protocols for communication between processes in a distributed system and external data representation.
4. Explain RPC
5. Discuss how OS support distributed system

Module-1 **9 Hours**

Characterization of Distributed Systems and System Models: Introduction, Examples of distributed systems, Resource sharing and the Web, Challenges, Architectural models.

***Self Learning Exercise*:**Two variants of the interaction model.

Module-2 **9 Hours**

Networking and Internetworking: Introduction, Networking issues for distributed systems, Types of Networks, Network principles

***Self Learning Exercise*:**The IP protocol in Internet protocols

Module-3: **7 Hours**

Inter-process Communication: Introduction, The API for the Internet protocols, External data representation and marshalling, Client -Server communication.

***Self Learning Exercise*:** Case study: Inter-process communicationinUNIX.

Module-4: **7 Hours**

Distributed Objects and Remote Invocation: Introduction, Communication between distributed objects, Remote procedure call.

***Self Learning Exercise*:** Roles for observers in distributed event notification

Module-5 **7 Hours**

Operating System Support: Introduction, The Operating system layer, protection, processes and threads.

***Self Learning Exercise*:** Monolithic kernels and microkernels in operatingsystemarchitecture**.**

Text Books:

1. George Coulouris, Jean Dollimore, Tim Kindberg: Distributed Systems, Concept and Design, 4th Edition, Pearson Education, 2009.

REFERENCE BOOKS:

1. Sukumar Ghosh: Distributed Systems, An Algorithmic Approach, Chapman &Hall / CRC,2007.
2. Pradeep K. Sinha: Distributed Operating Systems, Concepts and Design, PHI,2007.
3. Randy Chow, Theodore Johnson: Distributed Operating Systems and Algorithm Analysis, Pearson, 2009.

ARTIFICIAL INTELLIGENCE (3-0-0) (Elective)

Sub Code: MCN1E204 **CIE:50 Marks**

Hrs / Week: 03 **SEE: 50% Marks**

SEE Hrs: 03 Hours **Max Marks: 100**

***Course Outcomes*:**

On successful completion of the course, the students will be able to:

1. Discuss Artificial Intelligence and its application.
2. Categorize the properties of task environment.
3. Explain various strategies in formulation problems.
4. Compare various search techniques used in AI.
5. Computeoptimal decisions in games.

Module 1 **7 Hours**

Introduction, Definition of AI. The foundations of Artificial Intelligence. The history of artificial intelligence. Applications of AI.

***Self Learning Exercise*:** State of the artinAI.

Module 2 **8 Hours**

Intelligent agent, Agents and environments, behavior. The concept of rationality. The nature of environments. The structure of agents.

***Self Learning Exercise*:** How the components of agent's program work?

Module 3 **8 Hours**

Solving problems by searching problem solving agents, example problems, searching for solutions, uninformed search strategies, Informed (heuristic) search strategies, Heuristi functions.

***Self Learning Exercise*:** Learning heuristicsfromexperience.

Module 4 **8 Hours**

Beyond classical search Local search algorithms and optimization problems – this climbing search, simulated annealing, local beam search, genetic algorithms, local search in continuous spaces, searching with nondeterministic action searching with partial observations. Online search agents and unknown environments

***Self Learning Exercise*:** Learning in online search.

Module 5 **8 Hours**

Adversarial search Games, optimal decision in games, Alpha-beta pruning, imperfect real-time decision.

***Self Learning Exercise*:**Stochasticgames.

Textbook:

Artificial Intelligence A modern Approach Stuart Russell, Peter Norvig Third edition, Pearson publication, 2015

MOOC's :https://www.edx.org/course/artificial-intelligence-ucberkeleyx-cs188-1x

WIRELESS SENSOR NETWORKS (3-0-0) (Elective)

Sub Code: MCN1E205 **CIE:50 Marks**

Hrs / Week: 03 **SEE: 50% Marks**

SEE Hrs: 03 Hours **Max Marks: 100**

***Course Outcomes*:**

On successful completion of the course, the students will be able to:

1. Explain the sensor networks for various applicationsetups.
2. Describe the design space and conduct trade-off analysis between performance andresources.
3. Explain appropriate data dissemination protocols and model linkscost.
4. Discuss suitable medium access protocols and radiohardware.
5. Explain prototype sensor networks using commercialcomponents.

Module-1 **8 Hours**

Introduction, Overview and Applications of Wireless Sensor Networks Introduction, Basic overview of the Technology, **Applications of Wireless Sensor Networks: I**ntroduction, Background, Range of Applications, Examples of Category 2 WSN Applications, Examples of Category 1 WSN Applications.

***Self Learning Exercise*:**Another Taxonomy of WSN Technology.

Module-2 **7 Hours**

Basic Wireless Sensor Technology and Systems: Introduction, Sensor Node Technology, Sensor Taxonomy, WN Operating Environment, WN Trends, Wireless Transmission Technology and Systems: Introduction, Radio Technology Primer.

***Self Learning Exercise*:**Available Wireless Technologies.

Module-3 **7 Hours**

MAC and Routing Protocols for Wireless Sensor Networks: Introduction, Background, Fundamentals of MAC Protocols, MAC Protocols for WSNs, Sensor-MAC case Study.

Self Learning Exercise:IEEE 802.15.4 SLC:LR-WPANs StandardCaseStudy.

Module-4 **9 Hours**

Routing Protocols for Wireless Sensor Networks: Introduction, Background, Data Dissemination and Gathering, Routing Challenges and Design Issues in WSNs.

Self Learning Exercise: Routing Strategies in WSNs.

Module-5 **8 Hours**

Transport Control and Middleware for Wireless Sensor Networks

Traditional Transport Control Protocols, Transport Protocol Design Issues, Examples of Existing Transport Control Protocols, Performance of Transport Control Protocols. **Middleware for Wireless Sensor Networks:** Introduction, WSN Middleware Principles, Middleware Architecture.

***Self Learning Exercise*:** Existing Middleware.

Text Books:

1. KAZEM SOHRABY, DANIEL MINOLI, TAIEB ZNATI, "Wireless Sensor Networks: Technology, Protocols and Applications:, WILEY , Second Edition (Indian) , 2014

Reference Books:

1. Ian F. Akyildiz, Mehmet Can Vuran "Wireless Sensor Networks", Wiley2010
2. Feng Zhao & Leonidas J. Guibas, "Wireless Sensor Networks- An Information Processing Approach", Elsevier,2007.

E-Reference:

1.https://www.free-ebook-download.net/wireless-sensor-networks-and-applications/
2. https://ebookscart.com/wireless-sensor-networks-by-fadi-al-turjman-pdf-0/

II SEMESTER M. Tech.

CYBER CRIME AND DIGITAL FORENSIC (4-2-0) (Core)

Sub Code: MCN2C01 **CIE:50 Marks**

Hrs / Week: 06 **SEE: 50% Marks**

SEE Hrs: 03 Hours **Max Marks: 100**

***Course Outcomes*:**

On successful completion of the course, the students will be able to:

1. Identify the need for computer forensics
2. Analyze the computer forensictechnology
3. Describe the process of datarecovery
4. Explain legal aspects of collecting and preserving computerevidence
5. Describe computer image verification and authentication
6. Outline the reconstruction of past events.

