

**University of Rajshahi**

**Faculty of Science**

*H@san*



**Department of Information and  
Communication Engineering**

**Syllabus for M.Sc.**

**Session: 2006-2007**

**Examination – 2007**

The Master of Science (M.Sc) course in Information and Communication Engineering is divided into two groups, namely General Group (Group A) and Thesis Group (Group B). The course consists of total 800 marks (8 units, 32 credits) and its duration is one year.

### **General Group (Group A)**

The M.Sc. (Final) Examination in Information and Communication Engineering for General Group (Group A) comprises of six theoretical courses each of four hours duration and each carries 75 marks. Practical examinations shall be of 24 hours (4 days; 6 hours a day). Marks for practical examination are 140. Laboratory assessment carries 60 marks. Viva-Voce examination and continuous assessment carry 100 marks and 50 marks, respectively.

The courses ICE-501, ICE-502, ICE-503 and ICE-504 are compulsory. Two others courses shall be taken from optional courses with the prior approval of the chairman of the department.

### **Thesis Group (Group B)**

The Examination of the Thesis Group (Group-B) comprises of six theoretical courses out of which four courses are compulsory (i.e., ICE-501, ICE-502, ICE-503 and ICE-504) and two are optional courses, each of four hours duration and each carries 75 marks. Marks on continuous assessment, General Viva-Voce and Viva-Voce on Thesis are 50 marks, 100 marks, 50 marks, respectively. The Dissertation carries 150 marks. Student opting for the thesis group must take prior permission of the chairman of the department.

<u>Compulsory Courses</u>		Unit	Marks	Credit
ICE-501	: Network Planning and Management	0.75	75	3
ICE-502	: Mobile and Wireless Communication	0.75	75	3
ICE-503	: Cryptography and Network Security	0.75	75	3
ICE-504	: Data Warehousing and Data Mining	0.75	75	3
<u>Optional Courses</u>				
ICE-505	: Multimedia Communication Engineering	0.75	75	3
ICE-506	: Advanced Satellite Communication	0.75	75	3
ICE-507	: E-Commerce System	0.75	75	3
ICE-508	: Natural Language Processing	0.75	75	3
ICE-509	: Software Engineering	0.75	75	3
ICE-510	: Continuous Assessment	0.5	50	2
ICE-511	: Viva-Voce (General)	1	100	4
ICE-512	: Practical (For Group-A) (4X6 hours)	2	200	8
ICE-513	: Thesis (For Group-B)	2	200	8
<b>Total =</b>		<b>8</b>	<b>800</b>	<b>32</b>

**Marks Distribution of Practical ICE-512 (For Group-A)**

i)	Laboratory Assessment	60
ii)	Experiments (4x30)	120
iii)	Viva on Experiments (4x5)	20
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		200

**Marks Distribution of Thesis ICE-513 (For Group-B)**

i)	Dissertation	150
ii)	Viva- Voce on Thesis	50
		<hr/>
		200

## ICE-501: Network Planning and Management

75 Marks, 0.75 Unit

### Exam Duration : 4 Hours

There should be 8 questions in all. Question no. 1 should be compulsory and cover the entire syllabus. This question should be at least 5 short answer type questions. It should be of 15 marks. Student may be asked to attempt 4 questions out of remaining 7 questions of 15 marks each.

✓ **Network Planning Concepts:** Basic Concepts in Network Planning, Components of Network Planning, The Network Planning Process, Computer Aided Network Planning.

**Planning Local and Distribution network:** Structure of the Local Networks, Objectives of Cable Planning, Flexible Vs. Rigid Network, Basic Steps in Scientific Local Network Planning, Effects of Bad Planning, Information Required for Planning Distribution Network.

**Introduction to Cellular Network Planning:** Objectives of Radio Network Planning, The Impact of User Environment, Cellular Network Planning Approaches, Starting Points for the Planning Procedures: Desired Grade of Service, System Specification, Equipment Specification, Available Frequency Band, Service Area Topography, Traffic Distribution, Existing Infrastructure.

✓ **Radio Propagation Effects and Coverage Planning:** Starting Points and Objectives, Frequency Reuse, Prediction of Offered Traffic.

✓ **Multisuser Interference and Capacity Planning:** Goals of Coverage Planning, Multipath Propagation: Path Loss, Hata Mode, Walfish-Ikegami Model, Path Loss Corrections, Slow and Fast Fading, Connection Between Coverage and Quality of Service, Radio Link Power Budget: Antenna Feeder Loss, Antenna Gain.

