SINGHANIA UNIVERSITY

CURRICULUM AND SYLLABUS

M.Tec In Computer Science & Engineering
### Semester 1

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subject Type</th>
<th>Subject Name</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>MCSE-101</td>
<td>Theory</td>
<td>Applied Algorithms</td>
<td>4</td>
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<tr>
<td>MCSE-102</td>
<td>Theory</td>
<td>Emerging trends in Computer Architecture</td>
<td>4</td>
</tr>
<tr>
<td>MCSE-103</td>
<td>Theory</td>
<td>Principles and Practices for IT Management</td>
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<tr>
<td>MCSE-104</td>
<td>Theory</td>
<td>Elective-I</td>
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<td>MCSE-105</td>
<td>Theory</td>
<td>Elective-II</td>
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<tr>
<td>MCSE-106</td>
<td>Practical</td>
<td>Laboratory Practice-I</td>
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<tr>
<td>MCSE-107</td>
<td>Practical</td>
<td>Seminar-I</td>
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### Semester 2

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<tr>
<td>MCSE-201</td>
<td>Theory</td>
<td>Operating System Design</td>
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<tr>
<td>MCSE-202</td>
<td>Theory</td>
<td>High Performance Database Systems</td>
<td>4</td>
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<tr>
<td>MCSE-203</td>
<td>Theory</td>
<td>Advanced Software Engineering</td>
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<tr>
<td>MCSE-204</td>
<td>Theory</td>
<td>Elective-III</td>
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<td>MCSE-205</td>
<td>Theory</td>
<td>Elective-IV</td>
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<td>MCSE-206</td>
<td>Practical</td>
<td>Laboratory Practice-II</td>
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<tr>
<td>MCSE-207</td>
<td>Practical</td>
<td>Seminar-II</td>
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### Semester 3

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<td>MCSE-301</td>
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<td>Seminar-III</td>
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<tr>
<td>MCSE-302</td>
<td>Practical</td>
<td>Project stage-I</td>
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### Semester 4

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<td>MCSE-401</td>
<td>Practical</td>
<td>Project stage-II</td>
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## List of Elective Subjects

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<th>Elective II</th>
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<tr>
<td>A) Internet Routing Design</td>
<td>A) Wireless Technology</td>
<td>A) Network Programming</td>
<td>A) Infrastructure Management</td>
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<tr>
<td>B) Advanced TCP/IP</td>
<td>B) Information Security Audit and Management</td>
<td>B) Network Design, Modeling and Analysis</td>
<td>B) Convergence Technology</td>
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<td>C) Open Elective(Self Study)</td>
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Applied Algorithms

1. Introduction to Probability and Problem Solving:
   **Summation Formulas** and properties, Bounding Summations, **Counting and Probability**: Probability Axioms, Discrete and continuous Probability Distribution, Conditional Probability, Baye’s Theorem, Discrete Random Variables, Expected Value of Random Variable, Variance and standard deviation, Geometric and Binomial distribution, **Proof Techniques** contradiction, mathematical induction, strong induction, recursive mathematical definitions.

2. Analysis of Algorithms

3. Fundamental Computing Algorithms
   Numerical algorithms, Sequential and binary search algorithms. Quadratic sorting algorithms and O (n log n) sorting algorithms. Algorithms on graphs and their complexities.

4. Approximation Algorithms
   Introduction, Absolute approximation, Epsilon approximation, Polynomial time approximation schemes, Probabilistically good algorithms.

5. Advanced Algorithmic Analysis
   Amortized analysis, online and offline algorithms, randomized algorithms. Dynamic programming: matrix chain multiplication and longest common subsequence, Greedy algorithms: action-selection problem and Huffman codes, combinatorial optimization.

6. Parallel Algorithms

Reference Books:

1. Kishore S. Trivedi, “Probability & Statistics with Reliability, Queing, and Computer Science Applications” PHI
2. Cormen, Leiserson, Rivest, “Algorithms”, PHI
Emerging trends in Computer Architecture

1. Advanced Computer System architecture
   Case studies: IBM cluster, Beowulf cluster-caltech , Digital true Unix cluster(springerlink.com/content) , next generation clusters- infiniband.
   MPP - Technology , new generation of MPPs , Distributed memory MPPs -, Achieving high performance on NOW

2. System Interconnects:
   Basics revised, Gigabit network technologies – Giga Bit Ethernet, Myrient (Myricom), Quadrinet(Quadrics), PARAM net (CDAC), ATM switches & networks – ATM architecture, inter network connectivity

