M.Tech (R&M)

Two Year (Four Semesters)

Scheme of Instruction and Syllabus

(Choice Based Credit System)

(With effect from 2015 – 2016 admitted batch onwards)

Department of Electronics and Communication Engineering

AU College of Engineering (Autonomous)

Visakhapatnam-530 003

2015-2016

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

A.U College of Engineering (A)
Andhra University, Visakhapatnam

M.Tech (Radar & Microwave Engineering), Two year (Four Semester)
Scheme to be valid with effect from the admitted batch of 2015 – 2016

Semester – I

Subject code	*Subject title*	*Credits*	*Pds/week*		*Sessionals*	*Uni. Exam marks*	*Total*
			Theory	*Lab*			
MTRM –1.1	Digital Signal Processing	4	4	-	30	70	100
MTRM –1.2	Microprocessors Systems	4	4	-	30	70	100
MTRM –1.3	Modern Radar Systems	4	4	-	30	70	100
MTRM –1.4	Microwave Components and Networks	4	4	-	30	70	100
MTRM –1.5	Elective – I a)Optical Fibers and Applications b)DSP Processors and Architecture c)Wireless Communications and Networks	4	4	-	30	70	100
MTRM –1.6	Elective – II a)EMI/EMC b)Artificial Intelligence and Neural Networks c)Application Specific Integrated Circuits (ASIC)	4	4	-	30	70	100
MTRM –1.7	Microwave Engineering Laboratory	2	-	3	100	-	100
MTRM –1.8	Seminar – I	2	-	3	100	-	100
	Total	28	24	6	380	420	800

Semester – II

Subject code	***Subject title***	***Credits***	***Pds/week***		***Sessionals***	***Uni. Exam marks***	***Total***
			Theory	Lab			
MTRM-2.1	Phased Array Radars	4	4	-	30	70	100
MTRM-2.2	RF and Microwave Engineering	4	4	-	30	70	100
MTRM-2.3	Cellular and Mobile Communications	4	4	-	30	70	100
MTRM-2.4	GPS and Applications	4	4	-	30	70	100
MTRM-2.5	Elective – III a) Stealth Technologies b) Computer and Communication Networks c) Remote Sensing and Sensors	4	4	-	30	70	100
MTRM-2.6	Elective – IV a) Nanotechnology and Applications b) Micro Controllers and Embedded Systems c) Digital Image Processing	4	4	-	30	70	100
MTRM-2.7	Antenna Laboratory	2	-	3	100	-	100
MTRM-2.8	Seminar – II	2	-	3	100	-	100
	Total	28	24	6	380	420	800

Semester – III

Subject code	*Subject Title*	*Credits*	*Scheme of Examination*	*Total*
MTRM – 3.1	Thesis (Preliminary)	10	Viva-Voce	100

Semester – IV

Subject code	*Subject Title*	*Credits*	*Scheme of Examination*		*Total*
MTRM – 4.1	Thesis (Final)	14	Sessionals 30	External Viva 70	100

1. **The 3rd and 4th Semesters are allocated for the Project Work.**
2. **At the end of 3rd semester project review is conducted by HOD with the committee consisting of the HOD, Chair Person of BOS and the Guide. In the Affiliated Colleges, Project (Preliminary) will be evaluated by concerned HOD and the thesis Guide of their respective colleges.**
3. **At the end of the 4th semester there will be a final viva voce for the project work conducted by the HOD with the committee consisting of HOD, Chair Person of BOS, the Guide and an External examiner nominated by the university.**
4. **The students need to complete 80 credits (in all 4 semesters put together) to be qualified for getting M.Tech degree.**

DIGITAL SIGNAL PROCESSING

Credits: 4

Subject Code: MTRM – 1.1 **Max. Marks:** 70

Semester-I **Sessionals:** 30

Common with M.Tech (Electronic Instrumentation), Digital Signal Processing (MTEI-1.1)

Chapter – I : Advanced digital filter design techniques : Multiple band optimal FIR filters – design of filters with simultaneous constraints in time and frequency response, optimization methods for designing IIR filters, comparison of optimum FIR filters and delay equalized elliptic filters.

Chapter – II : Multirate DSP : The basic sample rate alteration – time – domain characterization, frequency – domain characterization : Cascade equivalences, filters in sampling rate alteration systems, digital filter banks and their analysis and applications, multi level filter banks, estimations of spectra from finite – duration observation of signals.

Chapter – III : linear prediction and optimum liner filters : forward and backward linear prediction, AR Lattice and ARMA lattice – ladder filters, Wieners filters for filtering on prediction.

Chapter – IV : DSP Algorithms : The Goertzel algorithm, the chirp – z transform algorithm the Levinson – Durbin algorithms, the Schur algorithm, and other algorithms, computations of the DFT, concept of tunable digital filters.

Chapter – V : Signal Processing Hardware : Multipliers, dividers, different forms of FIR Hardware, multiplexing, DTTR, TDM to FDM translator, realization of frequency synthesizer, FET hardware realization, different FFT architectures, special FFT processors, convolvers, Lincoln laboratory FDP and the compatible computer configurations.

Chapter – VI : Applications of DSP :

a) Speech : Model of speech production, speech analysis – synthesis system vocoder analyzers and synthesizers, linear prediction of speech.

b) DTMF System

Text Books :

1. Theory and applications of digital signal processing by Lawrence R. Rabiner and Bernard Gold, PHI
2. Digital Signal Processing. Principles, algorithms, and applications by John G. Proakis and Dimitris G. Manolakis, PHI, 1997.
3. Digital Signal Processing, A Computer – Based approach, by Sanjit K. Mitra, Tata Mc Graw-Hill, 1998

MICROPROCESSOR SYSTEMS

Credits : 4

Subject Code : MTRM –1. 2 **Max. Marks :** 70

Semester-I **Sessionals :** 30

Common with M.Tech (Electronic Instrumentation), Microprocessor Systems (MTEI-1.2)

Introduction : Historical background, Microprocessor based personal computer systems, RISC processor, Micro controllers, comparison of 8048, 8049, 8051 and 8052, Architecture of 8051.

Introduction and comparison of 8086, 8088, 80186 / 80188, 80286, 80386, 80486, Pentium and Pentium – Pro Processors, Addressing modes, Memory and Architecture. 8086 / 8088 Hardware specifications – Memory interface – I/O Interface – Interrupts – DMA – The Arithmetic Coprocessor Bus Interface - 8086 / 8088 Addressing Modes – Instructions – Programming.

References :

1. The Intel Microprocessors 8086 / 8088, 80186, 80188, 80286, 80386, 80486, Pentium and Pentium – Pro Processor Architecture, Programming and Interface by Barray B. Berry, 4th Edition, PHI.

2. Microprocessors Principles and Applications by Gilmore, 2nd Edition, TMH.

3. Microprocessors and Interfacing Programming and Applications by Douglas V. Hall, Mc Graw Hill.

4. Microprocessors / Microcomputers Architecture, Software and Systems by A.J. Khambata, John Wiely & Sons.

5. Advanced Microprocessors by Daniel Tabak, Mc Graw Hill, 1995.

MODERN RADAR SYSTEMS

Credits : 4

Subject Code : MTRM – 1.3 **Max. Marks :** 70

Semester-I **Sessionals :** 30

Fundamentals of Surveillance Radar and Design :

Bandwidth considerations, prf, Unambiguious range and velocity, Pulse length and Sampling, Radar Cross-section and Clutter.

Tracking Radar :

Tracking and Search Radars, Antenna beam shapes required, Radar guidance, Frequency agility, Importance of Monopulse Radar.

