| | |
|---|---|
| SC-FDMA Radio Resource(Sec 6.1 – 6.4 of Text).<br>.<br>**Downlink Transport Channel Processing:** Overview, Downlink shared channels, Downlink Control Channels, Broadcast channels, Multicast channels, Downlink physical channels, H-ARQ on Downlink(Sec 7.1 – 7.7 of Text). | |
| **Module – 4** | |
| **Uplink Channel Transport Processing:** Overview, Uplink shared channels, Uplink Control Information, Uplink Reference signals, Random Access Channels, H-ARQ on uplink (Sec 8.1 – 8.6 of Text).<br><br>**Physical Layer Procedures:** Hybrid – ARQ procedures, Channel Quality Indicator CQI feedback, Precoder for closed loop MIMO Operations, Uplink channel sounding, Buffer status Reporting in uplink, Scheduling and Resource Allocation, Cell Search, Random Access Procedures, Power Control in uplink(Sec 9.1- 9.6, 9.8, 9.9, 9.10 Text). | L1, L2 |
| **Module – 5** | |
| **Radio Resource Management and Mobility Management:** PDCP overview, MAC/RLC overview, RRC overview, Mobility Management, Inter-cell Interference Coordination(Sec 10.1 – 10.5 of Text). | L1, L2 |

**Course Outcomes:** At the end of the course, students will be able to:

- Understand the system architecture and the functional standard specified in LTE 4G.
- Analyze the role of LTE radio interface protocols and EPS Data convergence protocols to set up, reconfigure and release data and voice from users.
- Demonstrate the UTRAN and EPS handling processes from set up to release including mobility management for a variety of data call scenarios.
- Test and Evaluate the Performance of resource management and packet data processing and transport algorithms.

**Question Paper pattern:**

- The Question paper will have ten questions.
- Each full Question consisting of 16 marks
- There will be 2 full Questions (with a maximum of Three sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The Students will have to answer 5 full Questions, selecting one full Question from each module.

**Text Book:**

Arunabha Ghosh, Jan Zhang, Jefferey Andrews, Riaz Mohammed, 'Fundamentals of LTE', Prentice Hall, Communications Engg. and Emerging Technologies.

**Reference Books:**


1. LTE for UMTS Evolution to LTE-Advanced' Harri Holma and Antti Toskala, Second Edition - 2011, John Wiley & Sons, Ltd. Print ISBN: 9780470660003.
2. 'EVOLVED PACKET SYSTEM (EPS) ; THE LTE AND SAE EVOLUTION OF 3G UMTS' by Pierre Lescuyer and Thierry Lucidarme, 2008, John Wiley & Sons, Ltd. Print ISBN:978-0-470-05976-0.
3. 'LTE – The UMTS Long Term Evolution ; From Theory to Practice' by Stefania Sesia, Issam Toufik, and Matthew Baker, 2009 John Wiley & Sons Ltd, ISBN 978-0-470-69716-0.

# FIBER OPTICS and NETWORKS

**B.E., VIII Semester, Electronics &Communication Engineering**

[As per Choice Based Credit System (CBCS)]

| | | | |
|---|---|---|---|
| Subject Code | 15EC82 | IA Marks | 20 |
| Number of Lecture Hours/Week | 4 | Exam Marks | 80 |
| Total Number of Lecture Hours | 50(10 Hours / Module) | Exam Hours | 03 |
| CREDITS – 04 | | | |

**Course Objectives:** This course will enable students to:

- Learn the basic principle of optical fiber communication with different modes of light propagation.
- Understand the transmission characteristics and losses in optical fiber.
- Study of optical components and its applications in optical communication networks.
- Learn the network standards in optical fiber and understand the network architectures along with its functionalities.

