Semester I **Year:2014-2015**

Course Title: Wireless Ad-hoc Networks	**Course Code: 14SCN11**
Credits(L:T:P): 3:0:1	**Core/Elective: Core**
Type of Course: Lecture and practical	**Total Contact Hours:50**

COURSE OBJECTIVES

- To explore the design space and conduct trade-off analysis between performance and resources.
- To Determine suitable medium access protocols and radio hardware.
- To learn Provision quality of service, fault-tolerance, security and other dependability requirements while coping with resource constraints.
- To explore the Ad-hoc network concepts by using network simulators.

TOPICS

MODULE I

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, MAC Protocols that Use Directional Antennas

(Chapter 5: 5.1-5.3, Chapter 6: 6.1-6.8) **10 Hours**

MODULE II

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; On-Demand Routing Protocols, Hybrid Routing Protocols, Hierarchical Routing Protocols and Power-Aware Routing Protocols

(Chapter 7: 7.1-7.6, 7.8, 7.9) **10 Hours**

MODULE III

Multicast Routing in Ad hoc Wireless Networks: Introduction, 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 and Mesh-Based Multicast Routing Protocols.

(Chapter 8: 8.1-8.7) **10 Hours**

MODULE IV

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; Other Transport Layer Protocols for Ad hoc Networks; Security in Ad hoc Wireless Networks, Issues and Challenges in Security Provisioning, Network Security Attacks, Key Management and Secure Touting Ad hoc Wireless Networks.

(Chapter 9: 9.1-9.6, 9.7-9.12) **10 Hours**

MODULE V

Quality of Service and Energy Management in Ad hoc Wireless Networks

Introduction, Issues and Challenges in Providing QoS in Ad hoc Wireless Networks, Classification of QoS Solutions, MAC Layer Solutions, Network Layer Solutions; 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, System Power Management Schemes.

(Chapter 10: 10.1-10.5, Chapter 11: 11.1-11.6) **10 Hours**

LABORATORY WORK

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. Develop and 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.

COURSE OUTCOMES

Students will be able to

- Apply knowledge of wireless Ad-hoc networks to various application areas.
- Design, implement and maintain wireless Ad-hoc networks.
- Formulate and solve problems creatively.
- Practical knowledge acquired by hands-on session.

TEXT BOOKS:

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.

Semester I **Year: 2014-2015**

Course Title: Advances in Computer Networks	**Course Code: 14SCN12**
Credits(L:T:P): 3:0:1	**Core/Elective: Core**
Type of Course: Lecture and practical	**Total Contact Hours:50**

COURSE OBJECTIVES

- To become familiar with the basics of Computer Networks.
- To learn Network architectures.
- To learn Concepts of fundamental protocols.
- To gain the knowledge of internetworking concepts.
- To understand the knowledge of internetworking concepts in various applications.
- To acquire knowledge of implementation concepts in congestion control and error detections.

TOPICS

MODULE I

Foundation

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, Concurrent Logical Channels.

T1:**Chapter 1.1, 1.2, 1.5.1, 1.5.2**., **2.1, 2.5** **T2**:**Chapter 4** **10 Hours**

MODULE II

Internetworking- I

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), Virtual Networks and Tunnels.

T1: Chapter 3.1, 3.2. **10 Hours**

MODULE III

Internetworking- II

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 and Mobile IP

T1: Chapter3.3, 4.1.1,4.1.3 **T2**:Chapter 13.1 to 13.18 , Chapter 18. **10 Hours**

MODULE IV

End-to-End Protocols

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

T1: Chapter 5.1, 5.2.1 to 5.2.8, 6.2, 6.3 **10 Hours**

MODULE V

Congestion Control and Resource Allocation

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),Network Management(SNMP) .

T1: Chapter 6.4 **T2**: Chapter 23.1 to 23.16, Chapter 24, Chapter 25, Chapter 27.1 to 27.8

10 Hours

LABORATORY WORK

PART A: Implement the following using C/C++ or equivalent with LINUX/Windows environment:

1. Write a program to transfer the contents of a requested file from server to the client using TCP/IP Sockets (using TCP/IP Socket programming).
2. Write a program to archive Traffic management at Flow level by implementing Closed Loop Control technique. (Leaky Bucket Algorithm)
3. Write a program to implement dynamic routing strategy in finding optimal path for data transmission. (Bellman ford algorithm).
4. Write a program to implement Link State Routing (Dijkstra Algorithm).
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. (RSA Algorithm)
7. Write a program for encrypting 64 bit playing text using DES algorithm.

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 and vary the bandwidth and find the number of packets dropped.
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.

COURSE OUTCOMES

Students will be able to

- Classify network services, protocols and architectures, explain why they are layered.
- Knowledge on key Internet applications and their protocols, and ability to develop their own applications (e.g. Client Server applications, Web Services) using the sockets API.
- Practical knowledge gained by hands-on sessions.
- Gain the knowledge of application layer protocol.

Text books:

1. **T1**: **Larry Peterson and Bruce S Davis** "Computer Networks :A System Approach" 5th Edition , Elsevier -2014
2. **T2: Douglas E Comer, "**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
2. **Behrouz A Forouzan** "TCP/IP Protocol Suite" 4th Edition – Tata McGraw-Hill.

Semester I **Year: 2014-2015**

Course Title: Information and Network Security	**Course Code: 14SCN13**
Credits(L:T:P): 4:0:0	**Core/Elective: Core**
Type of Course: Lecture	**Total Contact Hours:50**

Course Objectives:

- To understand the fundamentals of Cryptography
- To acquire knowledge on standard algorithms used to provide confidentiality, integrity and authenticity.
- To understand the various key distribution and management schemes.
- To understand how to deploy encryption techniques to secure data in transit across data networks
- To design security applications in the field of Information technology.

TOPICS

MODULE I

Classical Encryption Techniques

Symmetric Cipher Model, Cryptography, Cryptanalysis and Brute-Force Attack, Substitution Techniques, Caesar Cipher, Monoalphabetic Cipher, Playfair Cipher, Hill Cipher, Polyalphabetic Cipher, One Time Pad.

Block Ciphers and the data encryption standard: Traditional block Cipher structure, stream Ciphers and block Ciphers, Motivation for the feistel Cipher structure, the feistel Cipher, The data encryption standard, DES encryption, DES decryption, A DES example, results, the avalanche effect, the strength of DES, the use of 56-Bit Keys, the nature of the DES algorithm, timing attacks, Block cipher design principles, number of rounds, design of function F, key schedule algorithm.

10 Hours

MODULE II

Public-Key Cryptography and RSA: Principles of public-key cryptosystems. Public-key cryptosystems. Applications for public-key cryptosystems, requirements for public-key cryptosystems. public-key cryptanalysis. The RSA algorithm, desription of the algorithm, computational aspects, the security of RSA. **Other Public-Key Cryptosystems:** Diffie-hellman key exchange, The algorithm, key exchange protocols, man in the middle attack, Elgamal Cryptographic systems, Elliptic curve arithmetic, abelian groups, elliptic curves over real numbers, elliptic curves over Zp, elliptic curves overGF(2m), Elliptic curve cryptography, Analog of Diffie-hellman key exchange, Elliptic curve encryption/ decryption, security of Elliptic curve cryptography, Pseudorandom number generation based on an asymmetric cipher, PRNG based on RSA.