Module –1 **9 Hours**

Computer forensics fundamentals

Introduction: what is computer forensics?, Use of computer forensics in law enforcement, Computer forensics assistance to human resources /employment proceedings, Computer forensics services, Benefits of professional forensics methodology

***Self Learning Exercise*: :** Steps taken by computer forensics specialists, who can use computer forensic evidence?

Module-2 **8 Hours**

Types of computer forensics technology

Types of military computer forensic technology, Types of law enforcement, Computer forensic technology, Types of business computer forensic technology, Occurrence of cybercrime, Cyber detectives, Fightingcyber-crime with risk –management techniques, Computer forensics investigative services

Self Learning Exercise:Forensic process improvement.

Module-3 **9 Hours**

Data recovery

Introduction of Data recovery , Data The data-recovery solution back-up and recovery, the role of back-up in data recovery,

***Self Learning Exercise*:** Computer data recovery solution

Module-4 **9 Hours**

Evidence collection and data seizure

Why collect evidence?, Collection options, Obstacles, Types of evidence, The rules of evidence, Volatile evidence, General procedure, Collection and archiving, Methods of collection, Artifacts, Collection steps, Preserving the digital crime scene, Computer evidence processing scene, Legal aspects of collecting

Self Learning Exercise: Preserving computer forensic evidence.

Module-5 **8 Hours**

Computer image verification and authentication

Special needs of evidential authentication, Practical consideration, Practical implementation, Electronic document discovery: a powerful new litigation tool, Time travel,

***Self Learning Exercise*:**Forensics identification and analysis of technical surveillance devices.

Module-6 **9 Hours**

Reconstruction past events

How to become a digital detective, Useable file formats, Unusable file formats, Converting files, Network forensics scenario, A technical approach, Destruction of e- mail, Damaging computer evidence, Documenting the intrusion on destruction of data

Self Learning Exercise:System testing.

Text Books:

1.Computer Forensics computer crime scene investigation by John R VACCA , Firewall Media, 2009 edition Reprint 2017.

Reference Books:

1. **Guide to computer forensics and investigations** by Bill Nelson, Amelia Phillips,Christopher Stuart, Cengage Learningpublications,4th edition 2013.

2. **Computer Forensics** by David Cowen -CISSP , Mc GrawHill education , Indian edition2013.

CLOUD COMPUTING (4-2-0) (Core)

Sub Code: MCN2C02 **CIE:50 Marks**

Hrs / Week: 06 **SEE: 50% Marks**

SEE Hrs: 03 Hours **Max Marks: 100**

***Course Outcomes*:**

On successful completion of the course, the students will be able to:

1. Explain the open source platforms for private cloud.
2. Illustrate Cloud computing applications and paradigms.
3. Describe importance of virtualization.
4. Explain knowledge in cloud resource virtualization and scheduling.
5. Discuss the security of virtualization and the security risks posed by cloud paradigm.
6. Use the different services provided by cloud application and build private cloud.

Module-1 **9Hours**

Introduction, Cloud Infrastructure: Cloud computing, Cloud computing delivery models and services, Ethical issues, Cloud vulnerabilities, Cloud computing at Amazon, Cloud computing the Google perspective, Microsoft Windows Azure and online services, Open-source software platforms for private clouds, Cloud storage diversity and vendor lock- in, Energy use and ecological impact, Service level agreements, User experience. Exercises

Self Learning Exercise:Software licensing.

Module-2 **9 Hours**

Cloud Computing: Application Paradigms: Challenges of cloud computing, Architectural styles of cloud computing, Workflows: Coordination of multiple activities, Coordination based on a state machine model: The Zookeeper, The Map Reduce programming model, A case study: The GrepTheWeb application , Cloud for science and engineering, High-performance computing on a cloud,

Self Learning Exercise:Cloud computing for Biology research, Social computing, digital content and cloud computing.

Module-3 **9 Hours**

Cloud Resource Virtualization: Virtualization, Layering and virtualization, Virtual machine monitors, Virtual Machines, Performance and Security Isolation, Full virtualization and paravirtualization, Hardware support for virtualization, Case Study:Xen a VMM based paravirtualization, Optimization of network virtualization, vBlades, Performance comparison of virtual machines,

***Self Learning Exercise*:**The dark side of virtualization, Exercises and problems.

Module-4 **9Hours**

Cloud Resource Management and Scheduling: Policies and mechanisms for resource management, Application of control theory to task scheduling on a cloud, Stability of a two- level resource allocation architecture, Feedback control based on dynamic thresholds, Coordination of specialized autonomic performance managers, A utility-based model for cloud-based Web services, Resourcing bundling: Combinatorial auctions for cloud resources, Scheduling algorithms for computing clouds, Fair queuing, Start-time fair queuing, Borrowed virtual time, Cloud scheduling subject to deadlines, Scheduling Map Reduce applications subject to

Self Learning Exercise:Resource management and dynamic scaling, deadlines. Exercises and problems.

Module-5 **8 Hours**

Cloud Security, Cloud Application Development: Cloud security risks, Security: The top concern for cloud users, Privacy and privacy impact assessment, Trust, Operating system security, Virtual machine Security, Security of virtualization, Security risks posed by shared images, Security risks posed by a management OS, A trusted virtual machine monitor, Amazon web services: EC2 instances, Connecting clients to cloud instances through firewalls, Security rules for application and transport layer protocols in EC2, How to launch an EC2 Linux instance and connect to it

Self Learning Exercise:How to use S3 in java.

Module-6 **8 Hours**

Cloud-based simulation of a distributed trust algorithm, A trust managementservice, A cloud service for adaptive data streaming,

***Self Learning Exercise*:**Cloud based optimal FPGA synthesis.

Text Book:

1. Dan C Marinescu: Cloud Computing Theory and Practice. Elsevier(MK) 2013.

References:

1. Rajkumar Buyya , James Broberg, Andrzej Goscinski: Cloud Computing Principles and Paradigms, Willey 2014.
2. John W Rittinghouse, James F Ransome:Cloud Computing Implementation, Management and Security, CRC Press 2013.

E-BOOKS:

1. Dr. Tim Chou's book on cloud computing-
https://docs.google.com/viewer?a=v&pid=sites&srcid=ZGVmYXVsdGRvbWFpbnxjbG91ZGNvbXB1dGluZ2NsYXNzfGd4OjJjNjlhMTdjNDdkZGE0N2Y&pli=1

MOOC's:https://www.coursera.org/course/cloudcomputing

PROTOCOL ENGINEERING (4-0-0) (Core)

Sub Code: MCN2C03 **CIE:50 Marks**

Hrs / Week: 04 **SEE: 50% Marks**

SEE Hrs: 03 Hours **Max Marks: 100**

***Course Outcomes*:**

On successful completion of the course, the students will be able to:

1. Explain the concept of protocol engineering.
2. Identify the components of protocol using communicating finite statemachine.
3. Design SDL based specification of aprotocol.
4. Apply different types of protocol verification techniques andtools.
5. Compare different types of protocol testing methods.
6. Discuss different methods to build correct protocol specification.