Radar waveform design :

Bandwidth and pulse duration requirements, Range and Doppler accuracy uncertainty relation, pulse compression and phase coding.

Principles of Secondary Surveillance Radar,

Radar studies of the atmosphere, OHR and Radar jamming, EC, ECC measures and stealth applications.

Text Books :

1. "Microwave and Radar Engineering" by Gottapu Sasi Bhushana Rao, ISBN – 978813179944 Pearson Education 2013.
2. “Understanding of Radar Systems”, Simon Kingsley and Shaun Quegan, McGraw Hill, 1993.
3. Radar Handbook by Skolnik.

MICROWAVE COMPONENTS AND NETWORKS

Credits: 4

Subject Code: MTRM – 1.4 **Exam Marks:** 70

Semester-I **Sessionals:** 30

1. Introduction to microwaves and applications, advantages of microwaves, EM spectrum domain, electric and magnetic fields static electric and magnetic fields, time varying electric and magnetic fields, electromagnetic field equations, Maxwell's equations for time-varying fields, meaning of Maxwell's equations, characteristics of free space, power flow by microwaves, expression for propagation constant of a microwave in conductive medium, microwave applications, relation between dB, dBm, dBw.
2. Microwave Tubes
   Limitation of conventional tubes, microwave tubes, velocity modulation, method of producing the velocity modulation, principle of operation of two cavity klystron, reflex klystron principle of operation, velocity modulation in reflex klystron, applegate diagram with gap voltage for a reflex klystron. Principle of operation of magnetron, hull cutoff condition, advantages of slow wave devices, principle of operation of TWT.
3. Microwave Semiconductor Devices
   Microwave bipolar transistor, FET, Principle of Operation and application of tunnel diode, Principle of operation of gunn diode, application of gunn diode advantages of gunn diode, principle of operation of PIN diode, applications of PIN diode.
4. Scattering Matrix Parameters of microwave networks
   Definition of scattering matrix, characteristics of S-matrix, scattering matrix of a two-port network, salient features of S-matrix, salient features of multiport network, losses in microwave circuits, return loss, insertion loss, transmission loss, reflection loss, impedance matrix, short circuit admittance parameters of a π-network, S-matrix of series element in the transmission line, S-matrix for E-plane Tee junction, S-matrix for H-plane Tee junctions, S-matrix for directional coupler.
5. Microwave Passive components
   Rrectangular waveguides resonator isolator, types of attenuators, fixed attenuators, step attenuators, variable attenuators, salient features of directional coupler, parameters of directional coupler, coupling factor, directivity, applications of directional coupler.
6. Microwave Integrated Circuits
   Salient features of MICs, types of electronic circuits, monolithic microwave integrated circuits (MMICs), film integrated circuit, advantages of MMICs, Basic materials used in MMIC fabrication, examples, characteristics and properties of substrate, conductor, dielectric and resistive materials, MMIC fabrication techniques, diffusion and ion implantation, oxidation and film deposition, epitaxial growth, lithography, etching and photo resist, deposition methods, steps involved in the fabrication of MOSFET
7. Microwave measurements
   Measurement of VSWR, attenuation and frequency.

Textbooks

1. "Microwave and Radar Engineering" by Gottapu Sasi Bhushana Rao, ISBN – 978813179944 Pearson Education, 2013.
2. "Microwave Engineering" by Prof. GSN Raju, IK International Publishers, 2007

References Books

1. "Microwave Engineering" by P.A. Rizzi, PHI, 1999.
2. "Microwave Engineering : Non-reciprocal active and passive circuits" by Joseph Helszajin, McGraw Hill, 1992.

ELECTIVE I

OPTICAL FIBERS AND APPLICATIONS

Credits : 4

Subject Code : MTRM – 1.5(a) **Max. Marks :** 70

Semester-I **Sessionals :** 30

Common with M.Tech. (Electronic Instrumentation), Optical Fibers and Applications (MTEI-1.5(a))

1. Optic Fiber Waveguides

   Step – Index Fiber, Graded – Index Fiber, Attenuation, Modes in Step-Index Fibers, Modes in Graded – Index Fibers, Pulse Distortion and Information Rate in Optic Fibers, Construction of Optic Fibers, Optic Fibers, Optic Fiber Cables,

2. Light Sources and Detectors

   Light-Emitting Diodes, Light-Emitting – Diodes Operating Characteristics, Laser Principles, Laser Diodes, Laser-Diode Operating Characteristics, Distributed – Feedback Laser Diode, Optical Amplifiers, Fiber Laser, Vertical-Cavity Surface-Emitting Laser Diodes

   Principles of Photodetection, Photomultiplier, Semiconductor Photodiode, PIN Photodiode, Avalanche Photodiode,

3. Couplers and Connectors

   Principles, Fiber end Preparation, Splices, Connectors, Source Coupling, Distribution Networks and Fiber Components, Distribution Networks, Directional Couplers, Star Couplers, Switches, Fiber Optical Isolator, Wavelength-Division Multiplexing, Fiber Bragg Gratings, Other Components : Attenuator, Circulator and Polarization Controller

4. Modulation, Noise and Detection

   Light-Emitting-Diode Modulation and Circuits, Laser-Diode Modulation and Circuits, Analog-Modulation Formats, Digital-Modulation Formats, Optic Heterodyne Receivers, Thermal and Shot Noise, Signal-to-Noise Ratio, Error Rates, Modal Noise, Amplifier Noise, Laser Noise, and Jitter, Additional Noise Contributors, receiver Circuit Design

5. System Design and Fiber Optical Applications

   Analog System Design, Digital System Design, Applications of Fiber Optics

Text Book :

1. Fiber Optic Communications, Joseph. C. Palais, Pearson Education, Asia, 2002

References :

1. Fiber Optic Systems, John Powers, Irwin Publications, 1997

2. Optical Fiber Communication, Howes M.J., Morgen, D.V John Wiely

ELECTIVE I
DSP PROCESSORS AND ARCHITECTURES

Credits: 4

Subject Code: MTRM – 1.5(b) **Max. Marks:** 70
Semester-I **Sessionals:** 30

UNIT I
INTRODUCTION TO DIGITAL SIGNAL PROCESING
Introduction, A Digital signal-processing system, The sampling process, Discrete time sequences Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT), Linear time-invariant systems, Digital filters, Decimation and interpolation, Analysis and Design tool for DSP Systems MATLAB, DSP using MATLAB.

UNIT II
COMPUTATIONAL ACCURACY IN DSP IMPLEMENTATIONS
Number formats for signals and coefficients in DSP systems, Dynamic Range and Precision, Sources of error in DSP implementations, A/D Conversion errors, DSP Computational errors, D/A Conversion Errors, Compensating filter.

UNIT III
ARCHITECTURES FOR PROGRAMMABLE DSP DEVICES AND EXECUTION
Basic Architectural features, DSP Computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities, Address Generation Unit, Programmability and Program Execution, Speed Issues, Features for External interfacing, Hardware looping, Interrupts, Stacks, Relative Branch support, Pipelining and Performance, Pipeline Depth, Interlocking, Branching effects, Interrupt effects, Pipeline Programming models

UNIT IV
PROGRAMMABLE DIGITAL SIGNAL PROCESSORS
Commercial Digital signal-processing Devices, Data Addressing modes of TMS320C54XX DSPs, Data Addressing modes of TMS320C54XX Processors, Memory space of TMS320C54XX Processors, Program Control, TMS320C54XX instructions and Programming, On-Chip Peripherals, Interrupts of TMS320C54XX processors, Pipeline Operation of TMS320C54XX Processors.