3. Threading, synchronization and communication
   Multithreaded Architecture, approaches to multi threading, Software multithreading, Synchronization mechanisms, TCP/IP protocol suite, fast & efficient communication-Log P Communication model, communication algorithms, Case Study: IBM Power IV, V

4. Storage
   Storage Area Network (SAN), Network attached storage and direct storage. Storage area network versus system area network, Computer Architecture Research Challenges: How Computer Architecture Trends may Affect Future Distributed Systems

5. Grid Computing
   Grid fundamentals – Cluster to grid computing , Grid computing models- ARC model, ARCC model, Sneha-Samuham computing model, Grid architecture considerations, Standards for grid -OGSA , OGSI ,OGSA-DAI, Grid FTP, WSRF, Web services related standards, Grid architecture models, Computational grid , Data grid , Grid topologies, Basic methodology

6. Parallel programming:
   Paradigms, parallel programming models, shared memory programming , message passing programming – paradigms , MPI , PVM ,Threads, Data parallel programming – model, Case study – High performance FORTRAN, CCC, HP Java, Other data parallel approaches

Reference Books
1. Kai Hwang, Zhiwei Xu -"Scalable Parallel Computers"
3. Introduction to grid computing - Bart Jacob , Michael Brown
4. Grid Computing – A research Monograph - D. Janakiram (TMGH)
5. Parallel Programming
6. Storage Networks – Wulfgong Muller (Wiley)
Principles and Practices for IT Management

1. Management Perspectives
Role and importance of management, process of management – planning, organizing, staffing, directing, controlling. Nature, purpose and principles of management, Business policy, tools and techniques of strategic management, business ethics and social responsibilities

2. Preliminary planning of an IT Project
Gathering project Information, defining the project goals, establishing project priorities, requirements analysis, risk management, budgeting a project, creating a work breakdown structure, estimation

3. Organizing an IT Project
Organizing a Project Team: - Assessing internal scales, creating a team, managing team issues, resources procurement
Preparing and Implementing the project plan: - Defining the project schedule, project network diagram creation and analysis, project constraints, tracking project progress and financial obligations
Revising the project plan:-need for revision , establishing change control, implementing the project changes, coping with project delays

4. Group Dynamics and Team Management
Theories of Group Formation –Formal and Informal Groups and their interaction, Importance of teams - Formation of teams – Team Work, Leading the team, Team Meeting, Conflict Management - Traditional vis-à-vis Modern view of conflict, Conflict Process - Strategies for resolving destructive conflict, Stress management, employee welfare, energy management and energy audit,

5. Modern approaches to management
Concept of Knowledge management, change management, technology management, supply chain management, introduction to Intellectual property Rights (IPR)and cyber laws, process and project quality standards – six sigma, CMM, CMMI, PCMM, Impact of IT quality management systems, learning organizations

6. Applications of IT in management
Application of IT in functions like finance and accounting, stores, purchase, product design and development, quality control, logistics, customer relationship, marketing, project management, health care, insurance, banking, agriculture and service sector.

Reference Books:

2. Management-Tasks, Responsibilities and practices, Peter Drucker
3. Management Theory and Practice- Ernst Dale
4. Management Information System-Javadekar
5. Business Policy- Azhar Kazmi
1 Networking and Network Routing: An Introduction

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

3 Routing Protocols: Framework and Principles

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

5. Analysis of Network Algorithms
Network Bottleneck, Network Algorithmics, Strawman solutions, Thinking Algorithmically, Refining the Algorithm, Cleaning up, Characteristics of Network Algorithms.
IP Packet Filtering and Classification: Classification, Classification Algorithms, Naïve Solutions, Two-Dimensional Solutions, Approaches for d Dimensions,

6. Quality of Service Routing

7. Routing and Traffic Engineering

REFERENCES:

1. **Introduction to Client-Server environment**
   Introduction Client-Server model, complexity of servers, RARP servers, UNIX IO paradigm and Network IO, Sending and Receiving data through a Socket, IP address manipulation routines, Obtaining Information about Host, Networks Protocols and Network services.

2. **BOOTP and DHCP** - BOOTP Operations, BOOTP Message format, DHCP Operations, DHCP Message format.

3. **Domain Name System** - Hierarchical Name space, Domain Name Space: Label, Domain name, FQDN, Distribution of Name space: Hierarchy of Name space, Zone, Root servers, DNS in the Internet, Resolution: Mapping Names to Address, Mapping Address to Names, Recursive resolution, Iterative resolution, caching, Types of Record: Resource record, Zone Delegation, Zone Transfer, DDNS

4. **TELNET and Rlogin** - Concept of Telnet, Telnet Protocol and options, Timesharing Environments, Network Virtual Terminals (NVT), Mode of operations, Rlogin

5. **File Transfer Protocol** - FTP, FTP features, process model, TFTP, NFS implementation, RPC.