10 Hours

MODULE III

Key Management and Distribution: Symmetric key distribution using Symmetric encryption, A key distribution scenario, Hierarchical key control, session key lifetime, a transparent key control scheme, Decentralized key control, controlling key usage, Symmetric key distribution using asymmetric encryption, simple secret key distribution, secret key distribution with confidentiality and authentication, A hybrid scheme, distribution of public keys, public announcement of public keys, publicly available directory, public key authority, public keys certificates, X-509 certificates. Certificates, X-509 version 3, public key infrastructure .**User Authentication:** Remote user Authentication principles, Mutual Authentication, one way Authentication, remote user Authentication using Symmetric encryption, Mutual Authentication, one way Authentication, Kerberos, Motivation , Kerberos version 4, Kerberos version 5, Remote user Authentication using Asymmetric encryption, Mutual Authentication, one way Authentication, federated identity management, identity management, identity federation, personal identity verification.

10 Hours

MODULE IV

Wireless network security: Wireless security, Wireless network threats, Wireless network measures, mobile device security, security threats, mobile device security strategy, IEEE 802.11 Wireless LAN overview, the Wi-Fi alliance, IEEE 802 protocol architecture. Security, IEEE 802.11i services, IEEE 802.11i phases of operation, discovery phase, Authentication phase, key management phase, protected data transfer phase, the IEEE 802.11i pseudorandom function, ..

Web Security Considerations: Web Security Threats, Web Traffic Security Approaches. **Secure Sockets Layer :**SSL Architecture, SSL Record Protocol, Change Cipher Spec Protocol, Alert Protocol, and shake Protocol, Cryptographic Computations. **Transport Layer Security:** Version Number, Message Authentication Code, Pseudorandom Functions, Alert Codes, Cipher Suites, Client Certificate Types, Certificate Verify and Finished Messages, Cryptographic Computations, and Padding. **HTTPS** Connection Initiation, Connection Closure. **Secure Shell (SSH)** Transport Layer Protocol, User Authentication Protocol, Connection Protocol.

10 Hours

MODULE V

Electronic Mail Security: Pretty good privacy, notation, operational; description, S/MIME, RFC5322, Multipurpose internet mail extensions, S/MIME functionality, S/MIME messages, S/MIME certificate processing, enhanced security services, Domain keys identified mail, internet mail architecture, E-Mail threats, DKIM strategy, DKIM functional flow. **IP Security:** IP Security overview, applications of IPsec, benefits of IPsec, Routing applications, IPsec documents, IPsec services, transport and tunnel modes, IP Security policy, Security associations, Security associations database, Security policy database, IP traffic processing, Encapsulating Security payload, ESP format, encryption and authentication algorithms, Padding, Anti replay service, transport and tunnel modes, combining security associations, authentication

plus confidentiality, basic combinations of security associations, internet key exchange, key determinations protocol, header and payload formats, cryptographic suits. **10 Hours**

Course Outcomes:

Students will be able to:

- Analyze the vulnerabilities in any computing system and hence be able to design a security solution.
- Identify the security issues in the network and resolve it.
- Evaluate security mechanisms using rigorous approaches, including theoretical.

Text Books:

1. William Stallings: Cryptography and Network Security, Pearson 6th edition.

References

1. V k Pachghare: Cryptography and Information Security. PHI Learning. ISBN 978-81-203-3521-9

Semester I **Year: 2014-2015**

Course Title: Advances in Storage area Network	**Course Code: 14SCN14**
Credits(L:T:P): 4:0:0	**Core/Elective: Core**
Type of Course: Lecture	**Total Contact Hours:50**

Course Objectives:

- To understand the fundamentals of storage centric and server centric systems
- To understand the metrics used for Designing storage area networks
- To understand the RAID concepts
- To enable the students to understand how data centre's maintain the data with the concepts of backup mainly remote mirroring concepts for both simple and complex systems
- To appreciate the use of cables technologies used in SAN technology.

TOPICS

MODULE I

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; The Battle for size and access. **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, Availability of disk subsystems. **10 Hours**

MODULE II

I/O Techniques: The Physical I/O path from the CPU to the Storage System; SCSI; Fibre Channel Protocol Stack; Fibre Channel SAN; IP Storage. **Network Attached Storage:** The NAS Architecture, The NAS hardware Architecture, The NAS Software Architecture, Network connectivity, NAS as a storage system. **File System and NAS**: Local File Systems; Network file Systems and file servers; Shared Disk file systems; Comparison of fibre Channel and NAS.

10 Hours

MODULE III

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 and Asymmetric storage virtualization in the Network.

10 Hours

MODULE IV

SAN Architecture and Hardware devices: Overview, Creating a Network for storage; SAN Hardware devices; The fibre channel switch; Host Bus Adaptors; Putting the storage in SAN; Fabric operation from a Hardware perspective. **Software Components of SAN:** The switch's Operating system; Device Drivers; Supporting the switch's components; Configuration options for SANs.

10 Hours

MODULE V

Management of Storage Network: System Management, Requirement of management System, Support by Management System, Management Interface, Standardized Mechanisms, Property Mechanisms, In-band Management, Use of SNMP, CIM and WBEM, Storage Management Initiative Specification (SMI-S), CMIP and DMI, Optional Aspects of the Management of Storage Networks, Summary

10 Hours

Course Outcomes:

Students will be able to:

- Identify the need for performance evaluation and the metrics used for it
- Have Knowledge on various RAID levels.
- Apply the techniques used for data maintenance.
- Develop techniques for evaluating policies for LUN masking, file systems.

Text Book:

1. Ulf Troppens, Rainer Erkens and Wolfgang Muller: Storage Networks Explained, Wiley India, 2013.

Reference Books:

1. Robert Spalding: "Storage Networks The Complete Reference", Tata McGraw-Hill, 2011.
2. Marc Farley: Storage Networking Fundamentals – An Introduction to Storage Devices, Subsystems, Applications, Management, and File Systems, Cisco Press, 2005.
3. Richard Barker and Paul Massiglia: "Storage Area Network Essentials A CompleteGuide to understanding and Implementing SANs", Wiley India, 2006.

Semester I **Year: 2014-2015**

Course Title: Advanced algorithms	**Course Code: 14SCN151**
Credits(L:T:P): 4:0:0	**Core/Elective: Elective**
Type of Course: Lecture	**Total Contact Hours:50**

COURSE OBJECTIVES

- To learn the graph search algorithms.
- To learn the hill climbing and dynamic programming design techniques.
- To develop recursive backtracking algorithms.
- To get an awareness of NP completeness and randomized algorithms.
- To get an awareness of probabilistic and randomize algorithms.

TOPICS

MODULE I

Review of Analysis Techniques: Growth of Functions: Asymptotic notations; Standard notations and common functions; Recurrences and Solution of Recurrence equations- The substitution method, The recurrence – tree method, The master method; Amortized Analysis: Aggregate, Accounting and Potential Methods.