✓ **Frequency and Channel Allocation:** Regular Frequency Reuse Patterns, Methods Applied in Frequency Planning: Interference Levels, Minimum Reuse Distances, Allocation of Frequencies, Adjacent Channel Interference Avoidance.

**Network management:** Overview of Distributed Computing and Technologies, RPC, NFS, Network Management System, Network management standards, SNMP, CMIP, Management Activities, Fault management Security Management, Accounting Management.

**Books Recommended**

1. William Stallings : Data and Computer Communication.
2. Roberts S. Cahn : Wide Area Network Design- Concepts and Tools for Optimization
3. S. Faruque, Artech House : Cellular Mobile Systems Engineering
4. J. Gardiner. B. West, Artech House : Personal Communication Systems and Technologies

## ICE-502: Mobile and Wireless Communication

75 Marks, 0.75 Unit

### Exam Duration : 4 Hours

There should be 8 questions in all. Question no. 1 should be compulsory and cover the entire syllabus. This question should be at least 5 short answer type questions. It should be of 15 marks. Student may be asked to attempt 4 questions out of remaining 7 questions of 15 marks each.

**Introduction:** Introduction to Wireless System, Generations of Wireless Communication Systems: Concept of 1G, 2G, 3G Systems, Recent Trends in Wireless Systems: Basic Idea of 4G Systems.

**Characteristics of Wireless Medium:** Radio Propagation Mechanism, Large Scale Path-Loss, Path-Loss Modeling and Signal Coverage, Small Scale Fading, Effects of Multi-path and Doppler, Channel Measurement and Modeling Technique,

**Cellular Concept- System Design Fundamentals:** Introduction, Frequency Reuse, Channel Assignment Strategies, Handoff strategies, Interference and System Capacity, Trunking and GoS, Techniques for Improving Coverage and Capacity of Cellular System.

**Modulation and Coding Techniques:** Frequency Modulation and Amplitude Modulation, Digital Modulation Techniques: an overview, Pulse shaping techniques, Linear Modulation Techniques: BPSK, DPSK, QPSK,  $\Pi/4$  QPSK. Constant Envelop Modulation: MSK and GMSK. Combined Modulation Technique: MPSK, QAM, 16-QAM, 64-QAM, MFSK, OFDM. Spread Spectrum Modulation Technique, FHSS, DSSS, MC-CDMA.

**Equalization and Diversity:** Characteristics of AWGN channel, Fundamentals of equalization, Training a generic equalizer, equalizers in communication receiver, linear and nonlinear equalizer, algorithms for Adaptive equalization, Diversity Techniques: Selection Diversity, MRC, MMSE, MLE, EGC, frequency and time diversity, RAKE receiver, Idea of Beamforming.

**Channel Source and Speech Coding:** Interleaving, Block Code, Trellis Code, Convolutional Coding, Space Time Coding, STBC, STTC, Characteristics of Speech Signals, Quantization Technique, ADPCM, Vocoders, Linear Predictive Coders, Choosing Speech Code for Mobile Communications

1 set } **Wireless Networking:** Introduction to Wireless Networks, Development of Wireless Networks, Traffic Routing in Wireless Networks, Wireless Data Services, Common Channel Signaling (CCS), ISDN, signaling system (SS7), PCS/PCNs, Protocols for Network Access, Network Databases.

2 set + Tika } **Wireless Systems and Standards:** AMPS and ETACS, USDC (IS-54 and IS-136), GSM, CDMA (IS-95), WLAN (IEEE 802.11), WPAN, WRAN (IEEE 802.22), PCS, UMTS, IMT-2000, GPS, Bluetooth, Ad hoc Networks, Wireless sensor networks.

#### Books Recommended

1. Kaveh Pahlavan & Prashant Krishnamurty : Principles of Wireless Networks (ch-5)
2. Theodore S Rappaport : Wireless Communications (ch-3)
3. Andrea Goldsmith : Wireless Communication
4. William Stallings : wireless communications and networks (ch-10)



## **ICE-503: Cryptography and Network Security**

**75 Marks, 0.75 Unit**

### **Exam Duration : 4 Hours**

There should be 8 questions in all. Question no. 1 should be compulsory and cover the entire syllabus. This question should be at least 5 short answer type questions. It should be of 15 marks. Student may be asked to attempt 4 questions out of remaining 7 questions of 15 marks each.

