PANJAB UNIVERSITY, CHANDIGARH-160014 (INDIA)
(Estd. under the Panjab University Act VII of 1947-enacted by the Govt. of India)

FACULTY OF ENGINEERING & TECHNOLOGY

SYLLABI

AND THE

REGULATIONS

FOR

Regular & Modular
M.E. in (Electronics & Communication Engineering)
2013-14

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### SEMESTER-WISE COURSE CODES & TITLES
#### EXAMINATION 2013-14

#### 1st Semester:

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<th>Subject Name</th>
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<th>Marks (Univ)</th>
<th>Int. As.</th>
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Total Marks: 750  
Total = 27 Hours/Wk  
Credits = 21

No marks are assigned to Research Seminar-I (ECE 6158) work. On successful presentation and completion of these courses the candidate will be awarded “S” grade i.e. satisfactory or else “X” grade i.e. unsatisfactory.

**Elective-I**
ECE 6104: Advanced Mathematics  
ECE 6106: Solid State Devices Modeling and Simulation  
ECE 6107: Bioinformatics

**Elective-I Lab**
ECE 6154: Advanced Mathematics  
ECE 6156: Solid State Devices Modeling and Simulation  
ECE 6157: Bioinformatics
### 2nd Semester:

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Total Marks: 700
Total= 27 Hours/Wk
Credits = 21

No marks are assigned to Research Seminar-II (ECE 6264) work. On successful presentation and completion of these courses the candidate will be awarded “S” grade i.e. satisfactory or else “X” grade i.e. unsatisfactory.

**Elective-II**
- (ECE-6204) Advanced Computer Networks
- (ECE-6205) Network Programming
- (ECE-6208) Advanced Antenna Systems
- (ECE 6212) Analog & Mixed Signal Design

**Elective-II Lab**
- (ECE-6254) Advanced Computer Networks
- (ECE-6255) Network Programming
- (ECE-6258) Advanced Antenna Systems
- (ECE 6262) Analog & Mixed Signal Design

**Elective -III**
- (ECE-6206) Information Theory & Coding
- (ECE-6207) PLCs & SCADA
- (ECE-6211) VLSI Design
- (ECE-6213) Nano Electronics
3rd Semester

<table>
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Total Marks: 200
Total= 28 Hours/Wk
Credit = 18

No marks are assigned to Thesis Work I (ECE 7106) work. On successful presentation and completion of these courses the candidate will be awarded “S” grade i.e. satisfactory or else “X” grade i.e. unsatisfactory.

Elective-IV
(ECE-7101) Neural Network & Fuzzy Logic
(ECE-7102) RF & Microwaves
(ECE-7103) Simulation & Modeling

Elective-V
(TQM-7105) Total Quality management
(MTE-7201) HRD & Training Methods
(MTE-7202) Research Methodology
(ECE-7105) Satellite Communications
(ECE-7107) Semi Conductor Memory Design and Testing
(ECE-7108) Cryptography & Network Security

4th Semester:

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Total marks:
Total= 30 Hours/Wk
Credits = 15

No marks are assigned to Thesis Work II (ECE 7201) work. On successful presentation and completion of these courses the candidate will be awarded “S” grade i.e. satisfactory or else “X” grade i.e. unsatisfactory.

Total Marks: 1650
Total Credits: 75
M.E. Modular Programme

In each of the Modular programme, there are a total of 12 theory subjects, each of 100 marks (including sessional of 50 marks), 9 practical subjects, each of 50 marks, two research seminars, Thesis work-I and Thesis work-II with a total of 1650 marks. No numerical marks are to be assigned to thesis work. It is either “Accepted” or “Rejected”. A candidate will study 12 theory subjects in 1st to 6th spells; Thesis work-I in 7th spell, and Thesis work-II in 8th spell. The courses of study and evaluation scheme for ME Modular programme are the same as described for ME Regular programme and is detailed here.

Spell-1

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<th>Credit Prac.</th>
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Elective-I

ECE 6104: Advanced Mathematics
ECE 6106: Solid State Devices Modeling and Simulation
ECE 6107: Bioinformatics

Elective –I Lab

ECE 6154: Advanced Mathematics
ECE 6156: Solid State Devices Modeling and Simulation
ECE 6157: Bioinformatics
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**Elective-II**
- (ECE-6204) Advanced Computer Networks
- (ECE-6205) Network Programming
- (ECE-6208) Advanced Antenna Systems
- (ECE 6212) Analog & Mixed Signal Design

**Elective-II Lab**
- (ECE-6254) Advanced Computer Networks
- (ECE-6255) Network Programming
(ECE-6258) Advanced Antenna Systems
(ECE 6262) Analog & Mixed Signal Design

**Elective -III**
(ECE-6206) Information Theory & Coding
(ECE-6207) PLCs & SCADA
(ECE-6211) VLSI Design
(ECE-6213) Nano Electronics

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**Elective- IV**
(ECE-7101) Neural Network & Fuzzy Logic
(ECE-7102) RF & Microwaves
(ECE-7103) Simulation & Modeling

**Elective-V**
(TQM-7105) Total Quality management
(MTE-7201) HRD & Training Methods
(MTE-7202) Research Methodology
(ECE-7105) Satellite Communications
(ECE-7107) Semi Conductor Memory Design and Testing
(ECE-7108) Cryptography & Network Security

### Spell-7

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Note:

No marks are assigned to Research Seminar-I (ECE 6158) work. On successful presentation and completion of these courses the candidate will be awarded “S” grade i.e. satisfactory or else “X” grade i.e. unsatisfactory.

No marks are assigned to Research Seminar-II (ECE 6264) work. On successful presentation and completion of these courses the candidate will be awarded “S” grade i.e. satisfactory or else “X” grade i.e. unsatisfactory.

No marks are assigned to Thesis Work I (ECE 7106) work. On successful presentation and completion of these courses the candidate will be awarded “S” grade i.e. satisfactory or else “X” grade i.e. unsatisfactory.

No marks are assigned to Thesis Work II (ECE 7201) work. On successful presentation and completion of these courses the candidate will be awarded “S” grade i.e. satisfactory or else “X” grade i.e. unsatisfactory.

**FIRST SEMESTER**

**ECE-6101 ADVANCED DIGITAL SIGNAL PROCESSING**

Max. Marks: 50

**Note for paper setter:** Total of seven questions may be set covering the whole syllabus. Candidates will be required to attempt any five.