10 Hours

MODULE II

Graph Algorithms: Bellman - Ford Algorithm; Single source shortest paths in a DAG; Johnson's Algorithm for sparse graphs; Flow networks and Ford-Fulkerson method; Maximum bipartite matching. **Polynomials and the FFT:** Representation of polynomials; The DFT and FFT; Efficient implementation of FFT. **10 Hours**

MODULE III

Number -Theoretic Algorithms: Elementary notions; GCD; Modular Arithmetic; Solving modular linear equations; The Chinese remainder theorem; Powers of an element; RSA cryptosystem; Primality testing; Integer factorization. **10 Hours**

MODULE IV

String-Matching Algorithms: Naïve string Matching; Rabin - Karp algorithm; String matching with finite automata; Knuth-Morris-Pratt algorithm; Boyer – Moore algorithms. **10 Hours**

MODULE V

Probabilistic and Randomized Algorithms: Probabilistic algorithms; Randomizing deterministic algorithms, Monte Carlo and Las Vegas algorithms; Probabilistic numeric algorithms.

10 Hours

COURSE OUTCOMES:

The students will be able to

- Design and apply iterative and recursive algorithms.
- Design and implement optimization algorithms in specific applications.
- Design appropriate shared objects and concurrent objects for applications.
- Get knowledge about different application based algorithm.

TEXT BOOKS:

1. T. H Cormen, C E Leiserson, R L Rivest and C Stein: Introduction to Algorithms, 3rd Edition, Prentice-Hall of India, 2010.
2. Kenneth A. Berman, Jerome L. Paul: Algorithms, Cengage Learning, 2002.

REFERENCE BOOKS:

1. Ellis Horowitz, Sartaj Sahni, S.Rajasekharan: Fundamentals of Computer Algorithms, 2nd Edition, Universities press, 2007

Semester I **Year: 2014-2015**

Course Title: Computer Systems Performance Analysis	Course Code: 14SCN152
Credits(L:T:P): 4:0:0	Core/Elective: Elective
Type of Course: Lecture	Total Contact Hours:50

COURSE OBJECTIVES

- To understand the mathematical foundations needed for performance evaluation of computer systems
- To understand the metrics used for performance evaluation
- To understand the analytical modeling of computer systems
- To enable the students to develop new queuing analysis for both simple and complex systems
- To understand the concept of planning and design in computer system.

TOPICS

TOPICS:

MODULE I

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, Setting Performance Requirements.

10 Hours

MODULE II

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

10 Hours

MODULE III

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

10 Hours

MODULE IV

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

10 Hours

MODULE V

Queuing Models: Introduction: Queuing Notation; Rules for all Queues; Little's Law, Types of Stochastic Process. Analysis of Single Queue: Birth-Death Processes; M/M/1 Queue; M/M/m Queue; M/M/m/B Queue with finite buffers; Results for other M/M/1 Queuing Systems. Queuing Networks: Open and Closed Queuing Networks; Product form networks, queuing Network models of Computer Systems. Operational Laws: Utilization Law; Forced Flow

Law; Little's Law; General Response Time Law; Interactive Response Time Law; Bottleneck Analysis; Mean Value Analysis and Related Techniques; Analysis of Open Queuing Networks; Mean Value Analysis; Approximate MVA; Balanced Job Bounds; Convolution Algorithm, Distribution of Jobs in a System, Convolution Algorithm for Computing G(N), Computing Performance using G(N), Timesharing Systems, Hierarchical Decomposition of Large Queuing Networks: Load Dependent Service Centers, Hierarchical Decomposition, Limitations of Queuing Theory.

10 Hours

COURSE OUTCOMES

Students will be able to:

- Identify the need for performance evaluation and the metrics used for it
- Define Little'e law and other operational laws
- Apply the operational laws to open and closed systems
- Use discrete-time and continuous-time Markov chains to model real world systems
- Develop analytical techniques for evaluating scheduling policies

Text Book:

1. 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.

Semester I **Year: 2014-2015**

Course Title: Multi-core Architecture and Programming	**Course Code: 14SCN153**
Credits(L:T:P): 4:0:0	**Core/Elective: Elective**
Type of Course: Lecture	**Total Contact Hours:50**

COURSE OBJECTIVES

- To understand the recent trends in the field of Computer Architecture and identify performance related parameters
- To expose the students to the problems related to multiprocessing
- To understand the different types of multi core architectures
- To expose the students to warehouse-scale and embedded architectures

TOPICS

MODULE I

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, Growing Returns: Gustafson's Law. **System Overview of Threading:** Defining Threads, System View of Threads, Threading above the Operating System, Threads inside the OS, Threads inside the Hardware, What Happens When a Thread Is Created, Application Programming Models and Threading, Virtual Environment: VMs and Platforms, Runtime Virtualization, System Virtualization.

10 Hours

MODULE II

Fundamental Concepts of Parallel Programming: Designing for Threads, Task Decomposition, Data Decomposition, Data Flow Decomposition, Implications of Different Decompositions, Challenges You'll Face, Parallel Programming Patterns, A Motivating Problem: Error Diffusion, Analysis of the Error Diffusion Algorithm, An Alternate Approach: Parallel Error Diffusion, Other Alternatives.

10 Hours

MODULE III

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, Thread Synchronization, Signaling, Compilation and Linking.

10 Hours

MODULE IV

OpenMP: 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 Multi-thread Execution, Data Copy-in and Copy-out, Protecting Updates of Shared Variables, Intel Task queuing Extension to OpenMP, OpenMP Library Functions, OpenMP Environment Variables, Compilation, Debugging, performance. **10 Hours**

MODULE V

Solutions to Common Parallel Programming Problems: Too Many Threads, Data Races, Deadlocks, and Live Locks, Deadlock, Heavily Contended Locks, Priority Inversion, Solutions for Heavily Contended Locks, Non-blocking Algorithms, ABA Problem, Cache Line Ping-ponging, Memory Reclamation Problem, Recommendations, Thread-safe Functions and Libraries, Memory Issues, Bandwidth, Working in the Cache, Memory Contention, Cache-related Issues, False Sharing, Memory Consistency, Current IA-32 Architecture, Itanium Architecture, High-level Languages, Avoiding Pipeline Stalls on IA-32,Data Organization for High Performance. **10 Hours**

COURSE OUTCOMES

Students will be able to:

- Identify the limitations of ILP and the need for multi-core architectures.
- Point out the salient features of different multi-core architectures and how they exploit parallelism.
- Critically analyze the different types of inter connection networks.
- Knowledge on architecture of GPUs, warehouse-scale computers and embedded processors.

Text Book

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

Semester I **Year: 2014-2015**

Course Title: Soft Computing	**Course Code: 14SCN154**
Credits(L:T:P): 4:0:0	**Core/Elective: Elective**
Type of Course: Lecture	**Total Contact Hours:50**

Course Objectives:

- To learn the key aspects of Soft computing
- To know about the components and building block hypothesis of Genetic algorithm.
- To understand the features of neural network and its applications
- To study the fuzzy logic components
- To gain insight onto Neuro Fuzzy modeling and control.
- To gain knowledge in machine learning through Support vector machines.