**Introduction:** Classical Security Techniques and Computer Network Security Concepts, Confidentiality and Security, Model for Network Security, Foundation of Cryptography: Cipher and Secret Messages, Security Attacks and Services.

**Symmetric Ciphers:** Symmetric Cipher Model, Substitution and Transposition Techniques, DES and The Strength of DES, Theory of Block Cipher Design, Block Cipher Modes of Operation, Modular Arithmetic, Euclid's Algorithm, Finite Fields, Polynomial Arithmetic, The AES Cipher, Triple DES, Blowfish, RC5, RC4 Stream Cipher, Placement of Encryption Function, Traffic Confidentiality, Key Distribution, Random Number Generation.

**Public-Key Encryption:** Prime Numbers and Testing for Primality, Discrete Logarithms, Principles of Public-Key Cryptosystems, The RSA Algorithm, Key Management, Diffie-Hellman Key Exchange.

**Hashes and Messages Digests:** Message Authentication, Hash Functions, Security of Hash Functions and MACs, MD5 Message Digest Algorithm, Secure Hash Algorithm, RIPEMD-160, HMAC.

**Digital Signatures and Authentication:** Digital Signature, Authentication Protocols, Digital Signature Standard, Authentication of Systems: Kerberos, X.509 Authentication Service.

**Electronic Mail Security:** Pretty Good Privacy (PGP), Secure/Multipurpose Internet Mail Extension (S/MIME).

**IP and Web Security:** IP Security Overview, IP Security Architecture, Authentication Header, Encapsulating Security Payload, Key Management, Web Security Considerations, Secure Socket Layer and Transport Layer Security.

**System Security:** Intruders, Intrusion Detection, Password Management, Viruses and Related Threats, Virus Countermeasures, Firewall Design Principles, Trusted Systems.

### **Books Recommended**

1. William Stallings : Cryptography and Network Security: Principles and Practices
2. Scan Convery : Network Security Architectures
3. William Stallings : Network Security Essential

## **ICE-504: Data Warehousing and Data Mining**

**75 Marks, 0.75 Unit**

### **Exam Duration : 4 Hours**

There should be 8 questions in all. Question no. 1 should be compulsory and cover the entire syllabus. This question should be at least 5 short answer type questions. It should be of 15 marks. Student may be asked to attempt 4 questions out of remaining 7 questions of 15 marks each.

**Data Warehousing:** Definition, The compelling Need for Data Warehousing, Data warehouses: The Building Blocks, Trends in Data Warehousing.

**Types of Data Warehouses:** Host Based, Single Stage, LAN Based, Stationary, Distributed and Virtual Data-Warehouses.

**Data Warehouses Architecture:** The Architectural Components, Infrastructure as the Foundation for Data warehousing, Data warehousing Architecture Model, 2-Tier, 3-Tier and 4-Tier Data warehouses.

**OLAP in the Data Warehouse:** Demand for Online Analytical Processing, Major Features and Functions, OLAP Models, OLAP Implementation Considerations.

**Data Warehousing and the Web:** Web-Enabled Data warehouse, Web-Based Information Delivery, OLAP and the Web, Building a Web-Enabled Data Warehouse.

**Data Mining:** Process, Technologies and Rules, Platform, Tools and Tools Characteristics, Data Mining Applications, Operational Vs. Information Systems, OLAP Technology for Data Mining.

**Data Mining Primitives, Language and System Architectures:** Data Mining Primitives: Task-Relevant Data, The kind of Knowledge to be Mined, Background Knowledge, A Data mining Query Language Architectures of Data Mining Systems.

**Data Classification and Prediction:** Knowledge Discovery through Statistical Techniques, Knowledge Discovery through Neural Network, Fuzzy Techniques and Genetic Algorithms.

**Books Recommended**

1. W.H. Inmon : Building the Data warehouse
2. W.H. Inmon, C. Kelly : Developing the Data warehouse
3. Fayyad, Usama M. : Advances in Knowledge Discovery and Data Mining etal
4. Alex Berson and Stephen J. Smith : Data Warehousing, Data Mining, & OLAP
5. Jiawei Han and Micheline Kamber : Data Mining Concepts & Techniques.

## ICE-505: Multimedia Communication Engineering

75 Marks, 0.75 Unit

Exam Duration : 4 Hours

There should be 8 questions in all. Question no. 1 should be compulsory and cover the entire syllabus. This question should be at least 5 short answer type questions. It should be of 15 marks. Student may be asked to attempt 4 questions out of remaining 7 questions of 15 marks each.