**PART A**

**Transformations:**
Review of Z-Transform, Solution of Linear Difference Equations, Fourier series and Fourier Transform, Discrete Fourier Transform, Radix-2 FFT.
Introduction to Radix-4 and Split Radix FFT, Discrete Cosine Transform, DCT as Orthogonal Transform, Walsh Transform, Hadamard Transform, Wavelet Transform. (6)

**Digital Filters:**

**Multirate Digital Signal Processing:**
Sampling Rate Alteration Devices, Multirate Structures for sampling rate conversion, Multistage design of Decimator and Interpolator, The Polyphase Decomposition,
Arbitrary Rate Sampling Rate Converter, Filter Banks, QMF banks, Multilevel Filter Banks, Sub-band Coding, Discrete Wavelet Transform.  

PART B

Linear Prediction and Optimum Linear Filters:
Forward and Backward Linear Prediction, Properties of Linear Prediction-Error Filters, AR Lattice and ARMA Lattice-Ladder Filters, Wiener Filters for Filtering and Prediction.  

Adaptive Digital Filters:

Power Spectrum Estimation:

DSP Chips:
Introduction to fixed point and floating point processors, ADSP21xx and TMS320Cxx-Architecture, Memory, Addressing Modes, Interrupts, Applications. Comparison of ADSP21xx and TMS320Cxx series.  

Practice Task:
(Implement the following programs in MATLAB)
2. Circular Convolution.
3. DFT and FFT of Discrete time sequences.
4. Design of FIR Filters.
5. Design of IIR Filters.
8. Decimation and Interpolation of Discrete time sequences.
9. Implementation of an Arbitrary rate Sampling Rate Converter.
10. Illustrate Adaptive Filtering using LMS Algorithm.
Recommended Books:

4. "Discrete Time Signal Processing”, Oppenheim & Schafer. PHI.
7. “Modern Filter Theory”, by Johnson & Johnson

ECE-6102  OPTICAL FIBER COMMUNICATION

Max. Marks: 50

Note for paper setter: Total of seven questions may be set covering the whole syllabus. Candidates will be required to attempt any five.

PART A

Review of Optical Fiber Communication:
Need of optical transmission, Fiber optic communication system, Advantage of OFC, Basic optical laws and transmission parameters, Geometrical optics description: Step Index Fiber & Graded Index Fiber, Mode Theory for optical propagation, Modes in planar wave, Phase & Group Velocity. (05)

Signal Degradation in OFS:
Attenuation, Material Absorption, Scattering Loss, Bending Loss, Information Capacity Determination, Group Delay, Material Dispersion, Waveguide Dispersion, Higher order Dispersion, Polarization Mode Dispersion. (06)

Optical Transmitter:
Basic Concept: Emission and absorption Rates, p-n junctions, Non-radiative recombination, semiconductor materials, LED: Power current relationship, LED spectrum, LASER Diodes, ILD & its characteristics, Optical Gain, Feedback and Laser threshold. (06)
Optical Receivers:
Optical detection principles & devices, Detection response time, p-i-n photo-diode, Avalanche photodiode, Receiver operation: Digital Transmission, Error sources, Receiver configuration, Digital receiver performance, Probability of error, the quantum limit. (07)

PART B

Digital and Analog Transmission System:
Point to point links: System consideration, Link power budget, Rise time budget, First generation distance, Transmission distance for single mode fiber.
Line coding: NRZ codes, RZ codes, error correction, noise effects on system performance,
Overview of Analog links, carrier to noise ratio. (07)

Optical Amplifier:
Basic application and types of optical amplifiers, Semiconductor optical amplifiers, Erbium doped fiber amplifiers: architecture and types, Amplifier-noise, Raman Amplifier, wavelength converters. (07)

Optical Networks:
Basic Networks, SONET/SDH networks, Operational principle of WDM networks, Non linear effects on network performance, Performance of WDM+EDFA system, Solitons, Optical CDMA & TDMA, Optical Switches/Cross Connect, Add/Drop Mux. (07)

Practice Task:
Practical tasks related to theory.

Recommended Books:
4. Optical Networks, Black, Pearson education.

ECE-6103 ADVANCED DIGITAL COMMUNICATION

Max. Marks: 50

Note for paper setter: Total of seven questions may be set covering the whole syllabus. Candidates will be required to attempt any five.
PART A

Elements of a Digital communication system, communication channels and their characteristics, mathematical models for communication channels, recent trends in digital communication, Deterministic and Random Signal Analysis, Band pass and Low pass Signal Representation, Signal space representation of waveforms.

5

Digital modulation Schemes
Representations of digitally modulated signals, memory less modulation methods, PAM,PM,QAM, multidimensional signaling, Signaling scheme with memory, CPFSK,CPM, Power spectrum of Digitally modulated signals, PSD of a digitally modulated signals with memory, PSD of linearly modulated signals.

10

Optimum Receivers for Additive White Gaussian Noise Channels
Waveforms and vector channel models, waveforms and Vector AWGN channels, Optimum detection for the Vector AWGN channel, Implementation of the optimal receiver for AWGN channels, the correlation receiver, matched filter receiver, frequency domain interpretation of the matched filter. Performance analysis for wire line and radio communication system.

10

PART B

Carrier and symbol synchronization
Signal parameter estimation, the likelihood function, carrier recovery and symbol synchronization in signal demodulation, carrier phase estimation, maximum likelihood carrier phase estimation, phase locked loop, effect of noise on the phase estimation, symbol timing estimation, maximum likelihood timing estimation, non –decision directed timing estimation.

8

Multichannel and Multicarrier System
Multichannel Digital Communication in AWGN channels, binary signals, M-ary orthogonal signals, Multicarrier communication, single-carrier versus multicarrier modulation, Capacity of a Nonideal linera filter channel, orthogonal frequency division multiplexing (OFDM), modulation and demodulation in an OFDM system, Spectral characteristics of multicarrier signals, Bit and Power allocation in multicarrier modulation.

8

Spread Spectrum Signals for Digital Communication
Model of spread spectrum digital communication system, direct sequence spread spectrum signals, frequency hopped spread spectrum signals, CDMA system based on FHSS signals, Synchronization of spread spectrum systems.

4

Practical Task:
1. Digital Modulation techniques using MATLAB
2. Study of Spread spectrum signals
3. Simulation of digital communication system

Books:
ECE 6104 ADVANCED MATHEMATICS

Max. Marks: 50

Note for paper setter: Total of seven questions may be set covering the whole syllabus. Candidates will be required to attempt any five.