| **Module -1** | **RBT Level** |
|---|---|
| **Optical fiber Communications:** Historical development, The general system, Advantages of optical fiber communication, Optical fiber waveguides: Ray theory transmission, Modes in planar guide, Phase and group velocity, Cylindrical fiber: Modes, Step index fibers, Graded index fibers, Single mode fibers, Cutoff wavelength, Mode field diameter, effective refractive index. Fiber Materials, Photonic crystal fibers. (Text 2) | L1, L2 |
| **Module -2** | |
| **Transmission characteristics of optical fiber:** Attenuation, Material absorption losses, Linear scattering losses, Nonlinear scattering losses, Fiber bend loss, Dispersion, Chromatic dispersion, Intermodal dispersion: Multimode step index fiber.<br><br>**Optical Fiber Connectors:** Fiber alignment and joint loss, Fiber splices, Fiber connectors, Fiber couplers. (Text 2) | L1, L2 |
| **Module -3** | |
| **Optical sources:** Energy Bands, Direct and Indirect Bandgaps, Light Emitting diodes: LED Structures, Light Source Materials, Quantum Efficiency and LED Power, Modulation. Laser Diodes: Modes and Threshold conditions, Rate equation, External Quantum Efficiency, Resonant frequencies, Laser Diode structures and Radiation Patterns: Single mode lasers.<br><br>**Photodetectors:** Physical principles of Photodiodes, Photodetector noise, Detector response time.<br><br>**Optical Receiver:** Optical Receiver Operation: Error sources, | L1, L2 |

| | |
|---|---|
| Front End Amplifiers, Receiver sensitivity, Quantum Limit. (Text 1) | |
| **Module -4** | |
| **WDM Concepts and Components:** Overview of WDM: Operational Principles of WDM, WDM standards, Mach-Zehnder Interferometer Multiplexers, Isolators and Circulators, Fiber grating filters, Dielectric Thin-Film Filters, Diffraction Gratings, Active Optical Components, Tunable light sources,<br><br>**Optical amplifiers:** Basic application and Types, Semiconductor optical amplifiers, Erbium Doped Fiber Amplifiers, Raman Amplifiers, Wideband Optical Amplifiers. (Text 1) | L1, L2 |
| **Module -5** | |
| **Optical Networks:** Optical network evolution and concepts: Optical networking terminology, Optical network node and switching elements, Wavelength division multiplexed networks, Public telecommunication network overview. Optical network transmission modes, layers and protocols: Synchronous networks, Asynchronous transfer mode, OSI reference model, Optical transport network, Internet protocol, Wavelength routing networks: Routing and wavelength assignment, Optical switching networks: Optical circuit switched networks, packet switched networks, Multiprotocol Label Switching, Optical burst switching networks, Optical network deployment: Long-haul networks, Metropoliton area networks, Access networks, Local area networks. (Text 2) | L1, L2 |

**Course Outcomes:** At the end of the course, students will be able to:

1. Classification and working of optical fiber with different modes of signal propagation.
2. Describe the transmission characteristics and losses in optical fiber communication.
3. Describe the construction and working principle of optical connectors, multiplexers and amplifiers.
4. Describe the constructional features and the characteristics of optical sources and detectors.
5. Illustrate the networking aspects of optical fiber and describe various standards associated with it.

**Question Paper pattern:**

- The Question paper will have ten questions.
- Each full Question consisting of 16 marks
- There will be 2 full Questions (with a maximum of Three sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The Students will have to answer 5 full Questions, selecting one full Question from each module.

**Text Books:**

1. Gerd Keiser , Optical Fiber Communication, 5th Edition, McGraw Hill

Education(India) Private Limited, 2015. ISBN:1-25-900687-5.
2. John M Senior, Optical Fiber Communications, Principles and Practice, 3rd Edition, Pearson Education, 2010, ISBN:978-81-317-3266-3

**Reference Book:**

Joseph C Palais, Fiber Optic Communication , Pearson Education, 2005, ISBN:0130085103

# Micro Electro Mechanical Systems

**B.E., VIII Semester, Electronics &Communication Engineering/ Telecommunication Engineering**

[As per Choice Based Credit System (CBCS) scheme]

| | | | |
|---|---|---|---|
| Subject Code | 15EC831 | IA Marks | 20 |
| Number of Lecture Hours/Week | 03 | Exam marks | 80 |
| Total Number of Lecture Hours | 40 (8 Hours per Module) | Exam Hours | 03 |
| CREDITS – 03 | | | |

**Course Objectives:** This course will enable students to:

- Understand overview of microsystems, their fabrication and application areas.
- Working principles of several MEMS devices.
- Develop mathematical and analytical models of MEMS devices.
- Know methods to fabricate MEMS devices.
- Various application areas where MEMS devices can be used.