6. **Simple Mail Transfer Protocol** - SMTP, User Agent, Addresses, Mail Transfer Agent, Mail transfer phases, MIME, Multi part messages, POP.

7. **Hyper Test transfer Protocols** - Architectural components, URL, HTTP transactions, Response Message, Header, WWW

8. **Voice Over IP (RTP)** - Real Time Transfer Protocol, RTP encapsulation, RTP Control protocol, operation, QoS, RSVP.

**Reference Books:**
3. Karnjit S. Siyan, Inside TCP/IP, Techmedia
4. Pete Loshin, TCP/IP Clearly Explained, Morgan Kaufmann Publications
1. **Transmission Fundamentals:**

2. **Antennas and Propagation:**

3. **Wireless Standards**
   **IEEE 802.11a/b/g and IEEE 802.15, 16:** Introduction to wireless networking, Nomenclature & Design, Types of networks: Satellite, GSM, Network Operation. Challenges for the MAC, MAC Access Modes and Timings, Contention-Based Access using the DCF. 802.11 frames.

4. **Wifi & Wi-Max & Bluetooth**

5. **Advanced Wireless Protocols**
   **WEP:** WEP Cryptographic Operations, WEP Data processing, Problems with WEP.
   **EAP:** EAP formats, Working of EAP.
   Mobile IP, TCP-Snoop, M-TCP.

**References:**
1. Wireless Communications and Networks, William Stallings, Pearson Education.
Objectives: After completing the course, students will be able to:
• Identify and prioritize information assets
• Identify and prioritize threats to information assets
• Define an information security strategy and architecture
• Plan for and respond to intruders in an information system
• Describe legal and public relations implications of security and privacy issues
• Present a disaster recovery plan for recovery of information assets after an incident

Syllabus

• Introduction to the management of Information security
• Planning for Security
• Planning for Contingencies
• Information security policy
• Developing the Security Program
• Security management Models and Practices
• Risk Management : Assessing and controlling risk
• Protection mechanism
• Personnel and security
• Law and Ethics
• Information Security Project Management

References:
4. Risk Management Guide for Information Technology Systems
5. Contingency *Planning Guide for Information Technology Systems*
Laboratory Practice – I

Seminar – I

Seminar on state-of-art topic.
Operating System Design

1. Overview of Basic Concepts


2. Process Management and CPU Scheduling

Creation, Suspension and Termination of Processes; Process State Preservation for Restarting a Suspended Process; CPU Scheduling in Uniprocessor and Multiple Processor Systems; Process Migration Policies and Mechanisms; Real-Time Scheduling; Multithreading and Threads Scheduling.

3. Interprocess Communication (IPC)

Need for IPC among Cooperating Processes; IPC between Processes on a Single Computer System (Shared Memory Approach); IPC between Processes on Different Systems (Message Passing Approach); Synchronous and Asynchronous IPC; Buffer Management Strategies; Group Communication.

4. Concurrency and Synchronization

Need for Concurrency and Mutual Exclusion; Critical Section Problem; Software Approaches for Mutual Exclusion; Hardware Support for Mutual Exclusion; Semaphore; Monitors; Classical Problems of Synchronization.

5. Deadlocks

System Model; Necessary Conditions for Deadlock, Deadlock Modeling using Resource Allocation Graph and Wait-for Graph; Deadlock Handling Mechanisms – Avoidance, Prevention; Detection and Recovery; Ways for Recovery from Deadlock; Issues in Recovery from Deadlock – Victim(s) Selection, Use of Transaction Mechanism to Rerun a Killed/Rolled-back Process.

6. File Management

File Management in Multiprocessor Systems – Caching, Replication, and Migration; File Sharing Semantics and Consistency Control Mechanisms; Stateful and Stateless File Servers; Directories and Directory Management.

7. Protection and Security

Access Validation, Granting Rights, Passing Rights and Rights Revocation in Case of ACLs and Capabilities.