PART A

Series solution of differential equations, Power series methods, Legendre’s polynomial, Generating functions, Recurrence relations. (08)

Frobenius method, Series solution of Bessel’s differential equation, Modified Bessel’s functions, Generating functions, Recurrence relations. (08)

Equations reducible to Bessel’s equation. (04)

Sturm Liouville’s problem, orthogonal functions, Orthogonality of eigen functions, Eigen function expansions. (06)

PART B

Conformal mapping, Exponential function, Trigonometric functions, Hyperbolic functions, Inverse trigonometric functions, Logarithmic function, Power function, Bilinear and Schwarz-Christoffel transformation, Applications to engineering problems. (8)

Matrices, Functions of square matrices, Quadratic and Hermitian forms, Solution of linear simultaneous equations by Gaussian elimination and its modifications, Crout’s
triangularization method, Iterative method’s-Jacobi’s method, Gauss-Seidel method, Eigenvalue by iteration.  

System simulation, Technique of simulation, Monte Carlo method, Comparison and simulation with analytical method, Numerical computation techniques.  

Recommended Books:

3. Narsingh Deo, System Simulation with Digital Computer, Prentice Hall of India
5. Geoffrey Gordon System Simulation, Prentice Hall of India

ECE-6105 DIGITAL SYSTEM DESIGN

Max. Marks: 50

Note for paper setter: Total of seven questions may be set covering the whole syllabus. Candidates will be required to attempt any five.

PART A

Introduction to Digital Design Concepts:
Design Constraints and Logic Representation of System.  

Analog interfacing:
A/D conversion concepts, Analog & Digital Conversion related errors.  

Combinational Logic Design and Implementation:
Multiplexer/Decoder, PLA/Pal/GAL,ROM,CPLD and FPGA level customized design, ALU, VHDL models and simulations of combinational circuits.  

PART B

Sequential Logic Design and Implementation:
Practical Synchronous and asynchronous circuit design. Design and Implementation of sequential digital system, state representation, analysis of digital systems, synchronization, design criteria, design procedure. High level modeling of digital systems, controller realization, Timing & Frequency consideration, system examples. VHDL models and simulation of sequential circuits

**Design for Testability:**
Fault and Fault coverage in digital circuits, internal scan test methodology, BIST and Boundary scan (JTAG) techniques.

**Practice Task:**
Practical tasks related to theory.

**Recommended Books:**

1. Combinational design & testing using PLA/PAL/ROM chips.
2. Combinational design, simulation, synthesis & implementation.
3. An Engineering Approach to Digital Design – W.J. Fletcher
4. Digital Design – M. Morris Mano
5. Digital Design principles and practices by J.F. Wakerly
6. Digital Systems-Principles and applications-Ronald Tocci.

**ECE 6106 Solid State Devices Modeling and Simulation**

**Max. Marks: 50**

**Note for paper setter:** Total of seven questions may be set covering the whole syllabus. Candidates will be required to attempt any five.

**PART -A**

PART-B

2. Junction field effect transistor:- JFET concepts, device characteristics, nonideal effects, equivalent circuit and frequency limitation, Metal oxide Semiconductor field effect transistors:- Metal semiconductor ohmic contacts, MOS structure and operation, capacitance-voltage characteristics, small signal equivalent circuits, nonideal effects. Hetrojunctions:- hetrojunction materials, energy-band diagrams, current-voltage characteristics. Optical Devices :– Optical absorption, solar cell, Light Emitting device.

References:

Practice Task:
Practical tasks related to theory.

ECE 6107 BIOINFORMATICS

Max. Marks: 50

Note for paper setter: Total of seven questions may be set covering the whole syllabus. Candidates will be required to attempt any five.

PART A

The NCBI Data Model:

The GenBank Sequence Database:

Submiting DNA Sequences to the Databases:
Introduction: Why, Where and What to submit?, DNA/RNA, Population, phylogenetic and Mutation Studies, Protein- only submissions, How to submit on the World Wide Web, how to submit with Sequin updates, Consequences of the data model, EST/STS/GSS/HTG/SNP and Genome Centers.

Structure Databases:
Introduction to Structures, PDB: Protein data bank at the research collaboratory for structural file formats, Visualizing structural information, Database structure viewers, advanced structure modeling, Structures similarity searching.

PART B

Genomic Mapping and Mapping Databases:
Interplay of mapping and sequencing Genomic map elements, Types of maps complexities and pitfalls of mapping, Data repositories, and mapping projects and associated resources, Practical uses of mapping resource.

Sequence Alignment and Database Searching:
Introduction, The evolutionary basis of sequence alignment, The modular nature of proteins, optimal alignment methods, Substitution scores and gap penalties Statistical significance of alignments, Database similarity searching, FASTA, BLAST, Database searching artifacts, Position –Specific scoring matrices, Spliced alignments.

Predictive Methods using DNA Sequences:

Expressed Sequence Tags (ESTs):
What is EST? EST Clustering, TIGR Gene Indices, STACK, ESTs and Gene Discovery, The human Gene Map, Gene prediction in Genomic DNA, ESTs and Sequence Polymorphisms, Assessing levels of Gene expression using ESTs.

Practice Task:
(using PEARL)
1. Finding the length of a Sequence File
2. Pattern matching
3. Extracting Patterns

Recommended Books:
2. David W. Mount, “Bioinformatics: Sequence & Genome Analysis.”
SECOND SEMESTER

ECE-6201 EMBEDDED SYSTEM DESIGN

Max. Marks: 50

Note for paper setter: Total of seven questions may be set covering the whole syllabus. Candidates will be required to attempt any five.