**Multimedia Communication:** Introduction, Media and Data streams, Multimedia, Multimedia Communication model, Elements of Multimedia Systems, User and Network requirements, and Multimedia Terminals, Fourier Transform, Discrete Fourier transform, Discrete Cosine Transform, Application of Multimedia communication Networks.

**Multimedia Information Representation and Processing in Communication:** Introduction, Digitization principles: Text, Image, Audio, Video; Digital media and Signal-Processing Elements, Data embedding and watermarking algorithms, Signal processing for networked Multimedia, NNs for Multimedia processing.

**Text and Image Compression:** Compression principles; Text compression: Static and Dynamic Huffman coding, Lempel-Ziv Coding, Lempel-Ziv-Welsh Coding; Image coding, Image Compression: Graphics Interchange Format, Digitized Documents, Digitized Pictures, JPEG Multimedia System Design.

**Audio/Video Processing and Communications:** Audio Fundamentals; Transform coding, Subband coding, Audio compression: Differential Pulse Code modulation, Adaptive Differential PCM, Adaptive predictive coding, Linear predictive coding, MPEG Audio Coder; Analog and Digital Video Formats, Video Coding Methods, Video Compression: Video Compression Principles, H.261, H.263, MPEG.

**Multimedia Database and Distributed Multimedia Systems:** MDBMS, Characteristics of an MDBMS, Integration in a Database Model, DMS, Main features of DMS, Networking, Multimedia operating system, Distributed Multimedia server, Distributed Multimedia application

**Signaling Protocols and Networking for Multimedia:** Protocols for multimedia communication: RTP, RTCP Signaling protocols: RTSP; Quality of Service(QoS) issues in networked Multimedia, QoS guarantees, Enhanced QoS: RSVP, IntServ, DiffServ; IP-based Transport: UDP Vs TCP, Streaming Media with TCP and UDP; Real-time multimedia streaming techniques, Multicast and Rate Control, Network Traffic, Network queue management, Scheduling.

**Multimedia Communication Standards:** Standards for Multimedia Applications, MPEG approach to Multimedia standardization, Coding of Moving pictures and associated Audio(MPEG-1), MPEG-2, System streams:H.221 framing for ISDN, MPEG-2 program streams, MPEG-2 Transport stream; Coding of Audiovisual Objects(MPEG-4), MPEG-7 architecture, Multimedia Framework(MPEG-21), ITU-T standardization of Audiovisual Communication Systems.

**Multimedia Communication Across Networks:** Audio/ video packet in the Network Environment, Video transport across generic networks, Multimedia transport across ATM networks, Multimedia across IP networks and DSLs, IP-based Transport: UDP Vs TCP, Streaming Media with TCP and UDP; Internet access networks and Multimedia Across Wireless.

### **Books Recommended**

1. K.R. Rao, Zoran S. Boojkovic, Dragorad A. Milovanovic : Multimedia communication Systems Techniques, Standards and Networks
2. Jerry D. Gibson : Multimedia Communications
3. Andleigh, Thakrar : Multimedia System Design
4. Sharda : Multimedia Information Networking
5. Vaughan : Multimedia Making it work
6. Fred Halsall : Multimedia Communications Applications, Networks, Protocols and Standards

## **ICE-506: Advanced Satellite Communication**

**75 Marks, 0.75 Unit**

**Exam Duration : 4 Hours**

There should be 8 questions in all. Question no. 1 should be compulsory and cover the entire syllabus. This question should be at least 5 short answer type questions. It should be of 15 marks. Student may be asked to attempt 4 questions out of remaining 7 questions of 15 marks each.

**Introduction to Satellite Communications:** Origin, History, Current Technology State and Overview of Satellite System Engineering.

**Orbital Aspects of Earth Satellites:** Orbital Mechanics and Orbital Elements, Azimuth and Elevation, Coverage Angle and Slant Range. Placement of a Satellite in a Geostationary Orbit.

**Satellite Link Design:** Basic Radio Transmission Theory, System Noise Temperature and G/T Ratio, Uplink and Downlink Design, Interference Analysis, Carrier-to-Noise plus Interference Ratio, Interference to and from Adjacent Satellite Systems, Terrestrial Interference, Cross-polarization Interference, Intermodulation Interference, Design of Satellite Links for Specified Carrier-to-Noise plus Interference Ratio, Digital Satellite Link

**Propagation on Satellite-Earth Paths and Its Influence on Link Design:** Absorptive Attenuation Noise by Atmospheric Gases, Rain Attenuation, Noise due to Rain, Rain Depolarization, Tropospheric Multipath and Scintillation Effects.