Topics:

MODULE I

Introduction to Soft computing, Neural networks, Fuzzy logic, Genetic algorithms, Hybrid systems and its applications. Fundamental concept of ANN, Evolution, basic Model of ANN, Terminologies used in ANN, MP model, Hebb model. **10 Hours**

MODULE II

Perceptron Network, Adaptive linear neuron, Multiple adaptive linear neurons, Back propogation Network (Theory, Architecture, Algorithm for training, learning factors, testing and applications of all the above NN models) **10 Hours**

MODULE III

Introduction to classical sets and fuzzy sets, Classical relations and fuzzy relations, Membership functions, **10 Hours**

MODULE IV

Defuzzification, Fuzzy decision making, and applications **10 Hours**

MODULE V

Genetic algorithms: Introduction, Basic operations, Traditional algorithms, Simple GA
General genetic algorithms, The schema theorem, Genetic programming, applications

10 Hours

Course Outcomes:

The student will be able to:

- Implement machine learning through neural networks.

- Write Genetic Algorithm to solve the optimization problem
- Develop a Fuzzy expert system.
- Model Neuro Fuzzy system for clustering and classification.

Text book:

1. Principles of Soft computing, Shivanandam, Deepa S. N Wiley India, Jun-2007
(Chapters 1, 2, 3(Upto 3.5), 7, 8, 9, 10, 13, 15 (upto 15.6 & 15.9,15,10)

Reference Books:

1. Neuro-fuzzy and soft computing, J.S.R. JANG, C.T. SUN, E. MIZUTANI, PHI (EEE edition) ISBN: 978-81-203-2243-1

Semester I **Year: 2014-2015**

Course Title: Information and Network security Lab	**Course Code: 14SCN16**
Credits(02)(L:T:P): 0:0:3	**Core/Elective: Core**
Type of Course: Practical	**Total Contact Hours:42**

Course Objectives:

- To understand the fundamentals of Cryptography through practical implementation.
- To implement standard algorithms used to provide confidentiality, integrity and authenticity.
- To understand the various key distribution and management schemes.
- To understand how to use cutting edge simulation tools
- To design security applications in the field of Information technology.

LABORATORY WORK

Note: Use C/C++/Java or equivalent tool to implement the following experiment

1. Consider a file with composite data, substitute the content and transpose the ciphers.
2. Consider an alphanumeric data, encrypt and Decrypt the data using advanced encryption standards and verify for the correctness.
3. Apply the RSA algorithm on a text file to produce cipher text file.
4. Develop a mechanism to setup a security channel using Diffie-Hellman Key Exchange between client and server
5. Implementation of Message Authentication Code using cryptography VMAC function.
6. Implement secure hash algorithm for Data Integrity. Implement MD5 and SHA-1 algorithm, which accepts a string input, and produce a fixed size number - 128 bits for MD5; 160 bits for SHA-1, this number is a hash of the input. Show that a small change in the input results in a substantial change in the output
7. Using any simulation tool: demonstrate packet filtering firewalls, create the ACL, create VLAN [Subnetting].
8. Develop a mechanism to setup(configure) a port scanner and identify the intrusion.

Course Outcomes:

Students will be able to:

- Analyze the vulnerabilities in any computing system and hence be able to design a security solution.

- Identify the security issues in the network and resolve it.
- Evaluate security mechanisms using rigorous approaches, including theoretical.

Semester II **Year: 2014-2015**

Course Title: Multimedia Communications	Course Code: 14SCN21
Credits(L:T:P): 3:0:1	Core/Elective: Core
Type of Course: Lecture and practical	Total Contact Hours:50

Course Objectives:

- To understand the Multimedia Communication Models
- To study the Multimedia Transport in Wireless Networks
- To solve the Security issues in multimedia networks
- To explore real-time multimedia network applications.
- To explore different network layer based application.

TOPICS

MODULE I

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

MODULE II

Framework for Multimedia Standardization: Introduction, Standardization activities, Standards to build a new global information infrastructure, Standardization processes on multimedia communications, ITU-T mediacom2004 framework for multimedia, ISO/IEC MPEG-21 multimedia framework, IETF multimedia Internet standards. **10 Hours**

MODULE III

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

MODULE IV

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

MODULE V

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

LABORATORY WORK

The following experiments should be practiced (Tools such as HTML/Frontpage/Dreamweaver/ equivalent, Multimedia application enabling software ,System software support for multimedia, Performance measurement tools for multimedia ,Multimedia authoring tools, Web tools and applications)

1. Audio and video editing
2. Image editing
3. 2D and 3D animation.

.The case studies are:

- Video on-demand
- Interactive TV
- Home shopping
- Remote home care
- Electronic album
- Personalized electronic journals.

COURSE OUTCOMES:

Students will be able to:

• Deploy the right multimedia communication models.
• Apply QoS to multimedia network applications with efficient routing techniques.
• Solve the security threats in the multimedia networks.
• Develop the real-time multimedia network applications.

TEXT BOOKS:

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

REFERENCE BOOKS:

1. Fred Halsall: Multimedia Communications – Applications, Networks, Protocols, and Standards, Pearson, 2001.

2. Nalin K Sharad: Multimedia information Networking, PHI, 2002.

Semester II **Year:2014-2015**

Course Title: Distributed Computing	**Course Code: 14SCN22**
Credits(L:T:P): 4:0:0	**Core/Elective: Core**
Type of Course: Lecture	**Total Contact Hours:50**

Course Objectives

- To learn Basic Concepts of DSM, Hardware DSM
- To understand File Sharing, DFS Implementation, Replication in DFS,
- To understand the concepts of Cryptanalysis, Secure channels, Access control.
- To understand some of the security concepts in distributed computing.

TOPICS

MODULE I

Distributed System management: Introduction, Resource management, Task Assignment Approach, Load-Balancing Approach, Load-Sharing Approach, Process management in a Distributed Environment, Process Migration, Threads, Fault Tolerance.

10 hours

MODULE II

Distributed Shared Memory : Introduction, Basic Concepts of DSM, Hardware DSM, Design Issue in DSM Systems, Issue in Implementing DSM Systems, Heterogeneous and Other DSM Systems, Case Studies.

10 hours

MODULE III

Distributed File System: Introduction to DFS, File Models, Distributed File System Design, Semantics of File Sharing, DFS Implementation, File Caching in DFS, Replication in DFS, Case studies. **Naming:** Introduction, Desirable features of a good naming system, Basic concepts, System-oriented names, Object-locating mechanisms, Issues in designing human-oriented names, Name caches, Naming and security, Case study: Domain name service.

10 hours

MODULE IV

Security in distributed systems: Introduction, Cryptography, Secure channels, Access control, Security Management, Case studies.

10 hours

MODULE V

Real-Time Distributed operating Systems: Introduction, Design issues in real-time distributed systems, Real-time communication, Real-time scheduling, Case study: Real-time communication in MARS. **Emerging Trends in distributed Computing:** Introduction to emerging trends, Grid Computing, SOA, Cloud computing, the future of emerging Trends.

10 hours

COURSE OUTCOMES:

The student will be able to

- Realize shared memory concept.
- Realize Advantages of DFS.
- Implement mechanisms to manage security in DS

Text Book.