Part A

Introduction to Embedded System:
Their classification & characteristics, Concepts and Processes of system level design of embedded system. (04)

Microcontrollers:
Introduction to microcontrollers, Memory, Buses, Direct Memory Access, Interrupts, Microprocessor Architecture, Interrupt Basic, Shared Data Problems, Interrupt Latency, PIC 16F8XX Flash Microcontrollers, CPU architecture, Register file structure, Instruction Set, Programs, Timers and Interrupts, Interrupt Service Routine, Features of Interrupts, Interrupt vector & Priority, Timing Generation & Measurements, Interfacing Methods, I/O Interface, LCD interfacing, Seven segment interfacing, I^2C Bus, DAC, ADC, UART. (11)

Program Modeling Concepts in Single and multiprocessor system Software-Development Process:
Modeling Processes for software Analysis before software implementation, Program model for event controlled, Modeling of Multiprocessor Systems. (08)

Part B

Embedded Core Based Design:
System-on-Chip, Application specific Integrated circuit, Overview of Embedded Processors like ARM, MIPS and Intel MMX series, Architecture, Organization and instruction set, Memory management, High level logic synthesis. Data parallel issues e.g SIMD, MIMD, MISD, SISD. Introduction to FPGA, Basics of FPGA (15)

Real Time programming and Operating System (RTOS)
RTOS Overview, Basics of RT- Linux as a RTOS, Assembly language, C++ (07)

Practice Task:
1. PIC Programming
2. FPGA Programming
3. PIC Microcontroller based projects
Recommended Books:

1. Microcontrollers (Theory and Applications)- Ajay V. Deshmukh
2. An Embedded System Primer, by David E. Simon
3. Embedded system Design by Steve Heath
4. PIC Microcontroller by John B. Peatman
5. ARM system architecture by Steve Furber (Addison Wesley)
6. Programming Embedded System in C/C++ by M. Barr
7. Real Time Systems by H. Kopetz
8. Embedded Systems- Raj Kamal

ECE-6202 IMAGE PROCESSING

Max. Marks: 50

Note for paper setter: Total of seven questions may be set covering the whole syllabus. Candidates will be required to attempt any five.

PART A

Introduction:
Fundamental concept of digital image processing, component of image processing system, image acquisition. (04)

Basic Image Fundamentals:
Image Sampling and Quantization, Spatial and Intensity Resolution, Relationship between pixels, Mathematical Tools used in image processing, Camera Angles and Perspective Transformation. (05)

Image Enhancement:
Concept of Spatial Domain and Frequency domain enhancement, Intensity Transformation Functions, Histogram Processing, Spatial Filtering, Smoothing Spatial Filters, Sharpening Spatial Filters. (06)

Image Restoration

PART B

Color Image Processing
Color Fundamentals, Color Models, Color Transformations, Smoothing and Sharpening. (04)

Wavelets and Multiresolution Processing
Background, Wavelet transforms in one dimension, Fast Wavelet Transform, Wavelet Transforms in two dimensions, Wavelet Packets.

Image Compression
Coding redundancy, Spatial and Temporal redundancy, Psychovisual Redundancy, Huffman Coding, Arithmetic coding, Symbol based coding, Bit-plane coding, Transform coding, predictive coding, Wavelet Coding, JPEG Compression.

Image Segmentation & Representation
Point, Line and Edge Detection, Edge Linking, Hough transforms, Thresholding, Region Based Segmentation, Representation, Boundary Descriptors, Regional Descriptors.

Practice Task:
(Based on MATLAB)
1. Intensity transformation
2. Histogram Processing.
3. Spatial Filtering.
5. Image Restoration.
6. Image Denoising
7. Color Image Processing
8. Wavelet Transform
9. Image Compression
10. Morphological Image Processing
11. Point, Line and Edge Detection
12. Image Segmentation
13. Image Representation and Description
14. Object Recognition

Recommended Books:
1. Digital Image processing by R.C. Gonzalez and R.F.Woods (Pearson Education)
5. Digital Image Processing by W.K.Pratt
6. Digital Image Processing using MATLAB by Woods & Gonzalez (Pearson Education)
Note for paper setter: Total of seven questions may be set covering the whole syllabus. Candidates will be required to attempt any five.

PART A

Mobile Communication:
Types of Mobile Communication Systems, Mobile radio systems around the world, Trends in cellular radio and personal communications. (03)

Cellular Design Fundamentals:
Frequency reuse, Channel alignment strategies, handoff strategies, interference and system capacity, improving coverage and capacity in cellular systems, mechanism for capacity improvement-cell splitting, cell sectoring, and micro cell zone concept. (05)

Multiple access schemes: TDMA, FDMA, CDMA, WCDMA, OFDMA, Random Multiple access Scheme, Packet Radio Protocols, CSMA, Reservation Protocols, Capacity of Cellular systems. (09)

GSM Architecture & Protocols, GSM Burst structure, Carrier and Burst Synchronization, Design Consideration. Security Aspects, Power Control strategies. (06)

PART B

CDMA Digital Cellular Standards, Services and Security Aspects, Network Reference Model and Key Features, Advantages over TDMA, CDMA WLL System. Recent developments. (05)


Introduction to 3G Wireless Networks:
WiFi, WiMax, Bluetooth (06)

Practice Task:-

1. Simulation and implementation of baseband digital signals
   (i) Types of baseband signals: unipolar, polar, bipolar, RZ, NRZ, etc.
(ii) Distortion and noise. Eye diagram.

2. Simulation and implementation of modulated digital signals
   (i) PSK, ASK and FSK modulations.
   (ii) Demodulation with envelope detection and synchronous.
   (iii) PSK differential modulation.
   (iv) Quadrature modulations (QASK and QPSK).
   (v) QAM modulation.

3. Global System for Mobiles (GSM)
   (i) Cellular telephony. GSM Architecture.
   (iii) AT Commands
   (iv) Working of GSM mobile station.

4. Multiple Access
   (i) Time division multiple Access
   (ii) Frequency division multiple access

5. Spread Spectrum communication systems
   (i) Pseudo-noise coders
   (ii) Direct sequence spread spectrum communication systems
   (iii) Frequency hopped spread spectrum communication systems
   (iv) CDMA wireless computer communication systems

6. Channel Characteristics
   (i) Multipath channel propagation characteristics
   (ii) Bit-error rate measurement

7. Wireless Networks
   (i) Bluetooth wireless network.
   (ii) Wi-Fi
   (iii) Wi-Max

8. Educational field visit to a Mobile Switching Center (MSC)


Recommended Books:

1. Mobile and personal Communication Systems and services by Raj Pandya (PHI)
2. Wireless Communication by Rappart (PHI)
PART A

Overview:

Data Link Layer:

Local/ Personal Area Networks:
IEEE LAN standards: Ethernet (802.3), Gigabit Ethernet, Wireless LAN (802.11), Bluetooth, and Broadband Wireless (802.16). (05)

Wide Area Networks: X-25, Frame Relay, ATM. (04)

Network Layer:

PART B

Internetworking and Internet Protocols:
Tunneling, Fragmentation. The IPv4 Protocol, IPv4 addresses, IPv6 Protocol, Mobile IP, OSPF, BGP, ARP, DHCP, Internet Control Protocols, Classless Inter-domain Routing (CIDR), Network Address Translation (NAT), Subnetting and Supernetting. (08)

Transport Layer:
Transport layer protocol issues: Addressing, Connection Establishment, Connection Release, Flow control and Multiplexing. Internet Transport Protocols: TCP and UDP.