| **Module 1** | **RBT Level** |
|---|---|
| **Overview of MEMS and Microsystems:** MEMS and Microsystem, Typical MEMS and Microsystems Products, Evolution of Microfabrication, Microsystems and Microelectronics, Multidisciplinary Nature of Microsystems, Miniaturization. Applications and Markets. | L1, L2 |
| **Module 2** | |
| **Working Principles of Microsystems:** Introduction, Microsensors, Microactuation, MEMS with Microactuators, Microaccelerometers, Microfluidics.<br><br>**Engineering Science for Microsystems Design and Fabrication**: Introduction, Molecular Theory of Matter and Inter-molecular Forces, Plasma Physics, Electrochemistry. | L1, L2 |
| **Module 3** | |
| **Engineering Mechanics for Microsystems Design:** Introduction, Static Bending of Thin Plates, Mechanical Vibration, Thermomechanics, Fracture Mechanics, Thin Film Mechanics, Overview on Finite Element Stress Analysis. | L1,L2,L3 |
| **Module 4** | |

| | |
|---|---|
| **Scaling Laws in Miniaturization:** Introduction, Scaling in Geometry, Scaling in Rigid-Body Dynamics, Scaling in Electrostatic Forces, Scaling in Fluid Mechanics, Scaling in Heat Transfer. | L1,L2,L3 |
| **Module 5** | |
| **Overview of Micromanufacturing:** Introduction, Bulk Micromanufacturing, Surface Micromachining, The LIGA Process, Summary on Micromanufacturing. | L1,L2 |

**Course Outcomes:** After studying this course, students will be able to:

- Appreciate the technologies related to Micro Electro Mechanical Systems.
- Understand design and fabrication processes involved with MEMS devices.
- Analyse the MEMS devices and develop suitable mathematical models
- Know various application areas for MEMS device

**Question paper pattern:**

- The question paper will have 10 full questions carrying equal marks.
- Each full question consists of 16 marks with a maximum of Three sub questions.
- There will be 2 full questions from each module covering all the topics of the module
- The students will have to answer 5 full questions, selecting one full question from each module.

**Text Book**:

Tai-Ran Hsu, MEMS and Micro systems: Design, Manufacture and Nanoscale Engineering, 2nd Ed, Wiley.

**Reference Books:**


1. Hans H. Gatzen, Volker Saile, JurgLeuthold, Micro and Nano Fabrication: Tools and Processes, Springer, 2015.
2. Dilip Kumar Bhattacharya, Brajesh Kumar Kaushik, Microelectromechanical Systems (MEMS), Cenage Learning.

# SPEECH PROCESSING

**B.E., VIII Semester, Electronics & Communication Engineering/ Telecommunication Engineering**

[As per Choice Based Credit System (CBCS) scheme]

| | | | |
|---|---|---|---|
| Subject Code | 15EC832 | IA Marks | 20 |
| Number of Lecture Hours/Week | 03 | Exam Marks | 80 |
| Total Number of Lecture Hours | 40 (8 Hours / Module) | Exam Hours | 03 |
| CREDITS – 03 | | | |

**Course Objectives:** This course enables students to:

- Introduce the models for speech production
- Develop time and frequency domain techniques for estimating speech parameters
- Introduce a predictive technique for speech compression
- Provide fundamental knowledge required to understand and analyse speech recognition, synthesis and speaker identification systems.

| **Modules** | |
|---|---|
| **Module-1** | **RBT Level** |
| **Fundamentals of Human Speech Production:** The Process of Speech Production, Short-Time Fourier Representation of Speech, The Acoustic Theory of Speech Production, Lossless Tube Models of the Vocal Tract, Digital Models for Sampled Speech Signals | L1, L2 |
| **Module-2** | |
| **Time-Domain Methods for Speech Processing:** Introduction to Short-Time Analysis of Speech, Short-Time Energy and Short-Time Magnitude, Short-Time Zero-Crossing Rate, The Short-Time Autocorrelation Function, The Modified Short-Time Autocorrelation Function, The Short-Time Average Magnitude Difference Function. | L1, L2 |
| **Module-3** | |
| **Frequency Domain Representations:** Discrete-Time Fourier Analysis, Short-Time Fourier Analysis, Spectrographic Displays, Overlap Addition(OLA),Method of Synthesis, Filter Bank Summation(FBS) Method of Synthesis, Time-Decimated Filter Banks, Two-Channel Filter Banks, Implementation of the FBS Method Using the FFT, OLA Revisited, Modifications of the STFT. | L1, L2 |
| **Module-4** | |
| **The Cepstrum and Homomorphic Speech Processing:** Homomorphic Systems for Convolution, Homomorphic Analysis of the Speech Model, Computing the Short-Time Cepstrum and Complex Cepstrum of Speech, Homomorphic Filtering of Natural Speech, Cepstrum Analysis of All-Pole Models, Cepstrum Distance Measures. | L1, L2, L3 |
| **Module-5** | |
| **Linear Predictive Analysis of Speech Signals:** Basic Principles of Linear | L1, L2, |