1. Sunitha Mahajan, Seema Shah: Distributing Computing, Published by Oxford University press 2010

Semester II **Year:2014-2015**

Course Title: Network Management	**Course Code: 14SCN23**
Credits(L:T:P): 3:0:1	**Core/Elective: Core**
Type of Course: Lecture and practical	**Total Contact Hours:50**

COURSE OBJECTIVES

- To understand the need for interoperable network management.
- To learn to the concepts and architecture behind standards based network management.
- To understand the concepts and terminology associated with SNMP and TMN.
- To understand network management as a typical distributed application

TOPICS

MODULE I

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 System platform, Current Status and Future of Network Management. **10 Hours**

MODULE II

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, Functional Model. **10 Hours**

MODULE III

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, Functional Model

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, RMON2 Conformance Specifications.

10 Hours

MODULE IV

Broadband Network Management: Broadband Access Networks 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, ADSL Configuration Profiles.

10 Hours

MODULE V

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, Policy- Based Management, Service Level Management. **10 Hours**

LABORATORY WORK:

1. Capture packets transferred while browsing a selected website (e.g. a page from the course website, a search engine home page). Investigate the protocols used in each packet, the values of the header fields and the packet sizes.

2. Explore at least the following features of Wireshark: filters, Flow Graphs (TCP), statistics, protocol hierarchies.

3. Create several example files for your Apache web server to serve. Configure your web server, and then ask a friend to test your web server by accessing the files. Capture the packets and observe the log file.

4. Configure authentication for a specific directory on your web server. Test, captured packets and observe the log file.
5. Login to another computer in the lab, capture and investigate the data exchanged.

6. Trace the path between several pairs of source/destination nodes.
7. Create fire wall rule(s) that will drop TCP packets destined to a specific computer on the lab network (e.g. yours neighbors computer).

8. Using the supplied client/server sockets programs, implement a third proxy server.

Note: NS2 or equivalent tool to be used.

Course Outcomes:
Upon completion of this course, the students will be able to

- Analyze the issues and challenges pertaining to management of emerging network technologies such as wired/wireless networks and high-speed internets.
- Apply network management standards to manage practical networks.
- Formulate possible approaches for managing OSI network model.
- Use on SNMP for managing the network
- Use RMON for monitoring the behavior of the network
- Identify the various components of network and formulate the scheme for the managing them

TEXT BOOKS:

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

REFERENCE BOOKS:

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

Semester II **Year:2014-2015**

Course Title: Switching & Statistical Multiplexing in Telecommunications	**Course Code: 14SCN24**
Credits(L:T:P): 4:0:0	**Core/Elective: Core**
Type of Course: Lecture	**Total Contact Hours:50**

Course Objectives:

- To understand Switching and multiplexing.
- To understand the transmission technology.
- To understand the transmission control.
- To understand basic knowledge on telecommunication.

Topics:

MODULE I

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

10 Hours

MODULE II

Switching: Crossbar Switching, Principles of Common Control, Touch Tone Dial Telephone, Principles of Crossbar Switching, Crossbar Switch Configurations, Crosspoint Technology, Crossbar Exchange Organization. **10 Hours**

MODULE III

Electronic Space Division Switching: Stored Program Control, Centralized SPC, Distributed SPC, Software Architecture, Application Software, Enhanced Services, Two-stage, Three-stage and n-stage Networks. **Digital Transmission and Multiplexing:** Sampling, Quantization and Binary Coding, Quantization Noise, Companding, Differential Coding, Vocoders, Pulse Transmission, Line Coding, Time Division Multiplexing.

10 Hours

MODULE IV

Time Division Switching: Basic Division Space and Time Switching, Time Multiplexed Space and Time Switching, Combination Switching, Three-stage and n-stage Combination Switching.

10 Hours

MODULE V

Traffic Engineering: Network Traffic Load and Parameters, Grade of Service and Blocking Probability, Modeling Switching Systems, Incoming Traffic and Service Time Characterization, Blocking Models and Loss Estimates, Delay Systems. **10 Hours**

Course Outcomes:

The student will be able to:

- Gain the knowledge about switching and multiplexing
- Gain the knowledge about telecommunication.
- Learn transmission control in telecommunication.

TEXT BOOKS:

1. Thiagarajan Viswanathan: Telecommunication Switching Systems and Networks, PHI, 1992.

2. John.C.Bellamy: Digital Telephony, 3rd Edition, John Wiley and Sons Inc., 2002.

Semester II **Year: 2014-2015**

Course Title: Cloud Computing	**Course Code: 14SCN251**
Credits(L:T:P): 4:0:0	**Core/Elective: Elective**
Type of Course: Lecture	**Total Contact Hours:50**

COURSE OBJECTIVES

- To learn how to use Cloud Services.
- To gain knowledge Virtualization
- To gain knowledge Task Scheduling algorithms.
- Apply Map-Reduce concept to applications.
- To build Private Cloud.
- To gain knowledge in cloud resource virtualization and scheduling.

TOPICS:

MODULE I

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 and software licensing. Exercises and problems.

10 Hours

MODULE II

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, Cloud computing for Biology research, Social computing, digital content and cloud computing.

10 Hours

MODULE III

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, The dark side of virtualization, Exercises and problems.

10 Hours

MODULE IV

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 deadlines, Resource management and dynamic scaling, Exercises and problems. **10 Hours**

MODULE V

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, How to use S3 in java, Cloud-based simulation of a distributed trust algorithm, A trust management service, A cloud service for adaptive data streaming, Cloud based optimal FPGA synthesis .Exercises and problems. **10 Hours**

Course Outcomes:

The student will be able to:

- Demonstrate simple Cloud Applications
- Apply resource allocation, scheduling algorithms.
- Implement Map-Reduce concept.
- Create virtual machines from available physical resources.
- Setup a private cloud.

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.

Semester II **Year:2014-2015**

Course Title: Wireless Sensor Networks	**Course Code: 14SCN252**
Credits(L:T:P): 4:0:0	**Core/Elective: Elective**
Type of Course: Lecture	**Total Contact Hours:50**

COURSE OBJECTIVES

- Architect sensor networks for various application setups.
- Explore the design space and conduct trade-off analysis between performance and resources.
- Devise appropriate data dissemination protocols and model links cost.
- Determine suitable medium access protocols and radio hardware.
- Prototype sensor networks using commercial components.

- Provision quality of service, fault-tolerance, security and other dependability requirements while coping with resource constraints.

TOPICS:

MODULE I

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, Another Taxonomy of WSN Technology

(Chapter 1: 1.1, 1.2, Chapter2: 2.1-2.6) **10 Hours**

MODULE II

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, Available Wireless Technologies

(Chapter3: 3.1-3.5, Chapter 4: 4.1-4.3) **10 Hours**

MODULE III

MAC and Routing Protocols for Wireless Sensor Networks: Introduction, Background, Fundamentals of MAC Protocols, MAC Protocols for WSNs, Sensor-MAC case Study, IEEE 802.15.4 LR-WPANs Standard Case Study. **Routing Protocols for Wireless Sensor Networks:** Introduction, Background, Data Dissemination and Gathering, Routing Challenges and Design Issues in WSNs, Routing Strategies in WSNs.

(Chapter 5: 5.1-5.6, Chapter 6: 6.1-6.5) **10 Hours**

MODULE IV

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, Existing Middleware.