Network Applications:
DNS, Electronic Mail, TELNET, FTP, SNMP, World-wide Web, Multi-media. (06)

Network Security:
Introduction to Network Security, Cryptography, Symmetric-key and Asymmetric Key Algorithms. Digital Signatures. (05)

Recommended Books:
8. SHELDON, TOM Encyclopedia of Networking, TMH

ECE-6205 NETWORK PROGRAMMING
Max. Marks: 50
Note for paper setter: Total of seven questions may be set covering the whole syllabus. Candidates will be required to attempt any five.
PART B

TCP/IP PROGRAMMING:

Interprocess Communication:
Remote procedure Call, Window Sockets, Named pipe, Mailslots, NetBIOS, and IPX/SPX. (08)

PART B

Windows programming:


Web Programming:
HTML, XML, Scripting. (05)

Practice Task: (To be covered under theory class)

1. Develop an SMTP client and a server.
2. Develop a POP client and a server
3. Develop a proxy server
Recommended Books:

1. SINHA, ALOK K. Network Programming in Windows NT, Addison-Wesley
2. STEVENS, R.W. TCP/IP Illustrated, Vol.1: The Protocols, Addison-Wesley
3. STEVENS, R.W. TCP/IP Illustrated, Vol.2
4. STEVENS, R.W. TCP/IP Illustrated, Vol.3
5. HTML in 24 Hours, SAMS.

ECE-6206 INFORMATION THEORY & CODING

Max. Marks: 50

Note for paper setter: Total of seven questions may be set covering the whole syllabus. Candidates will be required to attempt any five.

PART A

The Communication process and the nature of information. (02)

Information Sources, measurement of information and the Entropy Function:
Entropies defined, and why they are measures of information, marginal entropy, joint entropy, Conditional entropy and the Chain Rule for Entropy. (06)

Sources with and without Memory:
Sources coding theorem, Prefix, Variable and Fixed-length Codes. Error Correcting Codes. (06)

Channel Types, Properties, Noise and Channel Capacity:
Perfect communication through a noisy channel. The binary symmetric channel, their classification and capacity of a noiseless discrete channel. The Hartley and Shannon laws for channel capacity. (08)

PART B

Continuous Information; Density; Noisy Channel Coding Theorem:
Extensions of the discrete entropies and measures to the continuous case. Signal-to-noise ratio; power spectral density, Gaussian channels, Relative significance of bandwidth and noise limitations. The Shannon rate limit and efficiency for noisy continuous channels (06)

Error Control Coding:
Linear blocks codes and their properties, hard-decision decoding, cyclic codes, Convolution codes, Soft-decision decoding, Viterbi decoding algorithm. (08)

**Advanced Coding Techniques and Cryptography:**
BCH codes, Trellis coded modulation, introduction to cryptography, overview of encryption techniques, symmetric cryptography, DES, IDEA, asymmetric algorithms, RSA algorithm. (09)

**Recommended Books:**
2. Richard B. Wells, Applied Coding and Information Theory for Engineers, Pearson
4. R.G. Gallager, Information Theory and Reliable Communication, Wiley
8. Thomas Cover & Joy Thomas, Elements of Information Theory, John Wiley & Sons

**ECE-6207 PLCs AND SCADA**

Max. Marks: 50

**Note for paper setter:** Total of seven questions may be set covering the whole syllabus. Candidates will be required to attempt any five.

**PART A**

Introduction:
Fundamental Control Concepts, PLC System, CPU-Architecture, Programmers and Monitors, PLC Input and Output Modules- Analog and Digital, power Supply of PLCs, Internal Timers, Counters, and Flags. Criteria for Selection of PLC, PLC vs. PC. Memory requirements. (07)

SCADA:

**PART B**

Programming Procedures:
Different programming formats like ladder diagram, statement list, Boolean etc. Programming based on ladder diagrams using relay, timers counters sequencers, data
transfer, comparison, arithmetic, logical instructions & software flags, Programming equipments like computer, hand-held programmer, on-board programming, Human machine interface, Program Scanning, Proximity Sensors and their connection to PLC, PLC as PID Controller. (19)

NETWORKING:
Networking of PLCs, Types of Networking, and Cell control by PLCs. (04)

Recommended Books:
1. Introduction to Programmable Logic Controllers by Gray Dunmig, Boston, Delmar
2. Manuals on PLCs by Siemens/Allen Bradley
3. Programming Logic Controllers by Hackworth and Hackworth Jt.

ECE-6208 ADVANCED ANTENNA SYSTEMS
Max. Marks: 50

Note for paper setter: Total of seven questions may be set covering the whole syllabus. Candidates will be required to attempt any five.

PART A

Review of vector potentials & antenna parameters. Linear antennas viz. \( \lambda/2 \) & \( \lambda/4 \) (Input impedance, far fields, radiation resistance, directivity and efficiency). Antenna array (different types, discussion on binomial & Dolph- Tschebysheff array), Super directivity (Efficiency & directivity), design considerations. (05)

Antenna Synthesis and continuous sources (Line-source, Discretization of continuous sources), Schelkunoff polynomial method, Fourier transform method, Taylor Line-source, Triangular, cosine and cosine-squared amplitude distributions, continuous aperture. (05)

Broad-band antennas (Bi-conical, Sleeve Dipole, Cylindrical dipole, rhombic antenna, helical antenna, Yagi-Uda array), Frequency Independent antenna (planar and conical spiral, log periodic). (05)
Different antenna: (Field equivalence principle) Radiation equations, Directivity, Rectangular and Circular aperture (Radiation from apertures and distribution), Horn antenna (E-plane, H-plane, Corrugated, Di-electric loaded-field & directivity calculation). (07)

PART B

Micro-strip antenna, Basic characteristics, Rectangular and Circular patches, Transmission line and cavity model, Feeding techniques and recent advancement. (05)

Antenna fabrication techniques (Linear, Horn & Microstrip patch), Measurements (Impedance, Gain, polarization and Radiation pattern). Matching techniques. Antenna ranges. (05)

Smart Antenna (Principle, Block diagram), Design considerations and recent development. (03)

Review of radar range equation (using all parameters), Radar Signal Integration, Range Accuracy and Resolution, Signal detection and estimation, Clutter and noise suppression. (08)

Simulation Software based discussion of antenna and radar (Design and Calculation). (02)

Recommended Books:
1. C.A Balanis, Antenna Theory-Analysis, John Wiley
2. J.D.Karus- Antenna, McGraw Hill
5. B.Edde- Radar, Principles, Technology, Application-prentice Hall

ECE-6211 VLSI DESIGN

Max. Marks: 50

Note for paper setter: Total of seven questions may be set covering the whole syllabus. Candidates will be required to attempt any five.