Module-1. **9 Hours**

Introduction, Error Control, Flow Control: Communication model, Communication Software, Communication Subsystems, Communication Protocol Definition / Representation, Formal and Informal Protocol Development Methods, Protocol Engineering Phases, Introduction to Flow Control, Window Protocols, Sequence Numbers

***Self Learning Exercise*:** Negative Acknowledgments

Module-2. **9 Hours**

Network Reference Model: Layered Architecture, NetworkServices and Interfaces, Protocol Functions: Encapsulation, Segmentation, Reassembly, Multiplexing, Addressing, OSI Model Layer Functions, TCP/IP ProtocolSuite

***Self Learning Exercise*:** ApplicationProtocols.

Module-3. **8 Hours**

Protocol Specification: 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

***Self Learning Exercise*:** RSVPspecification.

Module-4. **9 Hours**

Protocol Specification Language (SDL), Protocol Verification / Validation: Salient Features. Communication System Description using SDL, Structure of SDL. Data types and communication paths, Examples of SDL based Protocol Specifications: Question andanswer protocol, X-on-X-off protocol, Alternating bit protocol, Sliding window protocol specification, TCP protocol specification, SDL based platform for network, OSPF, BGP, Protocol Verification using FSM, ABP Verification, Protocol Design Errors, Deadlocks, Unspecified Reception, Non-executable Interactions, State Ambiguities, SDL Based Protocol Verification: ABP Verification, Liveness Properties

***Self Learning Exercise*:**Protocol validation approaches

Module-5 **8 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, Testing Multimedia Systems, quality of service test architecture(QOS), SDL Based Performance Testing of TCP, OSPF, Interoperability testing

***Self Learning Exercise*:**Scalability testing

Module-6 **9 Hours**

Protocol Synthesis and 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.

***Self Learning Exercise*:** Method and principles in protocol implementation

Text Books:

Pallapa Venkataram, Sunilkumar S. Manvi, B. Sathish Babu: Communication Protocol Engineering, PHI, 2004.

Reference Books:

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

NETWORK MANAGEMENT (3-0-2) (Core)

Sub Code: MCN2C04 **CIE:50 Marks**

Hrs / Week: 05 **SEE: 50% Marks**

SEE Hrs: 03 Hours **Max Marks: 100**

***Course Outcomes*:**

On successful completion of the course, the students will be able to:

1. Describe the importance of Network topology.
2. Differentiate between organization model and information model
3. Analyze management information base with managed objects
4. Compare RMON1 groups and functions
5. Explain the broadband network management
6. Use different network tools for managing networks.

Module-1 **9Hours**

Introduction: Analogy of Telephone Network Management, Data and Telecommunication Network Distributed computing Environments, TCP/IP-Based Networks: The Internet and Intranets, Communications Protocols and Standards- Communication Architectures, Protocol Layers and Services; Case Histories of Networking and Management – The Importance of topology , Filtering Does Not Reduce Load on Node, Some Common Network Problems; Challenges of Information Technology Managers, Network Management: Goals, Organization, and Functions- Goal of Network Management, Network Provisioning, Network Operations and the NOC, Network Installation and Maintenance; Network and System Management, Network Management Systemplatform

***Self Learning Exercise*:**Current Status and Future of Network Management.

Module-2 **8 Hours**

Basic Foundations: Standards, Models, and Language: Network Management Standards, Network Management Model, Organization Model, Information Model – Management Information Trees, Managed Object Perspectives, Communication Model; ASN.1-Terminology, Symbols, and Conventions, Objects and Data Types, Object Names, An Example of ASN.1 from ISO 8824; Encoding Structure; Macros

***Self Learning Exercise*:** Functional Model concepts

Module-3 **9 Hours**

SNMPv1 Network Management: Managed Network: The History of SNMP Management, Internet Organizations and standards, Internet Documents, The SNMP Model, The Organization Model, System Overview. The Information Model – Introduction, The Structure of Management Information, Managed Objects, Management Information Base. The SNMP Communication Model – The SNMP Architecture, Administrative Model, SNMP Specifications, SNMP Operations, SNMP MIB Group

***Self Learning Exercise*:** Functional Model for SNMP V1

Module-4 **9 Hours**

SNMP Management – RMON: Remote Monitoring, RMON SMI and MIB, RMONI1-RMON1 Textual Conventions, RMON1 Groups and Functions, Relationship Between Control and Data Tables, RMON1 Common and Ethernet Groups, RMON Token Ring Extension Groups, RMON2 – The RMON2 Management Information Base

Self Learning Exercise: RMON2 Conformance Specifications.

Module-5 **8 Hours**

Broadband NetworkManagement: Broadband AccessNetworks and Technologies: Broadband Access Networks, Broadband Access Technology; HFCT Technology: The Broadband LAN, The Cable Modem, The Cable Modem Termination System, The HFC Plant, The RF Spectrum for Cable Modem; Data Over Cable. Reference Architecture; HFC Management – Cable Modem and CMTS Management, HFC Link Management, RF Spectrum Management, DSL Technology; Asymmetric Digital Subscriber Line Technology – Role of the ADSL Access Network in an Overall Network, ADSL Architecture, ADSL Channeling Schemes, ADSL Encoding Schemes; ADSL Management – ADSL Network Management Elements, ADSL Configuration Management, ADSL Fault Management, ADSL Performance Management, SNMP-Based ADSL Line MIB, MIB Integration with Interfaces Groups in MIB-2,

***Self Learning Exercise*:**ADS Configuration Profiles.

Module-6 **9 Hours**

Network Management Applications: Configuration Management- Network Provisioning, Inventory Management, Network Topology, Fault Management- Fault Detection, Fault Location and Isolation Techniques, Performance Management – Performance Metrics, Data Monitoring, Problem Isolation, Performance Statistics; Event Correlation Techniques – Rule-Based Reasoning, Model- Based Reasoning, Case-Based Reasoning, Codebook correlation Model, State Transition Graph Model, Finite State Machine Model, Security Management – Policies and Procedures, Security Breaches and the Resources Needed to Prevent Them, Firewalls, Cryptography, Authentication and Authorization, Client/Server Authentication Systems, Messages Transfer Security, Protection of Networks from Virus Attacks, Accounting Management, Report Management

***Self Learning Exercise*:** Policy- Based Management, Service Level Management.

Text Books:

Mani Subramanian: Network Management- Principles and Practice, 2nd Pearson Education, 2010.

Reference Books:

J. Richard Burke: Network management Concepts and Practices: a Hands-On Approach, PHI,2008.

CRYPTOGRAPHY AND NETWORK SECURITY LAB(0-0-2) (Core)

Sub Code: MCN2L01	**CIE:25 Marks**
Hrs / Week: 02	**SEE: 50% Marks**
SEE Hrs: 03 Hours	**Max Marks: 50**

***Course Outcomes*:**
On successful completion of the course, the students will be able to:

1. Implementing the cryptographic algorithms
2. Analyze the time required encryption/decryption process

Lab Set

1. Design and Implement your own cipher using any programminglanguage
2. Implement following classical encryption techniques: Hill Cipher, Transposition Cipher, Playfair Cipher. Also develop a code to break the HillCipher
3. Implementation of Data EncryptionStandard
4. Implementation of Advanced Encryption Algorithm (Rijndael'sAlgorithm)
5. Design an experiment to estimate the amount of timeto
   a. Generate key pair(RSA)
   b. Encrypt n bit message(RSA)
   c. Decrypt n bit message (RSA) As function of key size, experimentwith different n-bit messages. Summarize yourconclusion.
6. Implementation of Diffie-Hellman Key ExchangeAlgorithm
7. Implementation of Digital SignatureAlgorithm
8. Implementation of MD5 hashingtechnique
9. Implementation of email security using PGP (create yourself a 1024-bit PGP key. Use your name and email address for your key label. Use PGP to verify the signature on this assignment.