**Modulation, Multiplexing and Multiple Access Techniques in Satellite Communications:** Classification of Different Analog and Digital Modulation Schemes as Used in Satellite Communications and their Performance, Band-Limited Nonlinear Satellite Channel, Digital Modulation with Error-Correction Coding, Different Multiple and Multiple Access Techniques as Used in Satellite Communication.

**Satellite Networking:** Advantages and Disadvantages of Multibeam Satellites, Interconnection by Transponder Hopping, Interconnection by On-board Switching, Interconnection by Beam Scanning, On-Board Processing, Intersatellite Links.

**Performance and Reliability of Satellite Communications:** General Comments on Satellite Communication System Performance, Satellite System Reliability, Satellite System Availability, Sub-systems Reliability,

**Spacecraft and Earth Station Technology:** Spacecraft Subsystems, Description of Communication Subsystems, Types of Earth Stations and Design, Types of Antennas in Satellite Communications, Small Earth Station Antennas.

**Types of Satellite Networks:** Fixed Point Satellite Network, INTELSAT; Mobile Satellite Network, INMARSAT; Low Earth Orbit and Medium Earth Orbit Satellite Systems, Very Small Aperture Terminal (VSAT) Network, Direct Broadcast Satellite Systems.

#### **Books Recommended**

1. T. Ha : Digital Satellite Communications
2. Dennis Roddy : Satellite Communications
3. T. Pratt, C.W. Bostian, : "Satellite Communications
4. Shingo Ohmori, : Mobile Satellite Communications  
Hiromitsu and Seiichiro  
Kawase
5. R.M. Gagliardi : Satellite Communications
6. M.P.M. Hall, L. W. : Radio Propagation  
Barclay
7. L.J. Ippolito : Radiowave Propagation in Satellite  
Communications



## ICE-507: E-Commerce System

75 Marks, 0.75 Unit

**Exam Duration : 4 Hours**

There should be 8 questions in all. Question no. 1 should be compulsory and cover the entire syllabus. This question should be at least 5 short answer type questions. It should be of 15 marks. Student may be asked to attempt 4 questions out of remaining 7 questions of 15 marks each.

**Introduction to E-Commerce:** The Internet and Commercial Transactions, E-Commerce Definition, Infrastructure for E-Commerce, E-Commerce States and Processes, E-Commerce Challenges, E-Commerce Opportunities.

**E-commerce Options:** Internet Access Requirements, Web Hosting Requirements, Entry-Level Options, Storefront and Template Services, E-Commerce Software, E-Commerce Developers, E-Business Solutions.

**Marketing Issues:** Online and Offline Market Research, Data Collection, Domain Names, Advertising options, E-mail Marketing, Search Engines, Web site Monitoring, Incentives.

**Planning and Development:** Web Site Goals, International Issues, Planning Stages, Resource Allocation, Content Development, Site Map Development, Web Site Development, Web Site Design Principles, Web Site Design Tools, Web Page Programming Tools, Data Processing Tools, E-Commerce Components: Navigation Aids, Web Site Search Tools, Databases, Forms, Shopping Carts, Checkout Procedures, Shipping Options.

**Payment Processing:** Electronic Payment Issues, E-Cash, Credit Card Issues, Merchant Accounts, Online Payment Services, Transaction Processing, Taxation Issues, Mobile Commerce (M-Commerce).

**Security Technologies:** Security Treats to E-Commerce, Encryption, Digital Signatures, Certifying Authorities, Public Key Cryptography, Security Protocols, Secure Socket Layer, Secured Electronic Transaction, PKI.

**Customer Service:** Customer Service Issues, E-mail Support, Telephone Support, Live Help Services, Customer Discussion Forums, Value-Added Options.

**Books Recommended**

1. Jeffrey F. Rayport, Bernard J. Jaworsk : E-Commerce
2. David Kosiur : Understanding Electronics Commerce
3. Jeffrey F. Rayport, et al : Introduction to E-Commerce
4. Debra Cameron : E-Commerce Security Strategies: Protection the Enterprise
5. Charles Trepper : E-Commerce Strategies

## ICE-508: Natural Language Processing

75 Marks, 0.75 Unit

### Exam Duration : 4 Hours

There should be 8 questions in all. Question no. 1 should be compulsory and cover the entire syllabus. This question should be at least 5 short answer type questions. It should be of 15 marks. Student may be asked to attempt 4 questions out of remaining 7 questions of 15 marks each.