PART A

Introduction to VLSI:
Introduction to solid state electronics, CMOS Logic, VLSI Design Flow.
MOS FET theory: Ideal V-I Characteristics, C-V Characteristics, Non-ideal I-V Characteristics,
CMOS processing technology: P-well, N-well, Twin Tub and silicon on Insulator processing, layout Design rules, CMOS Process enhancement. (10)
CMOS Circuit and Logic design:
Sequential Circuit design: Sequencing methods, Max-Delay constraints, Min-delay constraints, time borrowing, and clock skew.
Data Path Subsystems: Adders, Subtractors, Comparators, flip-flops, Shifter, counters, Multiplier

PART B

Design Methodology & Tools:
Design Methodology: Introduction, structured Design, Programmable logic, fully Custom design, CAD tools in VLSI Design Process.
Architecture Design: Introduction, HDLs, High level synthesis, Logic Synthesis.

VLSI Simulation and Algorithm:
Hierarchy of simulation tools, Switch level simulations, Layout synthesis, Placements and routing algorithms, spice simulation.

Practice Task:
Design & Simulation of combinational and sequential circuits using
1. Front End VLSI tools like Xilinx ISE, ISE simulator or Modelsim simulator.

Recommended Books:
1. CMOS Vlsi design by Neil H.E. Weste, David Harris, Ayan Banerjee (Pearson Education)
2. Modern VLSI Design by Wayne Wolf (Pearson education)
3. FPGA-Based system design by Wayne Wolf (Pearson Education)
4. Introduction to VLSI Systems by Mead and Conway (Addison wisely)
5. VLSI Design by Puckneel.

ECE-6212 Analog and Mixed Signal Design

Max. Marks : 50

Note for paper setter: Total of seven questions may be set covering the whole syllabus. Candidates will be required to attempt any five.

PART- A

Theory and Design of Differential and general operational Amplifier with Bipolar Technology, Analog VLSI issues in CMOS technologies, Basic MOS Models, SPICE Models and frequency dependent parameters. Single stage amplifiers:-basic concepts, common-source

**PART- B**

**Textbooks:**

**Practice Task:**
Experiments based on design simulation and lay out preparation of various analog circuits block like current mirror and voltage Reference, differential amp, cascode amp, , High performance and high GB amplifiers, ADC using Tanner EDA tool and Micro wind tool ELDO AMS.

**References:**
ECE- 6213 NANO ELECTRONICS

Max. Marks : 50

Note for paper setter: Total of seven questions may be set covering the whole syllabus. Candidates will be required to attempt any five.

PART A

Materials for Nano-Electronics:
Crystal lattices, Bonding in Crystals, Electron energy bands, Semiconductor: Si, Si-Ge, Hetrostructures. Strained Si, III-V Semiconductors, Carbon- Nano- tube, Silicon nanowires. (08)

Properties of Individual Nanoparticles:
Introduction to semi conducting Nanoparticles, introduction to quantum Dots, wells, wires, preparation of quantum nanostructures, Introduction to carbon nano tubes, Fabrication , Structure, Electrical properties, vibrational properties, Mechanical properties. (08)

Bio-logical Materials:
Biological building blocks-polypeptide, nucleic acids- DNA, Biological nanostructure, Biological methods for Nano scale fabrication. (08)

PART B

Tools:
TEM, Infrared and Raman Spectroscopy, Photoemission and X-RAY spectroscopy, Electron microscopy, SPMs, AFMs, Electrostatic force microscopy, Magnetic force microscopy. (06)

Nano-scale Devices
Introduction, Nanoscale MOSFET-Planer and non-planer, Resonant-tunneling diodes, Single electron transistor, Quantum-dot Nano-electromechanical systems, Molecular/Bio molecular electron devices. (15)

Recommended Books:

5. K.E. Drexler, Nano-Systems, Wiley (1922)
THIRD SEMESTER

ECE-7101  NEURAL NETWORKS & FUZZY LOGIC

Max. Marks : 50

Note for paper setter: Total of seven questions may be set covering the whole syllabus. Candidates will be required to attempt any five.

PART A

Fundamentals of Neural Networks:
Introduction, Biological Neurons and Memory, Structure & Function of a single Neuron, Artificial Neural Networks (ANN). Typical Application of ANN - Classification, Clustering, Pattern Recognition, Function Approximation. Basic approach of the working of ANN – Training, Learning and Generalization. (10)

Supervised Learning:

PART B

Unsupervised Learning:
Winner-takes all Networks, Hamming Networks. Adaptive Resonance Theory, Kohonen’s Self-organizing Maps. (09)

Neurodynamical models:
Stability of Equilibrium states, Hopfield Network, Brain-state-in-a-Box network, Bidirectional associative memories. (06)

Fuzzy Logic:
Basic concepts of Fuzzy Logic, Fuzzy Vs. Crisp set Linguistic variables, membership functions, operations of fuzzy sets, Crisp relations, Fuzzy relations, Approximate reasoning, fuzzy IF-THEN rules, variable inference, techniques, defuzzification techniques, Fuzzy rule based systems. Applications of fuzzy logic. (10)

Practice Task: (To be covered under theory class)
1. Design and train NN for AND or gate using perceptron
2. Design and train perceptron to classify odd and even numbers
3. Design and train NN for alphabet recognition using back propagation
4. Design and train Hopfield network for recognizing patterns such as ‘+’ and ‘−’
5. Design and train NN for EXOR classification using back propagation

Recommended Books:

1. Satish Kumar – Neural Network: A classroom approach
2. Jacek M. Zurada - Artificial Neural Networks
3. Simon Haykin - Artificial Neural Network
4. Rajasekaran & Pai – Neural networks, Fuzzy logic and genetic algorithms
6. T. J. Ross – Fuzzy logic with engineering applications.

ECE-7102

RF AND MICROWAVES

Max. Marks : 50

Note for paper setter: Total of seven questions may be set covering the whole syllabus. Candidates will be required to attempt any five.