| | |
|---|---|
| Predictive Analysis, Computation of the Gain for the Model, Frequency Domain Interpretations of Linear Predictive Analysis, Solution of the LPC Equations, The Prediction Error Signal, Some Properties of the LPC Polynomial A(z), Relation of Linear Predictive Analysis to Lossless Tube Models, Alternative Representations of the LP Parameters. | L3 |

**Course outcomes:** Upon completion of the course, students will be able to:

- Model speech production system and describe the fundamentals of speech.
- Extract and compare different speech parameters.
- Choose an appropriate speech model for a given application.
- Analyse speech recognition, synthesis and speaker identification systems

**Question paper pattern:**

- The question paper will have ten questions.
- Each full question consists of 16 marks.
- There will be 2 full questions (with a maximum of Three sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module. The students will have to answer 5 full questions, selecting one full question from each module.

**Text Book:**

**Theory and Applications of Digital Speech Processing-**Rabiner and Schafer, Pearson Education 2011

**Reference Books:**


3. **Fundamentals of Speech Recognition-** Lawrence Rabiner and Biing-Hwang Juang, Pearson Education, 2003.

4. **Speech and Language Processing–An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition-** Daniel Jurafsky and James H Martin, Pearson Prentice Hall 2009.

## Radar Engineering

B.E., VIII Semester, Electronics & Communication Engineering/ Telecommunication Engineering

[As per Choice Based Credit System (CBCS) scheme]

| | | | |
|---|---|---|---|
| Subject Code | 15EC833 | IA Marks | 20 |
| Number of Lecture Hours/Week | 03 | Exam Marks | 80 |
| Total Number of Lecture Hours | 40 (8 Hours / Module) | Exam Hours | 03 |

**CREDITS – 03**

**Course objectives:** This course will enable students to:

- Understand the Radar fundamentals and analyze the radar signals.
- Understand various technologies involved in the design of radar transmitters and receivers.
- Learn various radars like MTI, Doppler and tracking radars and their comparison

| **Modules** | **RBT Level** |
|---|---|
| **Module-1** | |
| **Basics of Radar**: Introduction, Maximum Unambiguous Range, Radar Waveforms, Definitions with respect to pulse waveform - PRF, PRI, Duty Cycle, Peak Transmitter Power, Average transmitter Power.<br>**Simple form of the Radar Equation**, Radar Block Diagram and Operation, Radar Frequencies, Applications of Radar, The Origins of Radar, Illustrative Problems. **(Chapter 1 of Text)** | L1, L2, L3 |
| **Module-2** | |
| **The Radar Equation:** Prediction of Range Performance, Detection of signal in Noise, Minimum Detectable Signal, Receiver Noise, SNR, Modified Radar Range Equation, Envelope Detector — False Alarm Time and Probability, Probability of Detection,<br>**Radar Cross Section of Targets:** simple targets – sphere, cone-sphere, Transmitter Power, PRF and Range Ambiguities, System Losses (qualitative treatment), Illustrative Problems. **(Chapter 2 of Text, Except 2.4, 2.6, 2.8 & 2.11)** | L1, L2, L3 |
| **Module-3** | |
| **MTI and Pulse Doppler Radar:** Introduction, Principle, Doppler Frequency Shift, Simple CW Radar, Sweep to Sweep subtraction and Delay Line Canceler, MTI Radar with – Power Amplifier Transmitter, Delay Line Cancelers — Frequency Response of Single Delay- Line Canceler, Blind Speeds, Clutter Attenuation, MTI Improvement Factor, N- Pulse Delay-Line Canceler,<br>**Digital MTI Processing** – Blind phases, I and Q Channels, Digital MTI Doppler signal processor, Moving Target Detector- Original MTD. **(Chapter 3: 3.1, 3.2, 3.5, 3.6 of Text)** | L1, L2, L3 |
| **Module-4** | |
| **Tracking Radar**:<br>Tracking with Radar- Types of Tracking Radar Systems, Monopulse Tracking- Amplitude Comparison Monopulse (one-and two-coordinates), Phase Comparison Monopulse.<br>**Sequential Lobing**, Conical Scan Tracking, Block Diagram of Conical Scan | L1, L2, L3 |