(Chapter 7: 7.1-7.4, Chapter 8: 8.1-8.4) **10 Hours**

MODULE V

Network Management and Operating System for Wireless Sensor Networks

Introduction, Network Management Requirements, Traditional Network Management Models, Network Management Design Issues. **Operating Systems for Wireless Sensor Networks:** Introduction, Operating System Design Issues, Examples of Operating Systems.

(Chapter 9: 9.1-9.5, Chapter 10: 10.1-10.3)

10 Hours

COURSE OUTCOMES

The student will be able to:

- Develop applications of wireless sensor actuator networks
- Implement the elements of distributed computing and network protocol .

- Explore various hardware, software platforms that exist for sensor networks

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", Wiley 2010

2. Feng Zhao & Leonidas J. Guibas, "Wireless Sensor Networks- An Information Processing Approach", Elsevier, 2007.

Semester II **Year: 2014-2015**

Course Title: Optical Networks	**Course Code: 14SCN253**
Credits(L:T:P): 4:0:0	**Core/Elective: Elective**
Type of Course: Lecture	**Total Contact Hours:50**

Course Objectives:

- To learn the basic elements of optical fiber transmission link, fiber modes configurations and structures
- To understand the different kind of losses, signal distortion in optical wave guides and other signal degradation factors
- To learn the various optical source materials, LED structures, quantum efficiency, Laser diodes
- To learn the fiber optical receivers such as PIN APD diodes, noise performance in photo detector, receiver operation and configuration
- To learn the fiber optical network components, variety of networking aspects, FDDI, SONET/SDH and operational principles WDM
- To acquire knowledge about fault and congestion management.

Topics

MODULE I

Client Layers of the Optical Layer: SONET/SDH: Multiplexing, CAT and LCAS, Sonnet/SDH Layers, SONET Frame Structure, SONET/SDH Physical Layer , Elements of a SONET/SDH Infrastructure**, Optical Transport Network:** Hierarchy, Frame Structure, Multiplexing, Generic Framing Procedure Ethernet: Frame Structure, Switches, Ethernet Physical Layer, Carrier Transport IP: Routing and Forwarding, Quality of Service. **Multiprotocol Label Switching:** Labels and Forwarding, Quality of Service, Signaling and Routing, Carrier Transport, Resilient Packet Ring: Quality of Service, Node Structure, Fairness Storage-Area Networks: Fiber Channel. **10 Hours**

MODULE II

WDM Network Elements: Optical Line Terminals, Optical Line Amplifiers, Optical Add/Drop Multiplexers: OADM Architectures, **Reconfigurable OADMs Optical Cross connects**: All-Optical OXC Configurations.

10 Hours

MODULE III

Control and Management

Network Management Functions: Management Framework, Information Model, Management Protocols. Optical Layer Services and Interfacing, Layers within the Optical Layer, Multivendor Interoperability. **Performance and Fault Management:** The Impact of Transparency, BER Measurement, Optical Trace, Alarm Management, Data Communication Network (DCN) and Signaling, Policing, Optical Layer Overhead, Client Layers. **Configuration Management**: Equipment Management, Connection Management, Adaptation Management. Optical Safety: Open Fiber Control Protocol

10 Hours

MODULE IV

Protection in SONET/SDH: Point-to-Point Links, Self-Healing Rings, Unidirectional Line-Switched Rings, Bidirectional Line-Switched Rings, Ring Interconnection and Dual Homing. **Protection in the Client Layer**: Protection in Resilient Packet Rings, Protection in Ethernet, Protection in IP, Protection in MPLS, Why Optical Layer Protection: Service Classes Based on Protection. Optical Layer Protection Schemes: 1+1 OMS Protection, 1:1 OMS Protection, OMS-DPRing, OMS-SPRing, 1:N Transponder Protection, 1+1 OCh Dedicated Protection, OCh-SPRing, OCH-Mesh Protection, GMPLS Protection, Interworking between Layers.

10 Hours

MODULE V

WDM Network Design: Cost Trade-OFFS: A Detailed Ring Network Example LTD and RWA Problems, Light path Topology Design, Routing and Wavelength Assignment, Wavelength Conversion. Dimensioning Wavelength- Routing Networks, **Statistical Dimensioning Models:** First-Passage Model, Blocking Model, Maximum **Load Dimensioning Models**: Offline Light path Requests, Online RWA in Rings.

10 Hours

COURSE OUTCOMES

The student will be able to:

- Design a system, component or process as per needs and specification.
- Gain knowledge on optical network architectures ranging from optical access networks to backbone optical transport networks.
- Gain the knowledge on methodologies of optical network design optimization;
- Explore techniques of optical network survivability.
- Solve the Problems in the discipline of optical networks.

Text Books:

1. Optical Networks by Rajeev Ramaswamy, Kumar N Sivarajan, Galen H Sasaki, Elsevier Publication 3rd Edition, 2009.

References:

1. Uyless Black, Optical Networks-Third generation transport system: Pearson 2013.

Semester II **Year: 2014-2015**

Course Title: Advances in VLSI Design and Algorithms	Course Code: 14SCN254
Credits(L:T:P): 4:0:0	Core/Elective: Elective
Type of Course: Lecture	Total Contact Hours:50

Course Objectives:

- Able to understand the fundamentals of CMOS VLSI and associated technologies.
- Able to solve problems in the design of CMOS logic circuits, with particular reference to speed and power consumption.
- Able to appreciate the design process in VLSI, GALS.
- Able to explain basic operation principles of diodes and MOS FPGAs; PLA.
- Able to design the fundamental blocks of a VLSI circuits, both by circuit schematic and physical layout

TOPICS:

MODULE I

Introduction to Digital systems and VLSI: Why Design Integrated Circuits? Integrated Circuits manufacturing; Integrated Circuit Design Techniques; IP-Based Design.
Fabrication and Devices: Introduction; Fabrication processes; Fabrication theory and practice; Reliability.

10 Hours

MODULE II

Sequential Machines: Introduction; Latches and Flip-flops; Sequential systems and clocking disciplines; Performance analysis; Clock generators; Sequential systems design, Power optimization, Design validation, Sequential testing. **10 Hours**

MODULE III

Subsystem Design: Introduction; Combinational shifters; Adders; ALUs; Multipliers; High-density memory; Image sensors; FPGAs; PLA; Buses and networks on chips; Data paths; Subsystems as IP.

10 Hours

MODULE IV

Architecture Design: Introduction; Hardware description languages; Register Transfer design; Pipelining; High-level synthesis; Architecture for low power; GALS systems; Architecture testing; IP components; Design methodologies; Multiprocessor system-on-Chip design.

10 Hours

MODULE V

Simulations: General remarks; Gate-level modeling and simulations; Switch-level modeling and simulation.

10 Hours

Course Outcomes:

The student will be able to:

- Clear understanding of important concepts in CMOS technology and fabrication that affect design.
- Apply two-level and multi-level logic minimization techniques to the given Boolean logic function.
- Design and develop Layout a gate in CMOS VLSI technology.