PART A

Review of boundary conditions: Wave-guides and Cavity resonates (rectangular, circular & cylindrical) passive Circuits (design principles), impedance transformers, filters, hybrids, isolates. Detail discussion on S-matrix. (10)

High frequency semi-conductor devices: Intel valley Scattering, Gunn diodes, IMPATT diodes, Step recovery diodes. Lump elements: Equivalence circuits of Capacitors and Inductors, Design of lumped element resonators and circuits, Basic blocks in RF system and their VLSI implementation, Design of mixer, Basic topologies VCO and phase noise, Various RF Synthesizer architecture and frequency dividers, Design issues in integrated RF filters. Thin & Thick film technologies. (13)

PART B

Design aspects: Transmission lines for microwave circuits, Strip lines, Micro-strip lines, Slot line & Coupled lines. Characteristics impedance, Lumped parameters etc. Design considerations and implementation using simulation tools, Design of power dividers, combiners, and directional couplers (08)
Microwave measurements: SWR, Return loss, impedance, Scattering parameters, attenuation and familiarization with equipments such as vector network analyzer, Spectrum analyzer, power meters and their block diagrams discussion. Fabrication techniques in microwave. (10)


Recommended Books:

1. B.Bhat & S.koul, Stripline- Loke Transmission lines for MICS, John Wiley
3. Y.Konishi, Microwave integrated Circuit, Marcel Dekker
4. S.Y.Liao, Microwave Circuit Analysis and Amplifier Design, PHI
5. B.Razavi, RF Micro-Elements,PH.

ECE-7103 SIMULATION & MODELLING

Max. Marks : 50

Note for paper setter: Total of seven questions may be set covering the whole syllabus. Candidates will be required to attempt any five.

PART A

Modelling:
State and events, abstraction, Modelling approaches, Graphical Analogue, Scaled, Model characteristics. (08)

System Simulation:
Technique of simulation, montecarlo method, Comparison and simulation with analytical method, numerical computation techniques. (10)

Probability Concepts in Simulation:
Stochastic variables, Discrete and continuous probability functions, Numerical evaluation, Random number generators, discrete distribution generation. (06)

PART B

Arrival pattern and Service Times:
Arrival patterns: poisson, Exponential distribution, Coefficient of variations, Service times, Queuing, Solution of queuing, Solution of Queuing problems.
**Discrete System Simulation:**
Discrete events, Representation of time, Arrival patterns, Gathering statistics, Measuring utilization and occupancy.

**Analysis of Simulation Output:**

**Statistical Interference:**
Regression, correlation and analysis of variance. Simulation kernels, Strong predicted events, Event cancellation.

**Practice Task (To be covered under Theory)**
Simulation using package software such as IE3D, FDTD, VHDL, SDL, EDL & other Communication Software.

**Recommended Books:**
1. Geoffrey Gordon System Simulation, Prentice Hall of India
2. Kishor S. Trivedi, Probability and statistics with Reliability, Queuing and computer Science Applications, Prentice Hall of India(EEE)
3. Narsing Deo, System Simulation with Digital Computer, Prentice Hall of India

**TQM-7105 TOTAL QUALITY MANAGEMENT**

Max. Marks : 50

**Note for paper setter:** Total of seven questions may be set covering the whole syllabus. Candidates will be required to **attempt any five.**

**PART A**

Achieving Excellence through TQM; Concept & definition of quality, Total Quality and TQM, Role and importance of TQM in Indian business industry, TQM Thinkers and their Contributions, TQM Vs management, Cost of Quality, Cost of Poor Quality, Applications of TQM in Service and manufacturing Sectors in India.
Problem solving and QC tools; Statistical Process Control, SQC Vs SPC, Control Charts, Process capability, Failure mode effect analysis (FMEA), Taguchi Methods, Design of experiments (DOE), Just in Time (JIT), Waste Elimination, Fault tree analysis. (11)

Total employees involvement, Kaizen, Quality Circles, Team Work for Quality, Customer’s Satisfaction, benchmarking. (06)

PART B

Leadership and Communication for Quality, Creating Quality Culture, Quality Planning Process, Housekeeping for Quality. (05)

Inspection Vs Prevention, Total Productive and Preventive Maintenance, RFT, QFD, Daily Process Management, PDCA Cycle, BPR, Quality of Product Design and Service Quality; Product reliability, Validation and Verification. (10)

Acceptance Sampling, Six Sigma, Value Engineering, Lean Manufacturing, SMED, ISO 9000 and ISO 14000, Implementing TQM, Quality Audit, Quality Awards, Quality Information System, Quality of People, Quality in Marketing, Future of TQM in India. (11)

Recommended Books:

1. Total Quality Management, D.D. Sharma, Sultan Chand & Son, New Delhi, 2001
3. Total Quality Control, Armadv Feigenbaum, 1991
4. Total Quality Control, Sarv Singh Soni
12. Kaizen-he Key to Japan’s Competitive Success, I Mai M., 1986
18. Introduction to Quality Engineering, G. Taguchi, 1986

MTE-7201  HUMAN RESOURCE DEVELOPMENT AND TRAINING METHODS

Max. Marks : 50

Note for paper setter: Total of seven questions may be set covering the whole syllabus. Candidates will be required to attempt any five.

PART A

Introduction to Human Resource Development
Evolution Pre-industrial and Information age.
Mission and Purpose, Components of HRD, HRD problems and issues related to Indian Industry and technical education, HRD in the context of new industrial policy. (05)

Stages of HRD
Initial or Induction Training for job-related/professional development Training for horizontal and vertically mobility of employees. (05)

Training & Training Strategies
Training: Concepts, Assumptions- prevailing and alternative, phase in training, modalities of training, drawbacks in existing systems of training benefits of training, Six goals content and process orientation. (05)

Training Methods
Off-the –job Training Methods-Coaching, Counseling, mentoring, reflective practices, subjects groups, observing classes of seniors/experts etc. Characteristics, merits and demerits of training methods (08)

PART B

Developing Group and Climate
Social process: Three facets, Indicators of group development, the training Climate: personal and interpersonal dimensions (07)

Evaluation of Training
Concept, purposes, types and issues in evaluation
Steps in designing evaluation of training.  

**Systematic approach to Design of Training Programme:**

Concept of system, benefits of systematic approach to design of training programme, steps in systematic approach – need analysis, task analysis, entry behavior analysis, resource and constraints analysis, analysis of goals and objectives, Synthesis of criterion tests, Synthesis of contents, Synthesis of training methods and media, implementation of training methods and media, implementation of training, assessment of trainees’ performance, evaluation of training, improvement in training.