UNIT V
IMPLEMENTATIONS OF BASIC DSP ALGORITHMS AND FFT ALGORITHMS
The Q-notation, FIR Filters, IIR Filters, Interpolation Filters, Decimation Filters, PID Controller, Adaptive Filters, 2-D Signal Processing, An FFT Algorithm for DFT Computation, A Butterfly Computation, Overflow and scaling, Bit-Reversed index generation, An 8-Point FFT implementation on the TMS320C54XX, Computation of the signal spectrum

UNIT VI

INTERFACING MEMORY AND I/O PERIPHERALS TO PROGRAMMABLE DSP DEVICES

Memory space organization, External bus interfacing signals, Memory interface, Parallel I/O interface, Programmed I/O, Interrupts and I/O, Direct memory access (DMA). A Multichannel buffered serial port (McBSP), McBSP Programming, a CODEC interface circuit, CODEC programming, A CODEC-DSP interface example.

TEXT BOOKS:

1. Digital Signal Processing – Avtar Singh and S. Srinivasan, Thomson Publications, 2004.
2. DSP Processor Fundamentals, Architectures & Features – Lapsley et al. S. Chand & Co, 2000.

REFERENCES:

1. Digital Signal Processors, Architecture, Programming and Applications – B. Venkata Ramani and M.Bhaskar, TMH, 2004.
2. Digital Signal Processing – Jonatham Stein, John Wiley, 2005.

ELECTIVE-I

WIRELESS COMMUNICATIONS AND NETWORKS

Credits : 4

Subject Code : MTRM – 1.5(c) **Max. Marks :** 70
Semester-I **Sessionals :** 30

Common with M.Tech (Electronic Instrumentation)(MTEI 1.5(c))

UNIT -I

WIRELESS COMMUNICATION AND SYSTEM FUNDAMENTALS: Introduction to Wireless Communication Systems, Examples of Wireless Communications, Comparisons of Common Wireless Communication Systems, Trends in Cellular Radio and Personal Communications, Cellular Concepts, Frequency Reuse, Handoff Strategies, Interference and System Capacity, Trucking and Grade Of Service, Improving Coverage & Capacity In Cellular Systems.

UNIT-II

MULTIPLE ACCESS TECHNIQUES FOR WIRELESS COMMUNICATION: FDMA, TDMA, SSMA (FHMA/CDMA/Hybrid Techniques) SDMA Technique (As Applicable to Wireless Communications), Packet Radio Access Protocols, CSMA Protocols, Reservation Protocols, Capture Effect in Packet Radio, Capacity of Cellular Systems.

UNIT-III

WIRELESS NETWORKING: Introduction, Differences Between Wireless and Fixed Telephone Networks, Traffic Routing in Wireless Networks, Circuit Switching, Packet Switching, The X.25 protocol**.**

UNIT-IV

Wireless Data Services, Cellular Digital Packet Data (CDPD), Advanced Radio Data Information Systems (ARDIS), RAM Mobile Data (RMD), Common Channel Signaling (CCS), Broad Band ISDN and ATM, Signaling System .No.7 (SS7), Network Services Part (NSP), SS7 User Part, Signaling Traffic in SS7, SS7 Services, Performance of SS7.

UNIT-V

MOBILE IP AND WIRELESS APPLICATION PROTOCOL: Mobile IP Operation of Mobile IP, Co-located Address, Registration, Tunneling, WAP Architecture, Overview, WML Scripts, WAP Service, WAP Session protocol, Wireless Transaction, Wireless Datagram,Infrared LAN's, Spread Spectrum LAN's, Narrowband Microwave LAN's, IEEE 802 Protocol Architecture, IEEE 802 Architecture and Services, 802. 11 Medium Access Controls, 802.11 Physical Layers.

UNIT-VI

BLUE TOOTH AND MOBILE DATA NETWORKS: Overview, Radio Specification, Baseband Specification, Links Manager Specification, Logical Link Control and Adaptation Protocol, Introduction to WLL Technology, Introduction, and Data Oriented CDPD Network, GPRS and Higher Data Rates, Short Messaging Service in GSM, Mobile Application Protocol.

TEXT BOOKS:

1. Wireless communication and Networking -William Stallings, PHI, 2003
2. Wireless Communications, Principles, Practice - Theodore, S. Rappaport, PHI, 2nd Edition, 2002.

REFERENCES:

1. Wireless Digital Communications-Karnilo feher,PHI, 1999.
2. Principles of Wireless Networks - Kavehpahlaven and P.Krishna Murthy, Pearson Education, 2002

Elective - II

EMI / EMC

Credits : 4

Subject Code : MTRM – 1.6(a) **Max. Marks :** 70

Semester-I **Sessionals :** 30

Common with M.Tech. (Electronic Instrumentation), EMI / EMC , M.TEI 1.6(a)

I. Introduction, Natural and Nuclear sources of EMI / EMC :

Electromagnetic environment, History, Concepts, Practical experiences and concerns, frequency spectrum conservations. An overview of EMI / EMC, Natural and Nuclear sources of EMI.

II. EMI from apparatus, circuits and open area test sites :

Electromagnetic emissions, noise from relays and switches, non-linearities in circuits, passive intermodulation, cross talk in transmission lines, transients in power supply lines, electromagnetic interference (EMI). Open area test sites and measurements.

III. Radiated and conducted interference measurements and ESD :

Anechoic chamber, TEM cell, GH TEM Cell, characterization of conduction currents / voltages, conducted EM noise on power lines, conducted EMI from equipment, Immunity to conducted EMI detectors and measurements. ESD, Electrical fast transients / bursts, electrical surges.

IV. Grounding, shielding, bonding and EMI filters :

Principles and types of grounding, shielding and bonding, characterization of filters, power lines filter design.

V. Cables, connectors, components and EMC standards :

EMI suppression cables, EMC connectors, EMC gaskets, Isolation transformers, optoisolators, National / International EMC standards.

Text Books :

1. Engineering Electromagnetic Compatibility by Dr. V.P. Kodali, IEEE Publication, Printed in India by S. Chand & Co. Ltd., New Delhi, 2000.
2. Electromagnetic Interference and Compatibility IMPACT series, IIT – Delhi, Modules 1 – 9.

Reference :

1. Introduction to Electromagnetic Compatibility, Ny, John Wiley, 1992, by C.R. Pal.

ELECTIVE –II

ARTIFICIAL INTELLIGENCE AND NEURAL NETWORKS

Credits: 4

Subject Code: MTRM – 1.6(b) **Max. Marks:** 70

Semester-I **Sessionals:** 30

Common with M.Tech. (Electronic Instrumentation), Artificial Intelligence and Neural Networks (MTEI-1.6(b))

Artificial Intelligence as Representation and Search

Introduction to AI, Roots and Scope of AI, Definition, Turing Test, Application Areas of AI, Predicate Calculus , Structures and Strategies for State Space Search , Heuristic Search , Control and Implementation of State Space Search

Representation and Inference

Knowledge Representation , Strong Methods for Problem Solving , Reasoning in Uncertain , Situations, Machine Learning : Symbol-Based: Framework for Symbol – Based Learning, Version Space Search, ID3 Algorithm, Un-supervised learning, Reinforcement Learning , Connectionist: Perceptron Learning, Backpropagation Learning, Competitive Learning, Hebbian Coincidence Learning, Attractor Networks

Neural Networks and Fuzzy Systems

Neural and Fuzzy machine intelligence, fuzziness as multivalence, the dynamical-systems approach to machine intelligence, intelligent behaviour as adaptive model-free estimation.