DEPARTMENT ELECTIVE-3

OPTICAL NETWORK (3-0-0) (Elective)

Sub Code: MCN2E301 **CIE:50 Marks**

Hrs / Week: 03 **SEE: 50% Marks**

SEE Hrs: 03 Hours **Max Marks: 100**

***Course Outcomes*:**

On successful completion of the course, the students will be able to:

1. Explain different generations of digital transportnetworks
2. Describe the timing and synchronization in digitalnetworks
3. Describe architecture ofOTN
4. Describe theWDM
5. Explain the concept of label switching and its importance inOTN

Module-1 **8 Hours**

Introduction, Telecommunications Infrastructure, Characteristics of Optical Fiber: Three generations of Digital Transport Networks; A brief introduction to WDM and TDM; The Optical Marketplace; Key Optical Nodes; Other Key Terms; Evolution of Optical Systems; Key attributes of Optical Fiber, The Local Connections; The Backbone Connections; The Digital Multiplexing Hierarchy; The Digital Signaling Hierarchies; T1 / DS1 and T3 / DS3; The Layered Protocol Model in the Transport Network; considerations for Interworking Layer1, Layer 2, and Layer 3 Networks, The Basics; The Wavelength; The Basic Components; Structure of the Fiber; Fiber Types; Key Performance Properties of Fiber; Attenuation; Amplifier Spontaneous Emission; Chromatic Dispersion;.

***Self Learning Exercise*:** Wireless Optical Systems, Lasers

Module-2 **8 Hours**

Timing and Synchronization, SONET and SDH: 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; Synchronization Status Messages and Timing Loops, The SONET Multiplexing Hierarchy; SONET and SDH Multiplexing Structure; The SONET / SDH Frame Structure; SONET and SDH Functional Components; SONET and SDH Problem Detection; Locating and Adjusting Payload with Pointers; Virtual Tributaries in more detail; Virtual Tributaries in Virtual Containers; The Overhead Bytes;.

***Self Learning Exercise*:** Building Integrated Timing Supply, SONET and SDH Concatenation

Module-3 **8 Hours**

Architecture of Optical Transport Networks, WDM, Network Topologies and Protection Schemes: The Digital Wrapper; Control Planes; In-Band and Out-Band Control Signaling; Importance of Multiplexing and Multiplexing Hierarchies; Current Digital Transport Hierarchy;

SONET Multiplexing Hierarchy; SDH Multiplexing Hierarchy; Key Indexes and Other Terms; The New Optical Transport and Digital Transport Hierarchy; The OTN Layered Model; Encapsulation and Decapsulation Operations;
***Self Learning Exercise*:** Generic Framing Procedure.

Module-4 **7 Hours**

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, 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 o n Four-Fiber BLSR; Meshed Topologies; PONs; Ethernet in the Wide Area Backbone,
***Self Learning Exercise*:** Metro Optical Networking.

Module-5 **8 Hours**

MPLS and Optical Networks, Architecture of IP and MPLS-Based OTNs: Label Switching; FEC; Types of MPLS Nodes; Label Distribution and Binding; Label Switching and Traffic Forwarding; MPLS Support of VPNs; MPLS Traffic Engineering; Multiprotocol Lambda Switching; MPLS and Optical TE Similarities; Possibilities for the MPIS Network; Control and Data Planes Interworking, IP, MPLS, and Optical Control Planes; Interworking the three Control Planes; Management of the Planes; A Framework for the IP over Optical Networks; An Opposing View; Generalized MPLS use in Optical Networks; Bi-Directional LSPs in Optical Networks; GMPLS Extensions for G.709;
***Self Learning Exercise*:** GMPLS with SONET and SDH.

Text Books:

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

Reference Books:

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, PHI1999.

COMPUTER SYSTEM PERFORMANCE ANALYSIS (3-0-0) (Elective)

Sub Code: MCN2E302 **CIE:50 Marks**

Hrs / Week: 03 **SEE: 50% Marks**

SEE Hrs: 03 Hours **Max Marks: 100**

***Course Outcomes*:**

On successful completion of the course, the students will be able to:

1. Describe the mathematical foundations needed for performance evaluation of computer systems
2. Explain the metrics used for performance evaluation
3. Describe the analytical modeling of computer systems
4. Explain Capacity Planning and Benchmarking
5. Describe the concept of design and analysis in computer system.

Module-1 **8 Hours**

Introduction: 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,

***Self Learning Exercise*:** Setting Performance Requirements**.**

Module-2 **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,

***Self Learning Exercise*:** Markovmodels, Clustering.

Module-3 **8 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 logdata,

***Self Learning Exercise*:** Using accounting logs to answer commonly asked questions.

Module-4 **8 Hours**

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;

***Self Learning Exercise*:** Limitations of RTEs.

Module-5 **7 Hours**

Experimental Design and Analysis: Introduction: Terminology, Common mistakes in experiments, Types of experimental designs, 2k Factorial Designs, Concepts, Computation of effects, Sign table method for computing effects; Allocation of variance;

General 2k Factorial Designs, General full factorial designs with k factors: Model, Analysis of a General Design,

***Self Learning Exercise*:** Informal Methods.

Text Book:

Raj Jain: The Art of Computer Systems Performance Analysis, John Wiley and Sons, 2013.

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, 2nd Edition, Wiley India,2001.

WEB ENGINEERING (3-0-0) (Elective)

Sub Code: MCN2E303 **CIE:50 Marks**

Hrs / Week: 03 **SEE: 50% Marks**

SEE Hrs: 03 Hours **Max Marks: 100**

***Course Outcomes*:**

On successful completion of the course, the students will be able to:

1. Explain Requirement engineering for web applications.
2. Describe modeling of web applications
3. Identify different types of designs for web applications.
4. Explain Project management for web applications.
5. Discuss the characteristics of usability.

Module-1 **8 Hours**

Introduction: Motivation, Categories of web applications, Characteristics of web applications. Requirements Engineering : Introduction, Fundamentals, RE specifics in web engineering, Principles of RE for web applications, Adapting RE methods to web application development

***Self Learning Exercise*:**Outlook.

Module-2 **8 Hours**

Modeling Web Application: Introduction, Fundamentals, Modeling specifics in web engineering, Modeling requirements, Content modeling, Hypertext modeling, Presentation modeling, Customization modeling, Methods and tools, Outlook. Web Application Architectures: Introduction, Fundamentals, Specifics of web application architectures, Components of generic web application architecture, Layered architectures

***Self Learning Exercise*:**Data-Aspect Architectures.

Module-3 **8 Hours**

Technology-Aware Web Application Design: Introduction, Web design from an evolutionary perspective, Presentation design, Interaction design, Functional design, Outlook. Technologies for Web Applications: Introduction, Fundamentals, Client/Server communication on the web, Client side technologies, Document-specific technologies, Server-side technologies, Outlook. Testing Web Applications: Introduction, Fundamentals, Testing specifics in web engineering, Test approaches, Test scheme, Test methods and techniques,

***Self Learning Exercise*:** Test automation, Outlook.

Module-4 **8 Hours**

Operation and Maintenance of Web Applications: Introduction, Challenges following the launch of a web application, Content management, Usage analysis, Outlook. Web Project Management: From software project management to web project management, Challenges in

web project management, Managing web teams, Managing the development process of a web application, Outlook. The Web Application Development Process: Motivation,Fundamentals, Requirements for a web application development process, Analysis of the rational unified process.