TEXT BOOKS:

1. Wayne Wolf: "Modern VLSI design", 4th Edition, PHI Learning, 2007.

2. Sabih H Gerez: "Algorithms for VLSI Design Automation", Wiley India, 2007.

Semester II **Year: 2014-2015**

Course Title: Distributed Computing Lab	**Course Code: 14SCN26**
Credits(02)(L:T:P): 0:0:3	**Core/Elective: Core**
Type of Course: Practical	**Total Contact Hours:42**

Course Objectives

- To understand the main ideas and concepts on web services.
- Studying and working on a related topic of internet applications such as information hiding, system security and E-learning.
- To understand the concepts of UDDI, SOAP, JMS remote procedure calls.

LIST OF EXPERIMENTS:
Note: Use appropriate tools/language to implement the following experiment:

1. Design and implement client server application using RMI (Remote Method Invocation) to invoke a service to calculate the income tax.
2. Design and implement EJB (Entity Java Beans) session bean business logic to calculate income tax and invoke the service using stub, i.e., client side proxy object.
3. Design and implement an EJB entity bean to persist the client submitted data into an enterprise information system.
4. Design and implement an offline database communication system using JMS (Java Message Service) to service the client request.
5. Design and implement the client code to call the Micro soft service like free service from UDDI (Universal Description Discovery Protocol).
6. Design and implement business logic and bind it as service using SOAP (Simple Object Access Protocol), also implement client to call service.

NOTE: Use EJB 3.X or any equivalent tool.

COURSE OUTCOMES:

The student will be able to

- Develop and debug RPC based client-Server programs in UNIX.
- Realize the partial implementation of UDDI, SOAP, JMS in Web applications.

Semester IV **Year: 2014-2015**

Course Title: Client-Server Programming	**Course Code: 14SCN41**
Credits(L:T:P): 3:0:1	**Core/Elective: Core**
Type of Course: Lecture and practical	**Total Contact Hours:50**

COURSE OBJECTIVES

- To understand **Client-Server software,** Context Switching and Protocol Software, I/o.
- To understand System Calls, Basic I/O Functions available in UNIX
- To understand the Socket interface, TCP, UDP un detail.
- Various client software applications and their issues.
- To understand the concept of Socket interface in client server programming.

TOPICS:

MODULE I

The Client Server Model and Software Design: Introduction, Motivation, Terminology and Concepts **Concurrent Processing in Client-Server software:** 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, Concurrency and Asynchronous I/O. **Program Interface to Protocols:** 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 UNIX I/O with TCP/IP. **10 Hours**

MODULE II

The Socket Interface: 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 a Program, Symbolic Constants for Socket Call Parameters. **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 that uses UDP, Partial Close for UDP, A Warning about UDP Unreliability. **10 Hours**

MODULE III

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, A UDP Client for the ECHO Service. **10 Hours**

MODULE IV

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, A concurrent Connection-Oriented Server Algorithm, Using separate Programs as Slaves, Apparent Concurrency using a Single Process, When to use each Server Types, The Important Problem of Server Deadlock, Alternative Implementations.

10 Hours

MODULE V

Iterative, Connectionless Servers (UDP): Introduction, Creating a Passive Socket, Process Structure, An example TIME Server. **Iterative, Connection-Oriented Servers (TCP):** Introduction, Allocating a Passive TCP Socket, A Server for the DAYTIME Service, Process Structure, An Example DAYTIME Server, Closing Connections, Connection Termination and Server Vulnerability.

Concurrent, Connection-Oriented Servers (TCP): Introduction, Concurrent ECHO, Iterative Vs Concurrent Implementations, Process Structure, An example Concurrent ECHO Server, Cleaning up Errant Processes.

10 Hours

LABORATORY WORK:

1. Design, develop, and execute a program in C under UNIX / LINUX environment to implement a simple iterative connectionless server and demonstrate its functioning.
2. Design, develop, and execute a program in C under UNIX / LINUX environment to implement a simple iterative connection-oriented server and demonstrate its functioning.
3. Design, develop, and execute a program in C under UNIX / LINUX environment to implement a simple concurrent connection-oriented server and demonstrate its functioning.
4. Design, develop, and execute a program in C under UNIX / LINUX environment to implement a simple Day / Time Server and demonstrate its functioning.
5. Design, develop, and execute a program using JAVA networking facilities to implement a simple Day / Time Server and demonstrate its functioning. Repeat the above problems.

COURSE OUTCOMES

The student will be able to:

- Gain in depth knowledge about Client-Server software, Context Switching and Protocol Software, I/o.
- Programming System Calls, Basic I/O Functions available in UNIX
- Gain the knowledge on Socket interface, TCP, UDP in details.
- Pros and cons of Client Software Various applications and their issues.

TEXT BOOK:

1. Douglas E.Comer, David L. Stevens: Internetworking with TCP/IP – Vol. 3, Client-Server Programming and Applications, BSD Socket Version with ANSI C, 2nd Edition, Pearson, 2001

Semester IV **Year:2014-2015**

Course Title: Analysis of Computer Networks	Course Code: 14SCN421
Credits(L:T:P): 4:0:0	Core/Elective: Elective
Type of Course: Lecture	Total Contact Hours:50

COURSE OBJECTIVES

- To Become familiar with the concepts of computer networks
- What is a computer network and what are the fundamental protocols.
- To analyze network architectures in stochastic and deterministic way.
- RSVP, Principles of TCP
- To explore more on different network protocols.
- To understand the knowledge of multiplexing, streaming sessions in computer network.

TOPICS:

MODULE I

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

10 Hours

MODULE II

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

10 Hours

MODULE III

Stream Sessions: Deterministic Network Analysis: Events and processes in packet multiplexer models: Universal concepts; Deterministic traffic models and Network Calculus; Scheduling; Application to a packet voice example; Connection setup: The RSVP approach; Scheduling (continued). **10 Hours**

MODULE IV

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

10 Hours

MODULE V

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

10 Hours

Course Outcomes:

On completion, student will be able to:

- List and classify network services, protocols and architectures, explain why they are layered.
- Implement key Internet applications and their protocols, and will apply to develop their own applications (e.g. Client Server applications, Web Services) using the sockets API.

TEXT BOOKS:

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

REFERENCE BOOKS:

1. M. Schwartz: Broadband Integrated Networks, Prentice Hall PTR, 1996.

2. J. Walrand, P. Varaiya: High Performance Communication Networks, 2nd Edition, Morgan Kaufmann, 1999

Semester IV **Year:2014-2015**

Course Title: Service Oriented Architecture	**Course Code: 14SCN422**
Credits(L:T:P): 4:0:0	**Core/Elective: Elective**
Type of Course: Lecture	**Total Contact Hours:50**

Course Objectives:

- To understand various architecture for application development
- To understand the importance of SOA in Application Integration
- To learn web service and SOA related tools.
- To learn the concepts of SOA governance.