| | |
|---|---|
| Tracking Radar, Tracking in Range, Comparison of Trackers. **(Chapter 4: 4.1, 4.2, 4.3 of Text)** | |
| **Module-5** | |
| **The Radar Antenna:** Functions of The Radar Antenna, Antenna Parameters, Reflector Antennas and Electronically Steered Phased array Antennas. **(Chapter 9: 9.1, 9.2 9.4, 9.5 of Text)**<br>**Radar Receiver:** The Radar Receiver, Receiver Noise Figure, Super Heterodyne Receiver, Duplexers and Receivers Protectors, Radar Displays. **(Chapter 11 of Text)** | L1, L2, L3 |

**Course outcomes:** At the end of the course, students will be able to:

- Understand the radar fundamentals and radar signals.
- Explain the working principle of pulse Doppler radars, their applications and limitations
- Describe the working of various radar transmitters and receivers.
- Analyze the range parameters of pulse radar system which affect the system performance

**Question paper pattern:**

- The question paper will have ten questions.
- Each full Question consisting of 16 marks
- There will be 2 full questions (with a maximum of Three sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

**Text Book:**

Introduction to Radar Systems- Merrill I Skolink, 3e, TMH, 2001.

**Reference Books:**


1. Radar Principles, Technology, Applications — Byron Edde, Pearson Education, 2004.
2. Radar Principles – Peebles. Jr, P.Z. Wiley. New York, 1998.
3. Principles of Modem Radar: Basic Principles – Mark A. Rkhards, James A. Scheer, William A. HoIm. Yesdee, 2013

# MACHINE LEARNING

**B.E., VIII Semester, Electronics & Communication Engineering/ Telecommunication Engineering**

[As per Choice Based Credit System (CBCS) scheme]

| | | | |
|---|---|---|---|
| Subject Code | 15EC834 | IA Marks | 20 |
| Number of Lecture Hours/Week | 03 | Exam Marks | 80 |
| Total Number of Lecture Hours | 40 (8 Hours / Module) | Exam Hours | 03 |

CREDITS – 03

**Course Objectives:** This course will enable students to:

- Introduce some concepts and techniques that are core to Machine Learning.
- Understand learning and decision trees.
- Acquire knowledge of neural networks, Bayesian techniques and instant based learning.
- Understand analytical learning and reinforced learning.

| **Modules** | |
|---|---|
| **Module-1** | **RBT Level** |
| **Learning:** Designing Learning systems, Perspectives and Issues, Concept Learning, Version Spaces and Candidate Elimination Algorithm, Inductive bias. | L1, L2 |
| **Module-2** | |
| **Decision Tree and ANN:** Decision Tree Representation, Hypothesis Space Search, Inductive bias in decision tree, issues in Decision tree. Neural Network Representation, Perceptrons, Multilayer Networks and Back Propagation Algorithms. | L1, L2 |
| **Module-3** | |
| **Bayesian and Computational Learning:** Bayes Theorem, Bayes Theorem Concept Learning, Maximum Likelihood, Minimum Description Length Principle, Bayes Optimal Classifier, Gibbs Algorithm, Naïve Bayes Classifier. | L1, L2 |
| **Module-4** | |
| **Instant Based Learning and Learning set of rules:** K- Nearest Neighbour Learning, Locally Weighted Regression, Radial Basis Functions, Case-Based Reasoning.<br>Sequential Covering Algorithms, Learning Rule Sets, Learning First Order Rules, Learning Sets of First Order Rules. | L1, L2 |
| **Module-5** | |
| **Analytical Learning and Reinforced Learning:** Perfect Domain Theories, Explanation Based Learning, Inductive-Analytical Approaches, FOCL Algorithm, Reinforcement Learning. | L1, L2 |

**Course outcomes:** At the end of the course, students should be able to:

- Understand the core concepts of Machine learning.
- Appreciate the underlying mathematical relationships within and across Machine Learning algorithms.
- Explain paradigms of supervised and un-supervised learning.
- Recognize a real world problem and apply the learned techniques of Machine Learning to solve the problem.