***Self Learning Exercise*:** Analysis of extreme programming, Outlook.

Module-5 **7 Hours**

Usability of Web Applications: Motivation, What is usability? What characterizes the usability of web applications? Design guidelines, Web usability engineering methods, Web usability engineering trends, Outlook Performance of Web Applications: Introduction, What is performance? What characterizes performance of web applications, System definition and indicators, Characterizing the work load, Analytical techniques, Representing and interpreting results.

***Self Learning Exercise*:** Performance optimization methods, Outlook.

Text Book:

Gerti Kappel, Birgit Proll, SiegfriedReich, Werner Retschitzegeer (Editors): Web Engineering, Wiley India, 2007.

Reference Books:

Roger Pressman, David Lowe: Web Engineering : A Practitioner's Approach, McGraw Hill, 2008.

ADVANCES IN STORAGE AREA NETWORK (3-0-0) (Elective)

Sub Code: MCN2E304 **CIE:50 Marks**

Hrs / Week: 03 **SEE: 50% Marks**

SEE Hrs: 03 Hours **Max Marks: 100**

***Course Outcomes*:**

On successful completion of the course, the students will be able to:

1. Differentiate the server centric and storage centric networks
2. Classify the different types of Hard Disks and their configurations.
3. Discuss the various I/O techniques used in SAN, and differentiate between NAS and SAN
4. Explain the concepts of storage virtualization and different forms and approaches of virtualization
5. Explain the concept of creating a storage network from existing architectures and technologies.

Module-1 **8 Hours**

Introduction: Server Centric IT Architecture and its Limitations; Storage – Centric IT Architecture and its advantages. Case study: Replacing a server with Storage Networks, The Data Storage and Data Access problem;

***Self Learning Exercise*:** The Battle for size and access - Overview

Module-2 **8 Hours**

Intelligent Disk Subsystems: Architecture of Intelligent Disk Subsystems; Hard disks and Internal I/O Channels; JBOD, Storage virtualization using RAID and different RAID levels; Caching: Acceleration of Hard Disk Access; Intelligent disk subsystems,

***Self Learning Exercise*:** Availability of disk subsystems.

Module-3 **8 Hours**

I/O Techniques, Network Attached Storage, File System and NAS: The Physical I/O path from the CPU to the Storage System; SCSI; Fibre Channel Protocol Stack; Fibre Channel SAN; IP Storage, File System And NAS**:** Local File Systems; Network file Systems and file servers; Shared Disk file systems;

***Self Learning Exercise*:** Comparison of fibre Channel, iSCSI and NAS

Module-4 **8 Hours**

Storage Virtualization: Definition of Storage virtualization; Implementation Considerations; Storage virtualization on Block or file level; Storage virtualization on various levels of the storage Network; Symmetric storage virtualization in the Network

***Self Learning Exercise*:** Asymmetric storage virtualization in the Network.

Module-5 **8 Hours**

SAN Architecture and Hardware devices: ArchitectureOverview, Creating a Network for storage; SAN Hardware devices; The fibre channel switch; Host Bus Adaptors; Putting the storage in SAN.

***Self Learning Exercise*:** Fabric operation from a Hardware perspective.

Text Book:

1. Ulf Troppens, Rainer Erkens and Wolfgang Muller: Storage Networks Explained, Wiley India, 2007.
2. Robert Spalding: "Storage Networks The Complete Reference", Tata McGraw-Hill, 2003.

Reference Books:

1. Marc Farley: Storage Networking Fundamentals – An Introduction to Storage Devices, Subsystems, Applications, Management, and File Systems, Cisco Press, 2005.
2. Richard Barker and Paul Massiglia: "Storage Area Network Essentials A Complete Guide to understanding and Implementing SANs", Wiley India, 2006.

REAL TIME SYSTEMS (3-0-0) (Elective)

Sub Code: MCN2E305 **CIE:50 Marks**

Hrs / Week: 03 **SEE: 50% Marks**

SEE Hrs: 03 Hours **Max Marks: 100**

***Course Outcomes*:**

On successful completion of the course, the students will be able to:

1. Compare Hard and Soft real timesystems.
2. Explain the fundamental problems of real-timesystems;
3. Apply the different approaches to real time scheduling.
4. Describe the concepts of priority scheduling.
5. Distinguish the different real time protocols

Module 1 **8 Hours**

Hard Versus Soft Real-Time Systems: Jobs and Processors, Release Times, Deadline and Timing Constraints, Hard and Soft timing Constraints, Hard Real- Time Systems, Soft Real-Time Systems, **Reference model of Real-Time systems:** Processors and Resources, Temporal Parameters of Real-Time Work load, Periodic task model, Precedence Constraints and Data dependency, other types dependencies. Functional parameters of resources.

***Self Learning Exercise*:** Scheduling hierarchy.

Module 2 **8 Hours**

Approaches to Real-Time Scheduling: Clock-Driven approach, Weighted Round-Robin approach. Priority driven approach. Dynamic Versus Static Systems, Effective Release times and deadlines, optimality of the EDF and LST algorithms, Non-Optimality of the EDF and LST algorithms

***Self Learning Exercise*:** off-Line versus on-line scheduling.

Module 3 **8 Hours**

Clock-driven Scheduling: Notations and assumptions, static, Timer-Driven Scheduler, General Structure Cyclic Schedulers Cyclic executives, Improving the average response time of a periodicjobs Scheduling SporadicJobs

***Self Learning Exercise*:**Problem on sporadicjobs schedule.

Module 4 **8 Hours**

Priority-Driven Scheduling of Periodic Tasks: Static assumption, Fixed Priority Versus Dynamic Priority algorithms, Maximum Scheduling utilization, Optimality of the RM and DM algorithms, A schedulability test for fixed-Priority tasks with arbitrary response times.
***Self Learning Exercise*:** derivation of schedulability test of RMalgorithm.

Module 5 **7 Hours**

Resources and Resources Access Control: Assumptions on resources and their usage, Effects of resources contention and resources access control Non preemptive critical section, Basic Priority – Ceiling Protocol, Stack-Based priority – Ceiling Protocol, Use of priority-ceiling protocol in Dynamic-Priority Systems, Preemption-Ceiling Protocol, Model of Real-time Communication, Priority-Based Service Disciplines for switched Networks,
***Self Learning Exercise*:** Real time protocol.

Text Book:
Real Time Systems – Jane W.S. Liu Pearson Education Asia, First Indian Reprint-2001.

Reference Book:
Real Time Systems Design and Analysis: An Engineer's Handbook Second Edition, Lapante.

SOCIAL NETWORKS (3:0:0) (Elective)

Subcode	**:MCN2E306**	**CIE**	**: 50Marks**
Hrs/week	**:03**	**SEE**	**: 50%Marks**
SEEHrs	**:03**	**Max. Marks:100**	

***Course Outcomes*:**

On Successful completion of the course, the students will be able to:

1. Interpret the network structure by applying the concepts of graph theory.
2. Formulate the behavioral models in various environments of social networks. (Module2&3)
3. Illustrate link analysis and cascading behavior in social networks.
4. Describe interactions in Social networks.