Topics:

MODULE I

SOA BASICS: Software Architecture – Types of IT Architecture – SOA – Evolution – Key components – perspective of SOA – Enterprise-wide SOA – Architecture – Enterprise Applications – Solution Architecture for enterprise application – Software platforms for enterprise Applications – Patterns for SOA – SOA programming models

10 Hours

MODULE II

SOA ANALYSIS AND DESIGN: Service-oriented Analysis and Design – Design of Activity, Data, Client and business process services – Technologies of SOA – SOAP – WSDL – JAX – WS – XML WS for .NET – Service integration with ESB – Scenario – Business case for SOA – stakeholder OBJECTIVES – benefits of SPA – Cost Savings

10 Hours

MODULE III

SOA GOVERNANCE :SOA implementation and Governance – strategy – SOA development – SOA governance – trends in SOA – event-driven architecture – software s a service – SOA technologies – proof-of-concept – process orchestration – SOA best practices

10 Hours

MODULE IV

SOA IMPLEMENTATION: SOA based integration – integrating existing application – development of web services – Integration - SOA using REST – RESTful services – RESTful services with and without JWS – Role of WSDL,SOAP and Java/XML mapping in SOA – JAXB Data binding.

10 Hours

MODULE V

APPLICATION INTEGRATION: JAX –WS 2.0 client side/server side development – Packaging and Deployment of SOA component – SOA shopper case study –WSDL centric java WS with SOA-J – related software – integration through service composition (BPEL) – case study - current trends.

10 Hours

COURSE OUTCOMES

The student will be able to:

- Compare the different IT architecture
- Analysis and design of SOA based applications
- Implementation of web service and realization of SOA
- Implementation of RESTful services
- Design and implementation of SOA based Application Integration using BPEL

Textb Book:

1. Shankar Kambhampaly, "Service–Oriented Architecture for Enterprise Applications",Wiley 2008.

REFERENCES:

2. Mark D. Hansen, "SOA using Java Web Services", Practice Hall, 2007.
3. Waseem Roshen, "SOA-Based Enterprise Integration", Tata McGraw-HILL, 2009.

Semester IV **Year: 2014-2015**

Course Title: Mobile Application Development	**Course Code: 14SCN423**
Credits(L:T:P): 4:0:0	**Core/Elective: Elective**
Type of Course: Lecture	**Total Contact Hours:50**

Course Objectives:

- To Understand system requirements for mobile applications
- To Generate suitable design using specific mobile development frameworks
- To Generate mobile application design
- To Implement the design using specific mobile development frameworks
- To acquire knowledge of android applications development.

Topics:

MODULE I

Introduction to mobile communication and computing**:**, Introduction to mobile computing, Novel applications, limitations and GSM architecture, Mobile services, System architecture, Radio interface, protocols, Handover

and security. Smart phone operating systems and smart phones applications.

10 Hours

MODULE II

Fundamentals of Android Development: Introduction to Android., The Android 4.1 Jelly Bean SDK, Understanding the Android Software Stack, Installing the Android SDK, Creating Android Virtual Devices, Creating the First Android Project, Using the Text View Control, Using the Android Emulator, The Android Debug Bridge (ADB), Basic Widgets Understanding the Role of Android Application Components, Event Handling , Displaying Messages Through Toast, Creating and Starting an Activity, Using the Edit ext Control .

10 Hours

MODULE III

The Android Debug Bridge (ADB), Basic Widgets Understanding the Role of Android Application Components, Event Handling , Displaying Messages Through Toast, Creating and Starting an Activity, Using the Edit ext Control Building Blocks for Android Application Design, Laying Out Controls in Containers, Utilizing Resources and Media, Using Selection Widgets and Debugging Displaying and Fetching Information Using Dialogs and Fragments

10 Hours

MODULE IV

Using Selection Widgets and Debugging Displaying and Fetching Information Using Dialogs and Fragments Advanced Android Programming: Internet, Entertainment, and Services, Implementing drawing and animations,

10 Hours

MODULE V

Displaying web pages and maps, communicating with sms and emails,. creating and using content providers: Creating and consuming services, Publishing android applications.

10 Hours

Course Outcomes:

The student will be able to:

- Describe the requirements for mobile applications
- Explain the challenges in mobile application design and development
- Develop and design for mobile applications for specific requirements
- Implement the design using Android SDK
- Implement the design using Objective C and iOS

Text Books:

1. Mobile Computing: Technologies and Applications- N. N. Jani S chand,2009.
2. B.M.Hirwani- Android programming Pearson publications-2013

Semester IV **Year: 2014-2015**

Course Title: Cybercrime and Digital Forensic	**Course Code: 14SCN424**
Credits(L:T:P): 4:0:0	**Core/Elective: Elective**
Type of Course: Lecture	**Total Contact Hours:50**

Course Objectives

- To understand Accounting Forensics
- To analyze the nature and effect of cyber crime in society.
- To understand Sarbanes-Oxley Financial and Accounting Disclosure Information
- To understand Computer Crime and Criminals
- To understand Liturgical Procedures

Topics:

MODULE I

INTRODUCTION: Introduction and Overview of Cyber Crime, Nature and Scope of Cyber Crime, Types of Cyber Crime: Social Engineering, Categories of Cyber Crime, Property Cyber Crime.

10 Hours

MODULE II

CYBER CRIME ISSUES: Unauthorized Access to Computers, Computer Intrusions, White collar Crimes, Viruses and Malicious Code, Internet Hacking and Cracking, Virus Attacks, Pornography, Software Piracy, Intellectual Property, Mail Bombs, Exploitation, Stalking and Obscenity in Internet, Digital laws and legislation, Law Enforcement Roles and Responses.

10 Hours

MODULE III

INVESTIGATION: Introduction to Cyber Crime Investigation, Investigation Tools, e-Discovery, Digital Evidence Collection, Evidence Preservation, E-Mail Investigation, E-Mail Tracking, IP Tracking, E-Mail Recovery, Hands on Case Studies. Encryption and Decryption Methods, Search and Seizure of Computers, Recovering Deleted Evidences, Password Cracking.

10 Hours

MODULE IV

DIGITAL FORENSICS: Introduction to Digital Forensics, Forensic Software and Hardware, Analysis and Advanced Tools, Forensic Technology and Practices, Forensic Ballistics and Photography, Face, Iris and Fingerprint Recognition, Audio Video Analysis, Windows System Forensics, Linux System Forensics, Network Forensics. **10 Hours**

MODULE V

LAWS AND ACTS: Laws and Ethics, Digital Evidence Controls, Evidence Handling Procedures, Basics of Indian Evidence ACT IPC and CrPC , Electronic Communication Privacy ACT, Legal Policies.

10 Hours

Course Outcomes

The student will be able to:

- Understand financial and accounting forensics, and explain their role in preventing various forms of fraud.
- Distinguish various types of computer crime, and use computer forensic techniques to identify the digital fingerprints associated with criminal activities.
- Know how to apply forensic analysis tools to recover important evidence for identifying computer crime.
- Develop a custom computer forensic analysis tool.

Text:

1. Nelson Phillips and Enfinger Steuart, "Computer Forensics and Investigations", Cengage Learning, New Delhi, 2009.
2. Kevin Mandia, Chris Prosise, Matt Pepe, "Incident Response and Computer Forensics ", Tata McGraw -Hill, New Delhi, 2006.

References:

3. Robert M Slade," Software Forensics", Tata McGraw - Hill, New Delhi, 2005.
4. Bernadette H Schell, Clemens Martin, "Cybercrime", ABC – CLIO Inc, California, 2004.