**Question paper pattern:**

- The question paper will have ten questions.
- Each full question consists of 16 marks.
- There will be 2 full questions (with a maximum of Three sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module. The students will have to answer 5 full questions, selecting one full question from each module.

**Text Book:**

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

**Reference Books:**

1. **Introduction to Machine Learning-** Ethem Alpaydin, 2nd Ed., PHI Learning Pvt. Ltd., 2013.
2. **The Elements of Statistical Learning-**T. Hastie, R. Tibshirani, J. H. Friedman, Springer; 1st edition, 2001.

## NETWORK AND CYBER SECURITY

**B.E., VIII Semester, Electronics & Communication Engineering**

[As per Choice Based credit System (CBCS) Scheme

| | | | |
|---|---|---|---|
| Subject Code | 15EC835 | IA Marks | 20 |
| Number of Lecture Hours/Week | 03 | Exam marks | 80 |
| Total Number of Lecture Hours | 40 (8 Hours per Module) | Exam Hours | 03 |

CREDITS – 03

**Course Objectives:** This course will enable students to:

- Know about security concerns in Email and Internet Protocol.
- Understand cyber security concepts.
- List the problems that can arise in cyber security.
- Discuss the various cyber security frame work.

| **Module-1** | **RBT Level** |
|---|---|
| **Transport Level Security:** Web Security Considerations, Secure Sockets Layer, Transport Layer Security, HTTPS, Secure Shell (SSH) (Text 1: Chapter 15) | L1, L2 |
| **Module-2** | |
| **E-mail Security:** Pretty Good Privacy, S/MIME, Domain keys identified mail (Text 1: Chapter 17) | L1, L2 |
| **Module-3** | |
| **IP Security:** IP Security Overview, IP Security Policy, Encapsulation Security Payload (ESP), Combining security Associations Internet Key Exchange. Cryptographic Suites(Text 1: Chapter 18) | L1, L2 |
| **Module-4** | |
| **Cyber network security concepts:** Security Architecture, antipattern: signature based malware detection versus polymorphic threads, document driven certification and accreditation, policy driven security certifications. Refactored solution: reputational, behavioural and entropy based malware detection.<br><br>**The problems:** cyber antipatterns concept, forces in cyber antipatterns, cyber anti pattern templates, cyber security antipattern catalog (Text-2: Chapter1 & 2) | L1, L2, L3 |
| **Module-5** | |
| **Cyber network security concepts contd. :**<br>**Enterprise security using Zachman framework**<br>Zachman framework for enterprise architecture, primitive models versus composite models, architectural problem solving patterns, enterprise workshop, matrix mining, mini patterns for problem solving meetings.<br>**Case study:** cyber security hands on – managing administrations | L1, L2, L3 |

| | |
|---|---|
| and root accounts, installing hardware, reimaging OS, installing system protection/ antimalware, configuring firewalls (Text-2: Chapter 3 & 4). | |

**Course Outcomes:** After studying this course, students will be able to:

- Explain network security protocols
- Understand the basic concepts of cyber security
- Discuss the cyber security problems
- Explain Enterprise Security Framework
- Apply concept of cyber security framework in computer system administration

**Question paper pattern:**

- The question paper will have 10 full questions carrying equal marks.
- Each full question consists of 16 marks with a maximum of Three sub questions.
- There will be 2 full questions from each module covering all the topics of the module
- The students will have to answer 5 full questions, selecting one full question from each module.

**Text Books**:

1. William Stallings, "Cryptography and Network Security Principles and Practice", Pearson Education Inc., 6th Edition, 2014, ISBN: 978-93-325-1877-3.

2. Thomas J. Mowbray, "Cyber Security – Managing Systems, Conducting Testing, and Investigating Intrusions", Wiley.

**Reference Books**:

1. Cryptography and Network Security, Behrouz A. Forouzan, TMH, 2007.
2. Cryptography and Network Security, Atul Kahate, TMH, 2003.