8. Case Study: Unix Operating System


Reference Books

High Performance Database Systems

1. High performance Issues and concerns in databases, Database Tuning and Performance: benchmarking, TPC benchmarks, object oriented benchmarks; TP Monitors, Object Transaction Management
2. Query Optimization: Physical layer, Access Methods, Query Optimization, DBMS buffers, caches, and optimisation high level query languages and low level primitive operations, join algorithms.
3. Advanced concepts in Transaction Management: ACID properties, pessimistic locking, optimistic locking, flat transactions, nested transactions, deadlock detection and management; Recovery: write-ahead logging, shadow paging; Indexing structures: Btrees, hash files, multi-attribute indexing; Distributed databases, Schemas, Architectures, Queries, Transactions
4. Data warehousing: Heterogeneous information; the integration problem; the Warehouse Architecture; Data Warehousing; Warehouse DBMS, Data Warehouse Models and OLAP operations. ETL, materialized views, Dashboards, BI
5. SQL Extensions: Aggregations, SQL 3, SQL 2006 XML integration
6. Data Mining: KDD process, Data mining applications, Data mining Techniques and Algorithms
7. Emerging trends in databases: Active and Deductive databases, Main Memory databases, OR Databases, Semantic databases
8. Emerging database technology case studies: XML, Hibernate, Directory services and LDAP

Reference Books
4. Jiawei Han, Micheline Kamber, “Data Mining”, Second Edition, Elsevier

Advanced Software Engineering

1. Introduction to Software Engineering

2. Design Engineering

3. Software Development Methodologies
Iterative Software Development, Software Reuse, CBSE, Critical Systems Development, Software Evolution

4. Software Management
Verification and Validation, Software Testing, Critical Systems Validation, Managing People, Software Cost Estimation, Quality Management, Process Improvement, Configuration Management

5. Alternative Paradigms
Extreme Programming, Agile Software Engineering, Clean Room Software Engineering, Introduction to Formal Methods, soft systems

6. Advanced Software Engineering Process
Software Process Improvement, Software Economics, Software Quality, Software Metrics, Software Maintenance, Risk management, Requirement Engineering

Reference Books:

ELECTIVE-III
A) Network Programming

1. The Transport Layer: TCP and UDP with policy control

TCP Connection Establishment and Termination, TIME_WAIT State, Port Numbers, Concurrent Servers, Buffer Sizes and Limitations.

2. Sockets and Socket Programming
   Introduction, Socket Address Structures, Value-Result Arguments, Byte Ordering Functions, Byte Manipulation Functions, socket Function. TCP Client-Server: TCP Echo Server, TCP Echo Client, Crashing of Server Host, Crashing and Rebooting of Server Host, Shutdown of Server Host. UDP Sockets: UDP Echo server, UDP Echo Client.

3. Routing Sockets
   Datalink Socket Address Structure, Reading and Writing, Interface Name and Index Functions

4. Name and Address Conversions
   Domain Name System, Functions. Advanced Name and Address Conversions: Functions and Implementation

5. IPv4 and IPv6 Interoperability
   IPv4 Client, IPv6 Server, IPv6 Client, IPv4 Server, IPv6 Address Testing Macros, IPV6_ADDRFORM Socket Option

6. Multicasting and Broadcasting
   Broadcast Addresses, Unicast versus Broadcast, Multicasting: Multicast Addresses, Multicasting versus Broadcasting on A LAN, Multicasting on a WAN, Multicast Socket Options, Simple Network Time Protocol, SNTP.

7. Threads
   Thread Functions: Creation and Termination, TCP Echo Server, Thread-Specific Data, Web Client and Simultaneous Connections

8. Client-Server Design Alternatives
   TCP Client Alternatives, TCP Test Client, Iterative Server, Concurrent Server, Thread Locking around accept, TCP Preforked Server, Descriptor Passing, TCP Concurrent Server, One Thread per Client, TCP Prethreaded Server.

Reference Books:
1. **Essentials of Probability**


2. **Delay Models in Data Networks**

Multiplexing of Traffic on a Communication Link, Queuing Models- Little’s Theorem, Little’s Theorem, Probabilistic Form of Little’s Theorem, Application of Little’s Theorem, The M/M/1 Queuing System, Arrival Statistics, Service Statistics, Markov Chain Formulation, Deviation of the Stationary Distribution, Occupancy Distribution upon Arrival, Occupancy Distribution upon Departure, The M/M/m, M/M/∞, M/M/m/m, AND Other Markov Systems, The M/M/m: The m-Server Case, M/M/∞: The Infinite-Server Case, M/M/m/m: The m-Server Loss System, N-dimensional Markov Chains- Applications in Circuit Switching, The M/G/1 System, M/G/1 Queues with Vacations, Reservations and Polling, Priority Queuing