Module1 **7 Hours**

Overview: Aspects of Networks, Central Themes and Topics, Central Themes and Topics. Graph Theory and Social Networks Graphs Basic Definitions, Paths and Connectivity, Datasets: An Overview

***Self Learning Exercise*:** Distance and Breadth-First Search Network

Module2 **7 Hours**

Strong and Weak Ties :Triadic Closure ,The Strength of Weak Ties Tie Strength and Network, Structure in Large-Scale Data Tie Strength, Social Media, and Passive Engagement, Closure, Structural Holes, and SocialCapital

***Self Learning Exercise*:** Advanced Material: Betweenness Measures and Graph Partitioning

Module3 **10 Hours**

Networks in Their Surrounding Contexts Homophily Mechanisms Underlying Homophily: Selection and Social Influence Affiliation, Tracking Link Formation in On-Line Data

Positive and Negative Relationships Structural Balance, Characterizing the Structure of Balanced Networks, Applications of Structural Balance ,A Weaker Form of Structural Balance.

***Self Learning Exercise*:** A Spatial Model of Segregation, Advanced Material: Generalizing the Definition of Structural Balance

Module4 **8 Hours**

Link Analysis and Web Search , Searching the Web: The Problem of Ranking Link Analysis using Hubs and Authorities, PageRank, Applying Link Analysis in Modern Web Search , Applications beyond the Web , Advanced Material: Spectral Analysis, Random Walks, and Web Search

Cascading Behavior in Networks Diffusion in Networks, Modeling Diffusion through a

Network, Cascades and Clusters, Diffusion, Thresholds, and the Role of Weak Ties

***Self Learning Exercise*:** Extensions of the Basic Cascade Model, Knowledge, Thresholds, and Collective Action

Module5 **8 Hours**

Information Cascades: Following the Crowd Simple Herding Experiment Bayes' Rule: A Model of Decision-Making under Uncertainty Bayes' Rule in the Herding Experiment Simple, General Cascade, Sequential Decision-Making

Power Laws and Rich-Get-Richer Phenomena : Popularity as a Network Phenomenon , Power Laws , Rich-Get-Richer Models , The Unpredictability of Rich-Get-Richer Effects , The Long Tail , The Effect of Search Tools and Recommendation Systems .

***Self Learning Exercise*:** Lessons from Cascades, Advanced Material: Analysis of Rich-Get-Richer Processes

Text Books:

1. Networks, Crowds and Markets by David Easley and Jon Kleinberg, Cambridge University Press, 2010
2. SocialandEconomicNetworksbyMatthewO.Jackson,PrincetonUniversityPress,2010.

Reference Books:

"Networks:AnIntroductionbyM.E.J.Newman, acollege-leveltextbookaboutthescienceof networks.", M. E. J. Newman Hardback, Oxford University Press,2010.

DEPARTMENT ELECTIVE-4

BIG DATA ANALYTICS (3-0-0) (Elective)

Sub Code: MCN2E401 **CIE:50 Marks**

Hrs / Week: 03 **SEE: 50% Marks**

SEE Hrs: 03 Hours **Max Marks: 100**

***Course Outcomes*:**

On successful completion of the course, the students will be able to:

1. Explain the basics of Big Data
2. Use Technologies for Handling Big Data and Hadoop Ecosystem
3. Describe Map Reduce Fundamentals and HBase
4. Describe the different types of Analytics
5. Use of R programming in statistical analysis

Module 1 **6 Hours**

Getting an Overview of Big Data: What is Big Data? , History of Data Management – Evolution of Big Data, Structuring Big Data, Types of Data, Elements of Big Data, Volume, Velocity, Variety, Veracity ,Big Data Analytics ,Advantages of Big Data Analytics ,Careers in Big Data ,Skills Required, Future of BigData.

***Self Learning Exercise*:** Business Intelligence, Preventing Fraud Using BigData Analytics

Module 2 **9 Hours**

Introducing Technologies for Handling Big Data and Hadoop Ecosystem: Distributed and Parallel Computing for Big Data, Introducing Hadoop, How does Hadoop Function?, Cloud Computing and Big Data, Features of Cloud Computing, Cloud Deployment Models, Cloud Delivery Models, Cloud Services for Big Data, Cloud Providers in Big Data Market, In-Memory Computing Technology for Big Data, Hadoop Ecosystem, Hadoop Distributed File System, HDFS Architecture, Features of HDFS, MapReduce, Features of MapReduce, HadoopYARN.

Self Learning Exercise:HBase, Hive, Pig,Sqoop, Flume

Module 3 **8 Hours**

Understanding Map Reduce Fundamentals and H Base, The Map Reduce Framework, Exploring the Features of Map Reduce, Working of Map Reduce, Exploring Map and Reduce Functions, Techniques to Optimize Map Reduce Jobs, Hardware/Network Topology, Synchronization, File System, Uses of Map Reduce, Role of H Base in Big Data Processing, Characteristics of HBase.

Self Learning Exercise: Installation of Hbase

Module 4 **8 Hours**

Understanding Analytics and Big Data: Comparing Reporting and Analysis, Reporting, Analysis, The Analytic Process, Types of Analytics, Basic Analytics, Advanced Analytics, Operationalized Analytics, Monetized Analytics, Characteristics of Big Data Analysis, Points to Consider during Analysis, Frame the Problem Correctly, Statistical Significance or Business

Importance?, Making Inferences versus Computing Statistics, Developing an Analytic Team,Convergence of IT and Analytics, Understanding Text Analytics

***Self Learning Exercise*:** Skills required for an Analyst

Module 5 **8 Hours**

Analytical Approaches: Tools to Analyze Data, Exploring R Analytical Approaches, Ensemble Methods, Text Data Analysis, History of Analytical Tools, Graphical User Interfaces, Point Solutions, Data Visualization Tools, Introducing Popular Analytical Tools, The R Project for Statistical Computing, IBM SPSS, SAS, Comparing Various Analytical Tools, Exploring Basic Features of R, Statistical Features, Programming Features, Packages, Graphical User Interfaces, Exploring RGui, R Console, Developing a Program, Exploring RStudio, Handling Basic Expressions in R, Basic Arithmetic in R, Mathematical Operators, Variables in R, Calling Functions in R, Working with Vectors, Storing and Calculating Values in R, Creating and Using Objects, Interacting with Users, Handling Data in R Workspace, The ls() Function, The rm() Function, The getwd() Function, The save() Function, The load () Function, Executing Scripts, Creating Plots, Accessing Help and Documentation in R, Using Built- in Datasets in R

Self Learning Exercise: Installing R Studio.