**Recommended Books:**


**MTE 7202 RESEARCH METHODOLOGY**

Max. Marks : 50

**Note for paper setter:** Total of seven questions may be set covering the whole syllabus. Candidates will be required to attempt any five.

**Introduction to Educational Research**

Concept, types – basic, applied and action, Need for educational research

Reviewing Literature

Need, Sources – Primary and Secondary, Purposes of Review, Scope of Review, steps in conducting review.
Identifying and Defining Research Problem
Locating, analyzing stating and evaluating problem. Generating different types of hypotheses and evaluating them. (8)

Methods of Research
Descriptive research design - survey, case study, content analysis, Ex-post Facto Research, Correlational and Experimental Research (20)

Sampling Techniques
Concept of population and sample’ sampling techniques - simple random sampling, stratified random sampling, systematic sampling and cluster sampling, snow ball sampling, purposive sampling, quota sampling techniques. Determining size of sample. (10)

Design and Development of Measuring Instruments, Tests, questionnaires, checklists, observation schedules, evaluating research instruments, selecting a standardized test. (12)

Procedure Of Data Collection
Aspects of data collection, coding data for analysis (6)

Statistical Methods of Analysis
Descriptive statistics: Meaning, graphical representations, mean, range and standard deviation, characteristics and uses of normal curve.
Inferential statistics: t-test, Chi-square tests, correlation (rank difference and product moment), ANOVA (one way), Selecting appropriate methods. (14)

Procedure for Writing a Research Proposal
Purpose, types and components of research proposal. (4)

Procedure for Writing a Research Report
Audiences and types of research reports, Format of research report and journal articles. (4)

Strategies for Evaluating, Research disseminating and utilizing research – An Overview

Practice Tasks
• Define a research problem in polytechnic education/industry after studying problem situation and literature
• Given the purpose, objectives of research, write hypotheses
• Select research designs for the given research objectives
• Identify the measuring instruments for the given research objectives/hypotheses
• Identify the appropriate statistical methods of analysis for the given research proposal.
• Critically analyse the given research reports on various aspects such as hypothesis, design, measuring tools, statistical analysis, interpretation etc. to identify the gaps or weaknesses in the study.

Recommended Books:

3. CPSC: Developing Skills in Technician Education Research Modules 1 to 11 Singapore, Colombo Plan Staff College for Technician Education

ECE 7105 SATELLITE COMMUNICATIONS

Max. Marks : 50

Note for paper setter: Total of seven questions may be set covering the whole syllabus. Candidates will be required to attempt any five.

Unit-I: Communication Satellite: Orbit and Description

Unit-II: Satellite Sub-Systems
Attitude and Orbit Control system, TT&C subsystem, Attitude Control subsystem, Power systems, Communication subsystems, Satellite Antenna Equipment.

Satellite Link
Basic Transmission Theory, System Noise Temperature and G/T ratio, Basic Link Analysis, Interference Analysis, Design of satellite Links for a specified C/N, (With and without frequency Re-use).
Unit-III: Propagation effects
Introduction, Atmospheric Absorption, Cloud Attenuation, Tropospheric and Ionospheric Scintillation and Low angle fading, Rain induced attenuation, rain induced cross polarization interference.


REFERENCES:

ECE 7107 SEMICONDUCTOR MEMORY DESIGN

Max. Marks : 50

Note for paper setter: Total of seven questions may be set covering the whole syllabus. Candidates will be required to attempt any five.

PART-A

UNIT I:
Random Access Memory Technologies: SRAM – SRAM Cell structures, MOS SRAM Architecture, MOS SRAM cell and peripheral circuit operation, Bipolar SRAM technologies, SOI technology, Advanced SRAM architectures and technologies, Application specific SRAMs, DRAM – DRAM technology development, CMOS DRAM, DRAM cell theory and advanced cell structures, BICMOS DRAM, soft error failure in DRAM, advanced DRAM design and architecture, Application specific DRAM

UNIT II:
Non-volatile Memories: Masked ROMs, High density ROM, PROM, Bipolar ROM, CMOS PROMS, EPROM, Floating gate EPROM cell, One time programmable EPROM, EEPROM, EEPROM technology and architecture, Non-volatile SRAM, Flash Memories (EPROM or EEPROM), advanced Flash memory architecture

PART-B

UNIT III:
Semiconductor Memory Reliability and Radiation Effects: General reliability issues RAM failure modes and mechanism, Non-volatile memory reliability, reliability modeling and failure rate prediction, Design for Reliabilty, Reliabilty Test Structures, Reliabilty
Screening and qualification, Radiation effects, Single Event Phenomenon (SEP), Radiation Hardening techniques, Radiation Hardening Process and Design Issues, Radiation Hardened Memory characteristics, Radiation Hardness Assurance and Testing, Radiation Dosimetry, Water Level Radiation Testing and Test structures

UNIT IV:
Advanced Memory Technologies and High-density Memory Packing Technologies:
Ferroelectric RAMs (FRAMs), GaAs FRAMs, Analog memories, magnetoresistive RAMs (MRAMs), Experimental memory devices, Memory Hybrids and MCMs (2D), Memory Stacks and MCMs (3D), Memory MCM testing and reliability issues, Memory cards, High Density Memory Packaging Future Directions

TEXT BOOKS:

ECE-7108 CRYPTOGRAPHY & NETWORK SECURITY
Max. Marks : 50

Note for paper setter: Total of seven questions may be set covering the whole syllabus. Candidates will be required to attempt any five.

PART - A

Introduction:

Symmetric Key Cryptography:
Substitution and Transposition techniques. Block cipher principles. Data Encryption Standard (DES), Triple DES. Block cipher modes of operation. Stream cipher structure and RC4 algorithm. Confidentiality using symmetric key encryption. Symmetric key distribution. (08)

Asymmetric Key Cryptography:

Message Authentication:
Authentication requirements and functions. Message Authentication Code. Hash functions. Hash and MAC algorithms: MD5, Secure Hash Algorithm (SHA) and HMAC.

**Digital Signatures and Authentication:**


**PART - B**

**Email Security:**
Pretty Good Privacy (PGP) operation. S/MIME specifications and functionality.

**IP Security:**
Architecture, Authentication Header, Encapsulating Payload, Security Associations, Key Management.

**Web Security:**

**Intrusion Defence Mechanisms:**
Intrusion Detection techniques.

**Malicious Software:**
Viruses and related threats. Virus countermeasures. Distributed Denial of Service Attacks.

**Firewalls:**

**Recommended Books:**

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