3. **Inside an IMP**

Queueing in the Network Layer at an IMP, Basic Single Queue Model, Applications of Queueing Analysis Outside of Networking, The Poisson Arrival Model, Properties of a Poisson Process, Interarrival Times of a Poisson Process, The M/M/1 Queue, Aside: Queuing Notation, Aside: The D/D/1 Queue, State Analysis of an M/M/1 Queue, Balance Equations, Solving the Balance Equations, The Finite Buffer Case: M/M/1/N, Blocking Probability and the Right Size Buffer, Throughput in the Finite Buffer Case, Alternate way to compute throughput of M/M/1/N: Look at the output side, Aside: Derivation of = Using Throughput, Approximation of a Finite Buffer System by the Infinite Buffer Model, How Long is That Line?, Little's Formula and Queuing Delay, Applying Little's Formula to an M/M/1 Queue, Applying the M/M/1 Results to a Single Network Link, Other Queuing Models
4. **Network Design**

Problem definition: Multipoint line layout heuristics, CMST algorithm, ESAU-William’s algorithm, Sharma’s algorithm, Unified algorithm, Bin packing, Terminal assignments, Concentrator location

5. **Network Analysis**

Queuing Networks, Closed Queuing Network Example, Nodes in a Packet Switched Network (PSN), Queuing Network Model of Nodes in a PSN, Queuing Network Analysis of a PSN, performance analysis of Data Link Layer, Network layer, QoS

6. **Network Administration**

Functions and responsibilities, Network planning and implementation, Sub-netting, Bandwidth management, security issues, Tools for BW and security management, modifying network implementation

**Reference Books**

5. Stallings W., “High Speed Networks and Internet: Performance and Quality of Service”, Prentice-Hall
1. **Infrastructure Management Overview**
   Definitions, Infrastructure management activities, Evolutions of Systems since 1960s (Mainframes-to-Midrange-to-PCs-to-Client-server computing-to-New age systems) and their management, growth of internet, current business demands and IT systems issues, complexity of today’s computing environment, Total cost of complexity issues, Value of Systems management for business

2. **Preparing for Infrastructure Management**
   Factors to consider in designing IT organizations and IT infrastructure, Determining customer’s Requirements, Identifying System Components to manage, Exist Processes, Data, applications, Tools and their integration, Patterns for IT systems management, Introduction to the design process for information systems, Models, Information Technology Infrastructure Library (ITIL)

3. **Service Delivery Processes**
   Service-level management, financial management and costing, IT services continuity management, Capacity management, Availability management

4. **Service Support Processes**
   Configuration Management, Service desk, Incident management, Problem management, Change management, Release management

5. **Storage and Security Management**
   Introduction Security, Identity management, Single sign-on, Access Management, Basics of network security, LDAP fundamentals, Intrusion detection, firewall, security information management
   Introduction to Storage, Backup & Restore, Archive & Retrieve, Space Management, SAN & NAS, Disaster Recovery, Hierarchical space management, Database & Application protection, Bare machine recovery, Data retention

**Reference Books:**
1. **Convergence Standards and Protocols:**
   Why Convergence, Identifying benefits of Converged network, Voice Packetization, Voice Compression (G.711,G.726,G.729 Etc), Switching basics, Circuit Switching Vs Packet Switching, Identify capabilities of T carrier systems

2. **Switching Networks:**
   ISDN (Concept, services, architecture, protocol overview etc.), Overview Of Frame Relay Networks, B-ISDN

3. **ATM Technology :**
   ATM VPI and VCI Creation of virtual channels ,Definition of Switched Virtual Circuit and Permanent Virtual Circuit ,Step-by-step PVC example of how an ATM network processes cells ,Step-by-step SVC example of how an ATM network processes cells ,Connection Admission Control (CAC) ,Cell Loss Priority (CLP) ,SVC signaling - Q.2931 ,Adaptation layers from a Voice over ATM perspective ,AAL1 , AAL2 ,AAL5.

4. **Access Signaling Types:**

5. **VOIP Convergence:**
   IP telephony basics, VOIP and its features and benefits, Overview of VOIP technology (including access gateways), Quality Of service and VOIP.

6. **Network Convergence:**
   Characteristics of the H.323 protocol, Identify the key benefits of Session Initiation Protocol, SIP components and messages, Media Gateway Control Protocol (MGCP), Overview of NetMeeting,

**References:**
1. Multimedia Communications Directions and Innovations By Jerry Gibson Academic Press
3. VOIP by Ulyess Black
C) Open Elective (Self Study)

Laboratory Practice – II

Seminar – II

Seminar – III
Seminar on Dissertation Topic.

Project Stage – I

Project will consist of a System Development in Hardware/Software. Project work should be carried out using Software Engineering principles and practices.

Project Stage – II