Neural Dynamics

I. Activations and signals : Neurous as functions, signal monotonicity, biological activations and signals, neuron fields, neuronal dynamical systems, common signal functions, pulse-coded signal functions, Neuronal dynamics II : Activation Models : neuronal dynamical systems, additive neuronal dynamics, additive neuronal feedback, additive bivalent models, BAM Connection matrices, additive dynamic and the noise-saturation dilemma, general neuronal activations : Cohen-grossberg and multiplicative models

Synaptic Dynamics

I. Unsupervised Learning : Learning as encoding, change, and quantization, four unsupervised learning laws, probability spaces and random processes, stochastic unsupervised learning and stochastic equilibrium, signal hebbian learning, competitive learning, differential hebbian learning, differential competitive learning. Synaptic Dynamics II : Supervised learning : Supervised function estimation, supervised learning as operant conditioning, supervised learning as stochastic pattern learning with known class memberships, supervised learning as stochastic approximation, the back propagation algorithm.

Text Book:

1. "Artificial Intelligence – Structures and Strategies for Complex Problem Solving", George F. Luger, 4th Edition, Pearson Education , 2003.
2. Neural Networks & Fuzzy Systems, Bark Kosko, PHI Published in 1994.

Reference Books:

1. "Artificial Intelligence", Knight, Tata McGraw Hill
2. "Artificial Intelligence 'a Modern Approach" Russell & Norvig, second edition , Pearson Education , 2003.
3. Fundamentals of Artificial Neural Networks, Mohamad H Hassoum, PHI
4. Neural Network Design, Hagan, Demuth and Beale, Vikas Publishing House

Elective-II

APPLICATION SPECIFIC INTEGRATED CIRCUITS (ASIC)

Credits: 4

Subject Code: MTRM – 1.6(c) **Max. Marks:** 70

Semester-I **Sessionals:** 30

Common with M.Tech. (Electronic Instrumentation), Application Specific Integrated Circuits (ASIC) (MTEI-1.6(c))

1. Introduction to ASICs – Types of ASICs, Design flow, Economics of ASICs, ASIC cell libraries, CMOS Logic, CMOS design rules, Logic cells, I/O cells, cell compilers.
2. ASIC Library Design – Transistors as resistors, Transistor parasitic capacitance, Logical effort, Cell design, Programmable ASICs, Programmable ASIC logic cells, Programmable ASIC I/O cells, Programmable ASIC interconnect, Programmable ASIC design software.
3. Low-level design entry, Schematic entry, low-level design languages, PLA tools, EDIF, An overview of VHDL and verilog, Logic synthesis, Simulation.
4. ASIC construction, Floor planning and placement.
5. CMOS System Core Studies
   Dynamic Warp Processors : Introduction, The problem, the algorithm, a functional overview, detailed functional specification, structural floor plan, physical design, fabrication, Hierarchical layout and design of single chip 32 bit CPU : Introduction, Design methodology, Technology updatability and layout verification.
6. Practical Realities and Ground Rules
   Further thoughts on floor plans/layout, floor plan layout of the four bit processors, input/output (I/O) pads, "Real estate", further thoughts on system delays, ground rules for successful design, scaling of MOS circuits.

Textbooks

1. Application Specific Integrated Circuits by J.S. Smith, Addison Wesley, 1997.

Reference Books

1. Basic VLSI Design : Systems and Circuits, Doublas A. Puckness & Kamran Eshraghian, Prentice Hall of India Private Ltd., New Delhi, 1989.
2. Principles of CMOS VLSI Design : A system perspective, N. Westle & K. Eshraghian, Addition – Wesley Pub. Co. 1985.
3. Introduction to VLSI System, C. Mead & L. Canway, Addison Wesley Pub Co. 1990.
4. The Design & Analysis of VLSI Circuits, L.A. Glassey & D.W. Dobbephl, Addison Wesley Pub Co. 1985.
5. Introduction to NMOS & VLSI System Design, A. Mukharjee, Prentice Hall, 1986.
6. VLSI Design Techniques for analog and digital circuits, R.L. Geiger, P.E. Allen & N.R. Streder, McGraw Hill Int. 1990.
7. Digital Integrated Circuits, A Design Perspective, Jan A. Rabey, Prentice Hall of India Pvt. Ltd., 1997.
8. Application specific integrated circuits, J.S. Smith, Addison Wesley, 1997.

PHASED ARRAY RADARS

Credits : 4

Subject Code : MTRM – 2.1 **Max. Marks :** 70

Semester-II **Sessionals :** 30

Phased Arrays in Radar and Communication Systems :

System requirements for radar and communication antennas, Array characterization for radar and communication systems, Fundamental results from array theory, Array size determination, Time-delay compression.

Pattern characteristics of Linear and Planar Arrays :

Array analysis, characteristics of linear and planer arrays, Scanning to end-fire, Thinned arrays

Pattern Synthesis for Linear and Planar Arrays :

Linear arrays and planar arrays with separable distributions, circular planar arrays and adaptive arrays.

Electronic Scanning Radar Systems :

Frequency and phase scanning, Phase design techniques.

Text Books :

1. Phased Array Antenna Hand Book – Robert J. Mailloux, Artech House, Boston, London, 1994.

2. Radar Engineering Hand Book – Skolnic, McGraw Hill, 1970

Reference Book:

1. Electronic Scanning Radar Systems Design Hand Book – Peter J. Kahrilas, Artech House, 1976.

RF AND MICROWAVE ENGINEERING

Credits : 4

Subject Code : MTRM – 2.2 **Max. Marks :** 70

Semester-II **Sessionals :** 30

Chapter 1 : Introduction to RF and Microwave concepts and applications

Introduction, Reasons for using RF/Microwaves, RF/Microwave applications, Radio frequency waves, RF and Microwave circuit design, The unchanging fundamentals versus the ever-evolving structure, General active circuit block diagrams.

Chapter 2 : RF Electronics Concepts

Introduction, RF/Microwaves versus DC or low AC signals, EM spectrum, Wave length and frequency, Introduction to component basics, Resonant circuits, Analysis of a simple circuit in phasor domain, Impedance transformers, RF impedance matching, Three element matching.

Chapter 3 : Smith Chart and its Applications

Introduction, A valuable graphical aid the smith chart, Derivation of smith chart, Description of two types of smith charts, Smith charts circular scales, Smith charts radial scales, The normalized impedance-admittance (ZY) smith chart introduction, Applications of the smith chart, Distributed circuit applications, Lumped element circuit applications.

Chapter 4 : RF and Microwave Amplifiers Small and Large Signal Design

Introduction, Types of amplifiers, Small signal amplifiers, Design of different types of amplifiers, Multistage small signal amplifier design.

Introduction, High-power amplifiers, Large signal amplifier design, Microwave power combining/dividing techniques, Signal distortion due to inter modulation products, Multistage amplifiers, Large signal design

Chapter 5 : Radio Frequency and Microwave Oscillator Design

Introduction, Oscillator versus amplifier design, Oscillation conditions, Design of transistor oscillators, Generator-tuning networks.

Text Book :

1. “Radio Frequency and Microwave Electronics”, by Mathew M. Radmanesh, Person Education Inc., New Delhi

Reference

1. “Microwave Engineering, Active and Non-reciprocal Circuits”, by Joseph Helszain, McGraw Hill International Edition, 1992

CELLULAR AND MOBILE COMMUNICATIONS

Credits : 4

Subject Code : MTRM – 2.3 **Max. Marks :** 70

Semester-II **Sessionals :** 30

Unit -1 : Introduction to wireless communications , examples of wireless communication system , the Cellular concept and system design fundamentals , Frequency reuse, Channel assignment strategies, Handoff strategies , Interference and system capacity , Trunk and grade services , Methods for improving coverage and capacity in cellular system.