**Introduction to Natural Language Processing:** Brief History of NLP Research, Current Applications, Generic NLP System Architecture, Knowledge-Based Versus Probabilistic Approaches, Lexicon and Morphology, Phrase Structure Grammars.

**Finite-State Techniques:** Inflectional and Derivational Morphology, Finite-State Automata in NLP, Finite-State Transducers.

**Prediction and Part-of-Speech Tagging:** Corpora, Simple N-grams, Word Prediction, Stochastic Tagging, Evaluating System Performance.

**Parsing and Generation:** Generative Grammar, Context-Free Grammars, Syntactic Parsing, Parsing and Generation with Context-Free Grammars, Top Down and Bottom-Up Parsing, Weights and Probabilities, Parsing with Constraint-Based Grammars, Constraint-Based Grammar, Unification.

**Compositional and Lexical Semantics:** Simple Compositional Semantics in Constraint-Based Grammar, Semantic Relations, Word Net, Word Senses, Word Sense Disambiguation, Semantic Parsing.

**Discourse and Dialogue:** Anaphora Resolution, Discourse Relations.

**Applications:** Machine Translation, Question Answering System, Intelligent Information Retrieval.

### Books Recommended

1. D. Jurafsky and James H. Martin : Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition
2. S. Russell, T. Arturo : Developing Natural Language Interfaces  
Translation Engines: Techniques for Machine Translation
3. J. Allen : Natural Language Understanding

## **ICE-509: Software Engineering**

**75 Marks, 0.75 Unit**

### **Exam Duration : 4 Hours**

There should be 8 questions in all. Question no. 1 should be compulsory and cover the entire syllabus. This question should be at least 5 short answer type questions. It should be of 15 marks. Student may be asked to attempt 4 questions out of remaining 7 questions of 15 marks each.

**Introduction:** Role of Software, Software Characteristics, Software Components, Types of Software Applications, Influence of the Internet on Software, Commercial Factors Affecting the Software, Software Application Programming (SAP), Architecture of SAP, Generic View of Software Engineering.

**Software Development Life Cycle:** Components of the Development Frame Work, Phases of SDLC, Software Process, Software Process Models, Linear Sequential Model, Prototyping Models, RAD, Incremental Model, Spiral Model and Fourth Generation Techniques (4GT).

**Software Project Management and Project Planning:** Project Management Spectrum- People, Product, Process, Project, Structure of the Development Team, Coordination and Communication Issues, Software Scope, Resources, Decomposition, Project Planning Objectives, Software Metrics and Project Estimation, LOC Based and FP Based Estimation, Empirical Estimation Model, The COCOMO Model, Risk Management.

**Software Quality:** Emergence of Modern Concept of Quality, Quality Control, Quality Measures, SQA Plan and Activities, Formal Technical Review (FTR), Quality Function Deployment (QFD), Cost of Quality, Total Quality Management (TQM), Quality Standards and their Compliance-ISO 9000, ISO 1400.

**System Engineering and Requirement Specifications:** System Engineering Hierarchy, System Modeling Process, Overview of Information Engineering, Business Area Analysis (BAA), Information Strategy Planning, Product Engineering, Software Requirement Specifications, Requirement Engineering. Requirement Elicitation Techniques Like FAST.

**Software Design Concepts and Analysis Principles:** Software Design, Analysis Principles, Functional, Behavioral and Data Modeling, Prototyping Methods and Tools, Elements of the Analysis Modes, SADT, Requirement Analysis Using DFD, Data Dictionaries and ER Diagrams, Basic Design Principles Important Design Concepts-Abstraction, Refinement, Modularity, Portioning, Functional Independence, Classification of Cohesiveness and Coupling, Architectural Mapping, Interface Design Considerations, Object Oriented Design, Guidelines for User Interface Design, Design Documentation.

**Software Testing, Reliability and Maintenance:** Different Testing Philosophy and Methods, Software Reliability and Availability, Software Reengineering, Maintenance Process, Configuration Management, Development of an Application Using Software Engineering Concepts.

#### **Books Recommended**

1. R.S Pressman : Software Engineering-A Practitioner's Approach
2. K.K. Aggarwal, Yogesh Singh : Software Engineering