Text Book:

Big Data: Black Book, DT Editorial Services, Wiley India Pvt Ltd, 2015 Edition

Reference Books:

1. Arvind Sathi, "Big Data Analytics: Disruptive Technologies for ChangingtheGame", 1st Edition, IBM Corporation,2012
2. Big Data Analytics with R and Hadoop, Vignesh Prajapati, -Packt Publishing2013

COMPUTER FORENSICS (3-0-0) (Elective)

Sub Code: MCN2E402 **CIE:50 Marks**

Hrs / Week: 03 **SEE: 50% Marks**

SEE Hrs: 03 Hours **Max Marks: 100**

***Course Outcomes*:**

On successful completion of the course, the students will be able to:

1. Identify the need for legal and corporate investigation
2. Describe the procedure for computer investigation
3. Explain the data acquisition system
4. Discuss the evidence collection process
5. Identify the tools used for forensic

Module 1 **8 Hours**

Understanding Computer Forensics, Computer Forensics Versus Other Related Disciplines , A Brief History of Computer Forensics, Understanding Case Law , Developing Computer Forensics Resources ,Preparing for Computer Investigations ,Understanding Law Enforcement Agency Investigations., Following the Legal Processes, Understanding Corporate Investigations ,Establishing Company Policies, Displaying Warning Banners Designating an Authorized Requester, Conducting Security Investigations Distinguishing Personal and Company Property

***Self Learning Exercise*:** Maintaining Professional Conduct

Module 2 **8 Hours**

Understanding Computer ,Preparing a Computer Investigation ,An Overview of a Computer An Overview of a Company Policy Violation ,Taking a Systematic Approach ,Assessing the Case ,Planning Your Investigation Securing Your Evidence ,Procedures for Corporate High-Tech Investigations. . . Employee Termination Cases, Internet Abuse Investigations ,E- mail Abuse Investigations. Attorney-Client Privilege Investigations ,Media Leak Investigations, Industrial Espionage Investigations, Interviews and interrogations in High-Tech Investigations ,Understanding Data Recovery Workstations and Software Setting Up Your Workstation for Computer Forensics ,Conducting an Investigation ,Gathering the Evidence,Understanding Bit-stream Copies ,Acquiring an Image of EvidenceMedia

***Self Learning Exercise*:**Using ProDiscover Basic to Acquire a USB Drive

Module 3 **8 Hours**

Data Acquisition, Understanding Storage Formats for Digital Evidence ,Raw Format, Proprietary Formats, Advanced Forensic Format, Determining the Best Acquisition Method, Contingency Planning for Image Acquisitions Performing RAID Data Acquisitions Understanding, Acquiring RAID Disks . . . Using Remote Network Acquisition Tools, Remote Acquisition with ProDiscover ,Remote Acquisition with EnCase Enterprise, Remote

Acquisition with R-Tools R-Studio, Remote Acquisition with Wet Stone Live Wire, Remote Acquisition with F-Response

***Self Learning Exercise*:** Remote Acquisition with Runtime Software

Module 4 **8 Hours**

Identifying Digital Evidence, Understanding Rules of Evidence Collecting Evidence in Private-Sector Incident Scenes, Processing Law Enforcement Crime Scenes , Understanding Concepts and Terms Used in Warrants Preparing for a Search ,Identifying the Nature of the Case ,Identifying the Type of Computing System ,Determining Whether You Can Seize a Computer, Obtaining a Detailed Description of the Location ,Determining Who Is in Charge, Using Additional Technical Expertise, Determining the ToolsYouNeed,PreparingtheInvestigationTeam,SecuringaComputerIncidentorCrimeScene,Seizing Digital Evidence at the Scene,Preparing to Acquire Digital Evidence,Processing an Incident or Crime Scene,Processing Data Centers with RAID,Using a Technical Advisor, Documenting Evidence in the Lab.

***Self Learning Exercise*:** Processing and Handling Digital Evidence.

Module 5 **7 Hours**

Current Computer Forensics Tools ,Evaluating Computer Forensics Tool Needs ,Types of Computer Forensics Tools ,Tasks Performed by Computer Forensics Tools, Tool Comparisons ,Other Considerations for Tools . Computer Forensics Software Tools, Command-Line Forensics Tools UNIX/Linux Forensics Tools ,Other GUI Forensics Tools ,Computer Forensics Hardware Tools, Forensic Workstations ,Using aWrite-Blocker

***Self Learning Exercise*:** Recommendations foraForensic

Text Book

Guide to Computer Forensic and Investigation,BillNelson,AmeliaPhillips,4th edition, Cengage Learning,2015.

REFERENCE BOOK

Computer Forensic computer crime scene investigation , John R Vaca, Firewall media, 2009 edition.

HUMAN COMPUTER INTERFACE (3-0-0) (Elective)

Sub Code: MCN2E403 **CIE:50 Marks**

Hrs / Week: 03 **SEE: 50% Marks**

SEE Hrs: 03 Hours **Max Marks: 100**

***Course Outcomes*:**

On successful completion of the course, the students will be able to:

1. Describe the foundations of Human Computer Interaction
2. Explain HCI in software process
3. Describe different HCI Models.
4. Explain mobile HCI
5. Explain guidelines for user interface.

Module 1: **8 Hours**

FOUNDATIONS OF HCI: The Human: I/O channels – Memory – Reasoning and problem solving; The computer: Devices– Memory – processing and networks; Interaction: Models – frameworks – Ergonomics – styles – elements –interactivity.

Self Learning Exercise: Paradigms

Module 2: **8 Hours**

DESIGN & SOFTWARE PROCESS: Interactive Design basics – process – scenarios – navigation – screen design – Iteration and prototyping. HCI in software process – software life cycle – usability engineering – Prototyping in practice – design rationale. Design rules – principles, standards, guidelines, rules. Evaluation Techniques.

Self Learning Exercise: Universal Design

Module 3: **8 Hours**

MODELS AND THEORIES: Cognitive models –Socio-Organizational issues and stake holder requirements –Communication and collaboration models

Self Learning Exercise: Hypertext, Multimedia and WWW.

Module 4: **8 Hours**

MOBILE HCI: Mobile Ecosystem: Platforms, Application frameworks- Types of Mobile Applications: Widgets, Applications, Games- Mobile Information Architecture, Mobile 2.0, Mobile Design: Elements of Mobile Design

Self Learning Exercise: Tools for Mobile Design

Module 5: **7 Hours**

WEB INTERFACE DESIGN: Designing Web Interfaces – Drag & Drop, Direct Selection, Contextual Tools, Overlays, Inlays and Virtual Pages

Self Learning Exercise: Process Flow. Case Studies

Text Books:

1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, "Human Computer Interaction", 3rd Edition, Pearson Education, 2004 (MODULE I , II &III)
2. Brian Fling, "Mobile Design and Development", First Edition , O " Reilly Media Inc., 2009 (MODULE–IV)
3. Bill Scott and Theresa Neil, "Designing Web Interfaces", First Edition, O " Reilly, 2009.(MODULE-V)

INFORMATION RETRIEVAL SYSTEMS (3-0-0) (Elective)

Sub Code: MCN2E404 **CIE:50 Marks**

Hrs / Week: 03 **SEE: 50% Marks**

SEE Hrs: 03 Hours **Max Marks: 100**

***Course Outcomes*:**

On Successful Completion of the Course, the students will be able to:

1. Explain the process of retrieving information.
2. Describe retrieval performance and various types of queries.
3. Discuss automatic local- global analysis, document clustering and text compression techniques.
4. Describe different indexing and searching algorithms.
5. Explain the Challenges of searching the web.

Module1: **8 Hours**

Introduction: Motivation, Basic concepts, The retrieval process.

Modeling: Introduction, A taxonomy of information retrieval models, A formal characterization of IR models, Classic information retrieval, Alternative set theoretic models, Alternative algebraic models, Alternative probabilistic models Structured text retrieval models.

Self Learning Exercise : Models for browsing.