Unit-2: Multiple access techniques for wireless communications FDMA , TDMA , Spread spectrum techniques , SDMA , Packet Radio , CSMA , Capacity of cellular CDMA with multiple cells and capacity of SDMA.

Unit-3: Wireless systems and standards , AMPS , IS-94, GSM traffic, Examples of GSM cell , Frame structure of GSM cell, details of forward and reverse CDMA channels.

Unit-4: Personal access communication systems , Personal Mobile satellite communications , Integrating GEO, LEO, MEO Satellite and terrestrial mobile systems , Rake receiver and Advanced Rake receiver,

Unit-5: Mobile Radio propagation , Large scale path loss , Reflection , Diffraction , Scattering , Outdoor and Indoor propagation models , Small signal fading and multi path , measurement of small scale path loss , parameters of multi path channels , fading due to multi path , fading effect due to Doppler spread , small scale fading models , equalization , Diversity .

Text Book :

1. Mobile Cellular Communication by Gottapu Sasibhushana Rao, PEARSON International, 2012.

Recommended Books:

1.Wireless Communications Principles and Practice , Second Edition , THEODORE S.REPPAPORT .
2.Wireless Digital Communications , DR. KAMILO FEHER .
3.Electronic Communication system , WAYNE TOMASI.
4.Wireless Communications , SANJY SHARMA.

GLOBAL POSITIONING SYSTEM AND APPLICATIONS

Credits : 4

Subject Code : MTRM – 2.4 **Max. Marks :** 70

Semester-II **Sessionals :** 30

Common with M.Tech. (Electronic Instrumentation), Global Positioning System and Applications (MTEI-2.5(c))

Unit I

Overview of GPS :

Basic concept, system architecture, space segment, user segment, GPS aided Geo-augmented navigation (GAGAN) architecture.

Unit II

GPS Signals

Signal structure, anti spoofing (AS), selective availability, Difference between GPS and GALILEO satellite construction.

Unit III

GPS coordinate frames, Time references : Geodetic and Geo centric coordinate systems, ECEF coordinate world geodetic 1984 (WGS 84), GPS time.

Unit IV

GPS orbits and satellite position determination : GPS orbital parameters, description of receiver independent exchange format (RINEX) – Observation data and navigation message data parameters, GPS position determination.

Unit V

GPS Errors :

GPS error sources – clock error, ionospheric error, tropospheric error, multipath, ionospheric error estimation using dual frequency GPS receiver.

Textbooks :

1. G S RAO, **Global Navigation Satellite Systems,** McGraw-Hill Publications, New Delhi, 2010

Reference Books :

1. B. Hoffman – Wellenhof, H. Liehtenegger and J. Collins, 'GPS – Theory and Practice', Springer – Wien, New York (2001).
2. James Ba – Yen Tsui, 'Fundamentals of GPS receivers – A software approach', John Wiley & Sons (2001).

ELECTIVE III

STEALTH TECHNOLOGIES

Credits : 4

Subject Code : MTRM – 2.5 (a) **Max. Marks :** 70

Semester-II **Sessionals :** 30

Unit 1 : Introduction to Stealth Systems

Introduction, Introduction to low probability of intercept systems, A little history of stealth systems, Basic LPI equations, Introduction to radar cross-section, Introduction to signature balance

Unit 2 : Interceptability Parameters and Analysis

Interceptability parameters, Interceptability analysis, Example mode interceptability, Footprint calculation

Unit 3 : Stealth Waveforms

Waveform criteria, Frequency diversity, Power management, Pulse compression, Discrete phase codes, Hybrid waveforms, Noise propagation in pulse compressors

Unit 4 : Stealth Antennas and Radomes

Introduction, Antenna parameters, Single radiators, Antenna arrays, Electronically scanned arrays, Antenna scattering, Low RCS radomes

Unit 5 : Signal Processing for Stealth

Introduction to stealth signal processing, Air target search, acquisition, track, Terrain following/terrain avoidance, Doppler beam sharpening, Synthetic aperture radar (SAR) mapping, Ground MTI and MTT

Textbook

1. Introduction to RF Stealth by David Lynch, Jr., Scitech Publishing Inc., 2003., www.scitechpub.com

ELECTIVE III

COMPUTER AND COMMUNICATION NETWORKS

Credits : 4

Subject Code : MTRM – 2.5(b) **Max. Marks :** 70

Semester-II **Sessionals :** 30

1. Introduction to Computer Networks, OSI Reference Model: A Layered Approach, Intro to TCP/IP Protocol Suite.
2. Transmission Media and Digital Signaling, Analog vs. Digital Transmission, Nyquist and Shannon Limits, Digital or Analog Data to Digital Signals.
3. Wireless Communication, Advances in cellular, personal communications systems (PCS), global system for mobile communications (GSM), wireless LANs - applications, satellites, and fixed wireless networks.
4. Error Detection and CRC Polynomial Codes. Data Link Control, Stop & Wait, Sliding Window ARQ, Go-back-N, Selective Reject.
5. Data Link Layer Protocols and Multiplexing, HDLC, LAP-B, ARPANET DLC, Frequency and Time Division Multiplexing.
6. Circuit Switching and Packet Switching, Digital Switching Concepts, Packet Switching Principles, Virtual Circuits and Datagrams, X.25, Frame and Cell Relay, ATM.

Text Book:

1. William Stallings, "Wireless Communications and Networks", Prentice Hall, 2004
2. Stallings, William Data and Computer Communications, 8th Edition Prentice Hall, 2007,

Reference Books:

1. T.S. Rappaport, "Wireless Communications: Principles & Practice", Second Edition, Prentice Hall, 2002.
2. J R. Prasad, W. Mohr, and W. Konhauser (Editors), "Third Generation Mobile Communication Systems", Artech House Publishers, 2000.
3. W.C.Y. Lee, "Mobile Communication Engineering, Theory and Applications", Second Edition, McGraw-Hill, 1998.

ELECTIVE III

REMOTE SENSING AND SENSORS

Credits : 4

Subject Code : MTRM – 2.5(c) **Max. Marks :** 70

Semester-II **Sessionals :** 30

Unit-I Basics of Remote Sensing

a) Principles of Remote sensing, History of Remote sensing, Remote sensing in India,

- Electromagnetic Radiation and Electromagnetic Spectrum, EMR quantities: Nomenclature and Units
- Thermal Emission of Radiation, Radiation Principles (Plank's Law, Stephen Boltezman law), Interaction of EMR with the Earth Surface (Wien's displacement law, Kirchoffs Law)
- Spectral signature, Reflectance characteristics of Earths cover types, Remote sensing systems.