Module 2: **8 Hours**

Retrieval Evaluation: Introduction, Retrieval performance evaluation.

Query Languages: Introduction, keyword-based querying, Pattern matching,Structural queries

Self LearningExercise : Hierarchical Structure,Query protocols.

Module 3: **8 Hours**

Query Operations: Introduction, User relevance feedback, Automatic local analysis, Automatic, Global Analysis.

TextOperations: Introduction,Documentpreprocessing,Document clustering Text compression.

***Self Learning Exercise*:** Comparing Text compression Techniques.

Module 4: **7 Hours**

Indexing & Searching

Introduction; Inverted Files; Other indices for text; Boolean queries; Sequential searching; Pattern matching.

***Self Learning Exercise*:** Pattern matching using indices, Structural queries; Compression.

Module 5: **8 Hours**

User Interfaces and Visualization: Introduction, Human-Computer interaction, The information access process, Starting points, Query specification, Context, Using relevance judgments.
Searching theWeb: Introduction, Challenges, Characterizing the web Search engines, Browsing, Met searchers.
***Self Learning Exercise*:** Searching using hyperlinks.

Text Books:
Ricardo Baeza-Yates, Berthier Ribeiro-Neto: Modern Information Retrieval, Pearson.

Reference Books:
David A. Grossman, Ophir Frieder: Information Retrieval Algorithms and Heuristics, 2nd Edition, Springer,2004.

ADVANCED DIGITAL COMMUNICATION (3-0-0) (Elective)

Sub Code: MCN2E405 **CIE:50 Marks**

Hrs / Week: 03 **SEE: 50% Marks**

SEE Hrs: 03 Hours **Max Marks: 100**

***Course Outcomes*:**

On successful completion of the course, the students will be able to:

1. Describe fundamentals of digital transmission
2. Compare different techniques for error Detection and Correction
3. Describe elements of DCS
4. Compare different waveform coding techniques
5. Describe Nyquest Criterion and correlative coding

Module-1 **8 Hours**

Digital Trans mission 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: The Nyquist Signaling Rate, The Shannon Channel Capacity; Line Coding, Modems and Digital Modulation: Binary Phase Modulation, QAM and Signal Constellations, Telephone Modem Standards;

***Self Learning Exercise*:** Modems and Digital Modulation: Binary Phase Modulation, QAM and Signal Constellation.

Module-2 **8 Hours**

Properties of Media and Digital Trans mission 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.

***Self Learning Exercise*:** Error Detecting Capability of a Polynomial Code.

Module-3 **8 Hours**

Brief Review of digital communication systems: ElementsofDigitalcommunication systems; Communication channels and their characteristics;

***Self Learning Exercise*:** Historical perspective in the development of digital communication.

Module-4 **8 Hours**

Wave form Coding Techniques: PCM, Channel. Noise and error probability, DPCM, DM.
Self Learning Exercise: coding speech at low bitrates, Applications

Module-5 **7 Hours**

Base band Shaping for data trans mission: Discrete PAM signals, Inter-symbol interference (ISI) Nyquist criterion for distortion-less Base band binary transmission.
Self Learning Exercise: Correlative Coding.

TEXT BOOKS:

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

REFERENCE BOOKS :

John G Proakis: Digital Communications, 3rd Edition, McGraw Hill, 2008.

INDUSTRY DRIVEN ELECTIVES
INTRODUCTION TO MACHINE LEARNING (2:0:0)

Sub Code: MCN2I02 **CIE: 25 Marks**

Hrs / Week: 03 **SEE: 50% Marks**

SEE Hrs: 02 Hours **Max Marks: 50**

***Course Outcomes*:**

On Successful completion of the course, the students will be able to:

1. Illustrate basic concepts of machine learning
2. Explain Machine Learning Process
3. Demonstrate experiments in Azure ML studio with basic Pythoncode

Module1: **8 Hours**

Introduction to Machine Learning, Understand classification Vs Regression with examples of various algorithms, Designing a Learning system, Perspective and Issues in Machine Learning, Hand on model creation in Azure ML using basic Python Programming

***Self Learning Exercise*:** Basic Python Programming

Module2: **9 Hours**

Decision Tree Learning: Decision tree representation, Appropriate problems for decision tree learning, Basic decision tree learning algorithm, hypothesis space search in decision tree learning, Hands on Azure ML experiments with selectivebias

***Self Learning Exercise*:** Anomaly detection using ML

Module3: **9 Hours**

Guidance on which algorithm to use for which kind of problems, Illustrating the Machine Learning Process, Hands on model creation for regression problems using Python, Hands on model creation for classification problems using Python

***Self Learning Exercise*:** Recommender system

Text Books:

1. Tom M. Mitchell, Machine Learning, India Edition July 2017, McGraw HillEducation.
2. Azure Machine Learning – Microsoft Azure Essential(attached)

All the Microsoft e-books can be downloaded from this URL-
https://blogs.msdn.microsoft.com/mssmallbiz/2017/07/11/largest-free-microsoft-ebook-giveaway-im-giving-away-millions-of-free-microsoft-ebooks-again-including-windows-10-office-365-office-2016-power-bi-azure-windows-8-1-office-2013-sharepo/

Reference Links:
Azure Portal: https://portal.azure.com
Azure Machine Learning Studio: https://studio.azureml.net

Cognitive Services: Documentation: https://www.microsoft.com/cognitive-services/en-us/computer-vision-api/documentation
Client SDKs and Samples: https://www.microsoft.com/cognitive-services/en-us/sdk-sample

Products available by region: https://azure.microsoft.com/en-in/global-infrastructure/services/
Azure regions: https://azure.microsoft.com/en-in/global-infrastructure/regions/
Azure Services running status: https://azure.microsoft.com/en-in/status/

III SEMESTER M. Tech.

SEMINAR (Core)

Sub Code: MCN3C01 **CIE:50 Marks**

Course Outcomes:

On Successful completion of the course, the students will be able to:

1. Recognize relevance of the topic chosen
2. Explain current real world issues by doing literature survey
3. Identify the depth of thetopic
4. Prepare presentations to convey the essence of the topic clearly.
5. Justify the comments and questionnaires from audience.

INTERNSHIP(Core)

Sub Code: MCN3C02 **CIE:50 Marks**

***Course Outcomes*:**

On successful completion of the course, the students will be able to:

1. Appraise the problem to be analyzed
2. Apply the knowledge of the engineering to solve the problem
3. Outline the conducted work with a report

PROJECT PHASE-I (PROJECT)

Sub Code: MCN3C03 **CIE:50 Marks**

***Course Outcomes*:**

On successful completion of the course, the students will be able to:

1. Identify the different areas of interest feasible to the project.
2. Analyze the problem identified.
3. Develop the design methods to solve the identified problems.

IV SEMESTER M. Tech.

IV SEMESTER M. TECH.
PROJECT- PHASE-2 (PROJECT)

Sub Code: MCN4C01	**CIE:50 Marks**
Hrs / Week: 15	**SEE: 50% Marks**
SEE Hrs: 03 Hours	**Max Marks: 100**

***Course Outcomes*:**

On successful completion of the course, the students will be able to:

1. Implement the proposed design of phase-I.
2. Validate the results obtained from the implementation using various test cases.
3. Demonstrate the project work.
4. Articulate the project work.
5. Publish the project work done.