Unit - II

Platforms and sensors

Platforms, Remote sensing sensors, resolutions Across track and along the track scanning, Optical sensors,

- Thermal scanners
- Microwave sensing radar
- satellite missions
- Landsat series, SPOT series, IRS satellite series, IKNOS,

Unit-III Microwave Remote Sensing

- Airborne and Space borne radar systems basic instrumentation.
- System parameters - Wave length, Polarization, Resolutions, Radar geometry.
- Target parameters - Back scattering, Point target, Volume scattering, Penetration, Reflection, Bragg resonance, Cross swath variation. Speckie radiometric calibration.
- Radar - Grametry - Introduction, Mosaicing Stereoscope.
- Application : Geology, Forestry, Land use, Soils etc. Future trends and Research

Unit-IV Thermal Imaging system

- Thermal Imaging System: Introduction - IR region of the Electromagnetic spectrum, Atmospheric transmission, Kinetic and radiant temperature, Thermal properties of materials, Emissivity, Radiant temperature. Thermal conductivity. Thermal capacity, thermal inertia, Apparent thermal inertia, Thermal diffusivity.
- IR - radiometers, Airborne and Satellite TTR scanner system
- Characteristics of IR images
  i) Scanner distortion, ii) image irregularities, iii) Film density and recorded iv)Temperature ranges

- Effects of weather on images
  i) Clouds, ii) Surface winds, iii) Penetration of smoke plumes
- Interpretation of thermal imagery
- Advantages of Thermal imagery

Unit-V

- Meteorological satellites
- Meteorological satellite characteristics and their orbits, TIROS, NIMBUS, NOAA, TIROS N, SEASAT, GOES, METEOSAT, INSAT
- Measurement of Earth and Atmospheric energy and Radiation budget parameters from satellites

Text books

1. Imaging Radar for Resource Survey: Remote Sensing Applications, 3, W Travelt, Chapman & Hall
2. Remote Sensing: The quantitative approach, P.H. Swain and S.M. Davis, McGraw Hill
3. Floyd, F. Sabins, Jr: Remote Sensing Principles and Interpretation, Freeman and Co.San Franscisco, 1978
4. Applied Remote Sensing C.P.L.O., Longman Scientific and Technical Publishers.
5. Introduction to Environmental Remote Sensing, E.C. Barrett & L.F Curtis, Chapman and Hall, London
6. Fundamentals of remote sensing, George Joseph, Universities Press

ELECTIVE IV

NANOTECHNOLOGY AND APPLICATIONS

Credits : 4

Subject Code : MTRM – 2.6(a) **Exam Marks :** 70

Semester-II **Sessionals :** 30

Common with M.Tech. (Electronic Instrumentation), Nanotechnology and Applications (MTEI-2.6(a))

Unit 1 : Introduction to Nanotechnology

Essence of Nanotechnology, Nano in daily life, Brief account of nano applications, Properties of nano materials, Metal nano clusters, Semiconductor nano particles.

Unit 2 : Nano Materials

Nano composites, Nanofying electronics, Sensing the environment, Mechanising the micro world, Energy and cleaner environment with nano technology.

Unit 3 : Carbon Nano Structures

Introduction, Carbon molecules, Carbon clusters, Carbon nanotubes, Applications of carbon nanotubes.

Unit 4 : Diagnosing Personal Health and Medical Applications

Lab on a chip, Super X-ray vision, Mapping the genes, Understanding how pharmaceutical company develops drugs, Delivering a new drug the Nanotech way, Cooking cancer with nano cells, Biomimetics.

Unit 5 : Biological Materials

Introduction, Biological building blocks, Nucleic acids, Biological nanostructures.

Textbooks

1. Nanotechnology by Richard Booker, Earl Boysen, Wiley Publishing Inc., 2006.
2. Introduction to Nanotechnology by Charles P. Poole Jr., Frank J. Owens, John Wiley & Sons Publications, 2003.

ELECTIVE IV

MICRO CONTROLLERS AND EMBEDDED SYSTEMS

Credits: 4

Subject Code: MTRM – 2.6(b) **Exam Marks:** 70
Semester-II **Sessionals:** 30

Common with M.Tech. (Electronic Instrumentation), Microcontrollers and Embedded Systems(MTEI-2.6(b))

1. Introduction

Embedded systems overview, Design challenge, Processor Technology, IC Technology, Design Technology, Trade-offs.

2. Custom single-purpose processors: Hardware

Introduction, Combinational logic, Sequential logic, Custom single-purpose processor Design , RT-level custom single-purpose processor design, Optimizing custom single-purpose processors.

3. General purpose processors : Software

Introduction, Basic Architecture, Operation, Programmer's view, Development environment, Application-Specific Instruction-set Processors, Selecting a Microprocessor.

4. Memory:

Introduction, Memory types, Memory Hierarchy and cache, Advanced Memory Interfacing : Communication Basics, Memory Access, I/O addressing, Interrupts, DMA, Arbitration, Multilevel Architecture, Protocols.

5. Microcontrollers:

Review 8051 Microcontroller Architecture & Programming.

Peripherals:

Timers, Counters and Watchdog Timers, UART, Pulse width Modulators, LCD controllers, Stepper Motor Controllers, Analog to Digital converters, Real-Time clocks.

6. An Exemplary Embedded Systems using Microcontrollers: Digital Camera Introduction, Specifications, Design.

7. State Machine and Concurrent process models:

Introduction, Models Vs. Languages, Text Vs. Graphics:
Textual Languages Vs. Graphical Languages, an Example, A Basic State Machine Model, FSM, FSM with Datapath Model: FSMD, Using State Machines, Concurrent Process Model, Communication among Processes.

Text Books:

1. Embedded System Design: A Unified Hardware/Software Introduction By Frank vahid / Tony Givargis John wiley & sons
2. The 8051 Microcontroller & Embedded Systems By Muhammad Ali Mazidi & Janice Gillispie Mazidi PHI

References:

1. Embedded Systems Architecture, Programming and Design By Raj Kamal TMH
2. Embedded Software Priner By Simon.
3. The 8051 Microcontroller: Architecture, Programming & Applications. By Kenneth J.Ayala Penram International. 2nd edn.

ELECTIVE IV

DIGITAL IMAGE PROCESSING

Credits : 4

Subject Code : MTRM – 2.6(c) **Exam Marks :** 70

Semester-II **Sessionals :** 30

Common with M.Tech. (Electronic Instrumentation), Digital Image Processing (MTEI-2.6(c))

1. Digital Image Fundamentals
   An image model – sampling & quantization – basic relation between pixels : imaging geomentry.
2. Image Transforms
   Properties of 2-D fourier transforms, FFT algorithm and other separable image transforms, Walsh transforms, Hadamard, Cosine, Haar, Slant Transforms, RL Transforms and their properties.
3. Image Enhancement & Restoration
   Spatial domain methods, Frequency domain methods, Histogram Modification technique, Neighbourhood averaging, Median filtering, Low pass filtering, Averaging of Multiple Images, Image sharpening by differenctiation, High pass Filtering, Degradation model for Continuous functions, Discrete Formulation, Diagonalization of Circulant and Block – Circulant Matrices, Effects of Diagonalization, Constrained and unconstrained Restorations Inverse filtering, Wiener Filter, Constrained least Square Restoration.
4. Image Encoding
   Objective an subjective Fidelity Criteria, the encoding process, the Mapping, the Quantizer and the Coder, Contour Encoding, Run length Encoding, Image Encoding relative to a Fidelity Criterion, Differential Pulse Code Modulation, Transform Encoding.
5. Image Compression
   Fundamentals, Image compression models, error free compression, lossy compression, image compression standards.
6. Image Segmentation
   The detection of Discontinuities, Point Line and Edge Detections, Gradient Operators, Combined Detection, Thresholding.
7. Image Representation
   Representation Schemes, Chain Codes, Polygon Approximation, Boundary Descriptors, Simple Descriptors, Shape Numbers, Fourier Descriptors.
8. Image Construction from Projections
   Radon Transforms, Convolution/filterback Projection.

Textbooks

1. Gonzalez RC & Woods RE, Digital Image Processing, Addison Wesley Publishing Company.
2. Jain AK, Fundamentals of Digital Image Processing, PHI
3. Rosefeld & Kak AC, Digital Picture Processing Academic Press Inc.

1st SEMESTER MODEL QUESTION PAPERS

M.Tech (Radar & Microwave Engineering)
1st Semester
DIGITAL SIGNAL PROCESSING
Subject Code : MTRM-1.1 & MTEI-1.1 **Max Marks : 70**
(Common with M.Tech (EI))

Note : Answer any **FIVE** questions

1. A digital low-pass filter is required to meet the following specifications.
   (i) Pass band ripple ≤ 1 dB (ii) Pass band edge : 4 KHz (iii) Stop band attenuation ≥ 40 dB (iv) Stop band edge : 6 GHz (v) Sampling rate : 24 KHz
   The filter is to be designed by performing a bilinear transformation on an analog system function satisfying above specifications. Determine the order of butterworth, chebyshev and elliptic analog designs to be used to meet the specifications in the digital implementation. Determine the transfer function of the digital filter in each case. [14M]
2. (a) Explain about optimization methods for designing IIR filters and delay equalized elliptic filters. 7M]
   (b) Compare optimum FIR filters and delay equalized elliptic filters. [7M]
3. (a) Define (i) decimation (ii) interpolation and explain the process of decimation by factor 'D' [7M]
   (b) Decimating x(n) by a factor of D = 2 produces the signal $x_d(n) = x(2n)$ for all n shows that $x_d(n)$ and its transform $x_d(w)$. Do we lose any information when we decimate the sampled signal $x_s(n)$? [7M]
4. (a) Show that the linear interpolation is a second order approximation. [7M]
   (b) Explain the implementation of digital filter banks. [7M]
5. (a) Consider the ARMA process generated by the difference equation
   x(n) = 1.6x(n-1) - 0.6x (n-2) + w(n) + 0.9w(n-1) [7M]
   (i) Determine the system function of the whitening filter and its poles and zeros (ii) Determine the power density spectrum of {x(n)} [7M]
   (b) Illustrate how the whitening property of a prediction area filter and the AR modeling of a discrete time stochastic process are complementary. [7M]
6. (a) What is the role of wiener filters for filtering and prediction of signals. [6M]
   (b) Consider a signal x(n) = s(n) + w(n) where s(n) is an AR (1) Process that satisfies the difference equation. S(n) = 0.8 s(n-1) + v(n) where {v(n)} is a white noise sequence with variance $\sigma_v^2 = 0.49$ and {w(n)} is a white noise sequence with variance $\sigma_w^2 = 1$. The process {v(n)} and {w(n)} are uncorrelated (i) Determine the autocorrelation sequence $\{r_{ss}(m)\}$ and $\{r_{xx}(m)\}$. (ii) Design a wiener filter of length M = 2 to estimate {s(n)} (iii) Determine the MMSE for r = 2 [8M]
7. (a) Determine the reflection coefficient k_3 in terms of the autocorrelations $\{\psi_{xx}(m)\}$ from the scheme algorithm and compare your result with the expression for k_3 obtained from the Levinson Duebin algorithm.
   (b) Explain the Goertzel algorithm. If this algorithm fails which algorithm do you suggest ?
8. Describe the following [14M]
   (i) Convolves
   (ii) Channel vocoder
   (iii) TDM to FEM translate

Model Question Paper
M.Tech (Radar & Microwave Engineering)
1st Semester
MICROPROCESSOR SYSTEMS

Subject Code : MTRM-1.2 & MTEI-1.2 **Max. Marks : 70**

(Common with M.Tech (EI))

Note : Answer any **Five** Questions

1. Draw the architectural block diagram of Intel 8051 microcontroller and explain the function of each block. [14]

2. (a) Draw the programming model of Intel 8086 and explain the function of registers and flags. [10]

   (b) Which instruction places the E-flags on the stock in the Pentium-IV microprocessor. [4]

3. (a) Explain the programming addressing modes and two stack memory addressing modes. [10]

   (b) Explain how LOOPE instruction operates [4]

4. (a) Explain how do you interface a 8259 A programmable intercept controller to 8086 microprocessor. [10]

   (b) Describe the differences between a protected mode and real mode intercept [4]

5. Describe how a direct memory access controller device an be connected to a 80686 system and describe how a DMA data transfer takes place [14]

6. (a) Explain with a block diagram how a co-processor can be connected to an 8086 operating in a maximum mode [10]

   (b) What ways are a standard microprocessor and a co-processor different from each other. [4]

7. Draw a 8-bit LED display interfaced to the 8086 microprocessor through an 82C55 PIA and explain the operation with the help of programming modes[14].

8. Write notes on any two of the following

   (a) RISC processor [7]
   (b) 8251 [7]
   (c) Interrupts used in 8086 [7]
   (d) differences between 8086 and 8088 [7]

Modal Question Paper
M.Tech (Radar & Microwave Engineering)
1st Semester
MODERN RADAR SYSTEMS

Subject Code : MTRM-1.3 **Max Marks : 70**

Note : Answer any **FIVE** questions

1(a) What is meant by Radar cross-section and how does it influence detectability? 7M
(b) State Radar range equation and discuss the influence of radar cross section on the range realizable. 7M

2(a) What is meant by "frequency agility" and how does it influence the radar Performance. 7M
(b) Describe the importance and functioning of a monopulse radar. 7M

3(a) What are the main components of a "Tracking Radar". 7M
(b) Two aircrafts are at the same elevation from a radar system but travelling on different glide paths .Explain how the two targets can be resolved and tracked. 7M

4 (a) How is a target "acquired". 7M
(b) Explain whether modulation is required for implementing surveillance radar . 7M

5 (a) What factors determine accuracy in a Doppler radar? 7M
(b) A Doppler radar works at 12GHz and uses a pulse modulator. If the pulse width 1 μ sec, what is the range and velocity detectable if peak power is 500watts?Assume Suitable parameters for antenna and target cross section and discriminator Sensitivity. 7M

6 (a) Describe the performance of a radar system which is useful in measuring velocity of a target accurately. 7M
(b) What is the need for pulse compression in radar receiver. 7M

7 (a) Briefly describe how a Stealth aircraft avoids detection by radar. 7M
(b) What steps are to be taken in a defence radar system if it is known that the frequency used information is available to the enemy. 7M

8 Write short notes on the following: 14M
(a) Range Resolution
(b) Pencil Beam
(c) Electronic Counter Measure(ECM)

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Modal Question Paper
M.Tech (Radar & Microwave Engineering)
1st Semester
MICROWAVE COMPONENTS AND NETWORKS
Subject Code : MTRM-1.4 **Max Marks : 70**

Note : Answer any **FIVE** questions

1. a) Specify the reasons with examples why conventional transistor , IC and wire won't work at microwave frequencies. (5)
   b) Write the applications of the E.M. spectrum (300 MHz-300GHz) (3)
   c) A radar transmitter output power measured is 1000w. Express the power in terms of dBw and dBm. (6)

2. a) write the principle of operation of two cavity klystron amplifier with neat diagram. (5)
   b) Explain the velocity modulation in reflex klystron using Applegate diagram for 13/4 cycle. (6)
   c) Reflex Klystron operates at 9GHz with beam voltage of 300V, repeller space is 20mm for 13/4 mode. Find the maximum power when I_B = 20 mA. (3)

3. a) Differentiate between linear beam tubes and M type tube with reference to the Electric and Magnetic fields. (5)
   b) Explain the principle of operation of Magnetron and write the Hull cutoff condition (9)

4. a) write the principle of operation of tunnel diode and PIN diode (6)
   b) what are difference between fixed step and variable attenuators (6)
   c) Input VSWR of an attenuator which is shorted at the other end is observed to be 2.5. what is the attenuation introduced by the attenuator? (2)

5. a) what are the properties of scattering Matrix? (5)
   b) Obtain the '**S**' Matrix for '4-port' directional coupler? (9)

6. a) Differentiate between the 'E' and 'H' planes of Tee junction? (6)
   b) write the 'S' matrix for Magic Tee or Hybrid junction. (8)

7. a) what are the advantages of MMICs? (3)
   b) What are the basic materials used in fabrications of MMICs. Explain the substrate and conductor material characterized with examples. (6)
   c) Explain the diffusion, Ion implementation and epitaxial growth methos of MMIC fabrications (5)

8. a) Draw the experimental setup and explain the procedure for measuring the VSWR of less than 10. (7)
   b) Explain the following with respect to directional coupler. (7)
      i. Coupling factor
      ii. Directivity
      iii. Isolation.

Modal Question Paper
M.Tech (Radar and Microwave Engineering)
1st Semester
Elective-I : OPTICAL FIBERS AND APPLICATIONS

Subject Code : MTRM-1.5(a) & MTEI-1.5(a) **Max Marks : 70**

(Common with M.Tech (EI))

Note : Answer any **FIVE** questions

1.	a)	Discuss the properties and characteristics of Optical fibers	7
	b)	Explain the difference between a step-index fiber and a graded index fiber. What are the advantages of using graded index core in a fiber?	7
2.	a)	Explain the principle of operation of LED. Enumerate the characteristics of LED	7
	b)	Discuss the operation of an Avalanche Photodiode. Explain the factors that limit the time response of Avalanche photodiode.	7
3.	a)	Explain the operation of a LASER.	6
	b)	Explain the following properties of LASER : i) Line Width ii) Beam Divergence angle	8
4.	a)	With neat diagrams explain the various types of splicing and source couplings used in optical fibers.	7
	b)	Explain the principle of operation of i) Optical fiber isolator ii) Optical attenuator	7
5.	a)	What is system risk time?. Explain how does it limit an optical fiber communication link.	7
	b)	Explain quantum limit.A certain optical fiber link at 850 nm requires maximum bit error rate(BER) = 10^{-9} . Find the quantum current at a data rate of 10 Mb/Sec. (Assume h= 6.626 X 10^{-34} J-Sec)	7
6	a)	Draw the block diagram of an optical receiver and give the noise equivalent circuit of the voltage amplifier.	6
	b)	Explain the principle of operations of Photo detectors and photo multipliers.	8
7	a)	What is multiplexing?. Explain in detail the Wavelength division multiplexing.	7
	b)	Explain various network topologies in multiplexing fiber optic sensors.	7
8		Write short notes on: a) PIN photo diodes b) Fiber Bragg Gratings c) Digital System design.	14

Model Question Paper

M.Tech (Radar and Microwave Engineering)

Ist Semester

Elective-II : EMI / EMC

Subject Code : MTRM– 1.6(a) & MTEI – 1.6(a) **Max. Marks :** 70

(Common with M.Tech (Electronic Instrumentation))

Note : Answer any **FIVE** questions.

1 (a). List out the mechanisms in which EMI propagates from source to receiver and briefly explain the Electromagnetic spectrum and it's utilization. [7]

(b). List out sources of EMI in detail. [7]

2 (a). What is meant by ESD. Explain effects of lightening discharge on transmission lines. [7]

(b). Draw an ESD equivalent circuit and explain Electromagnetic pulse and it's impact. [7]

3 (a). Draw an equivalent circuit of relay / switching circuit and explain the characteristics of Electromagnetic noise produced by switches. [7]

(b). How do you explain phenomenon of crosstalk in transmission lines and list out materials to be used and materials to be avoided for reducing passive intermodulation. [7]

4 (a). Compare radiated interference test facilities in detail. [7]

(b) Explain the precautions to be taken in open area test site measurements. [7]

5 (a). Explain the conducted EM noise on power supply lines and conducted EMI from equipment and how do you eliminate them. [7]

(b). Describe different types of grounding techniques with suitable examples. [7]

6 (a). Define shielding effectiveness and explain different methods of shielding and design methodologies. [7]

(b). Describe characteristics of EMI filters. [7]

7 (a). Describe the characteristics of cables, connectors and compensators in EMC design. [7]

(b). Briefly discuss isolation transformers and optoisolators. [7]

8 . Write short notes on. [14]

(a) EMC Standards (b) Electrical bonding

(c) Electrical surges (d) Statistical EMI / EMC modules.

2nd SEMESTER MODEL QUESTION PAPERS

M.Tech (Radar and Microwave Engineering)

2nd Semester

PHASED ARRAY RADARS

Subject Code: MTRM-2.1 **Max Marks : 70**

Answer any **FIVE** questions

1. (a) Describe directive properties of arrays?
   (b) Explain radar and communication systems considerations?
2. What are the lines of distributions and point out their pattern characteristics?
3. (a) Differentiate linear and planar arrays in terms of directivity and pattern characteristics?
   (b) What did you mean by grating lobe and discuss the conditions under which they are produced?
4. What is meant by thinning of arrays and describe different space distributions by which thinning is possible?
5. Differentiate broad side and end-fire arrays and explain how do you obtain characteristics from broad side array.
6. Describe Woodward method of synthesis and obtain amplitude distribution required to produce sector beam between -45° to $+45^{\circ}$.
7. (a) What are the types of electronic scanning and compare them in detail?
   (b) Explain how phase shift is produced in phased array radars?
8. Write short notes on
   (a) Phase design techniques
   (b) Circular arrays
   (c) Adaptive arrays.

Modal Question Paper

M.Tech (Radar and Microwave Engineering)

2nd Semester

RF AND MICROWAVE ENGINEERING

Subject Code : MTRM-2.2 **Max Marks : 70**

Answer any **FIVE** questions

1. a) Explain merits and demerits of RF and Microwaves in detail. (7)
   b) Describe in detail RF and Microwave circuits design methodologies. (7)
2. a) Compare RF / Microwave and DC/low frequency signal in detail. (5)
   b) Analyze the following circuit (fig. 1) in phasor domain. (4)

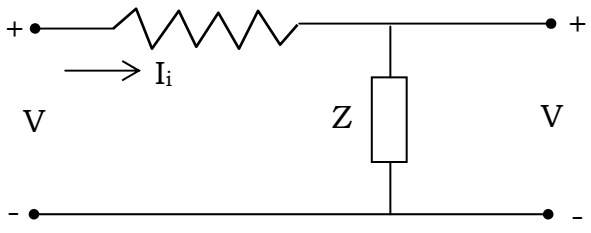

Fig. 1

   c) Calculate and plot the voltage gain magnitude and phase, if (i) the shunt element in Fig. 1 is a perfect capacitor, (ii) the shunt element in Fig. 1 is a perfect inductor. (5)

3. a) Define and explain (7)
   (i) Reflection Coefficient
   (ii) Power Reflection Coefficient
   (iii) Return Loss
   (iv) Reflection Loss or Mismatch Loss
   b) A lossless transmission line of $Z_0 = 100\ \Omega$ is connected to a load $Z_L = 100 + j\ 100\ \Omega$. Using a Smith Chart, (7)
   (i) Determine the Reflection Coefficient at the load
   (ii) Calculate the return loss (R_{loss})
   (iii) Find the VSWR on the line
4. a) For a common distributed circuit element explain the method of determination of input impedance (Z_{in}) using a known load (Z_L) and reflection coefficient, (7)
   b) Find out the input impedance of a Transmission line with $Z_0 = 50\ \Omega$ that has a length of $\lambda/8$ and is connected to a load impedance $Z_L = 50 + j\ 50\ \Omega$ (7)

5. a) Explain the steps involved in Maximum gain Amplifier design and also for a low noise amplifier design. (7)

   b) Design a high gain amplifier for a Power gain of 15 dB at a frequency of 3 GHz. The selected Bipolar transistor has the following S-Parameters (at V_{CE} = 4 V and I_C = 5 mA) (7)

$$[S] = \begin{bmatrix} 0.7 & \angle -155^0 & 0 & \\ 4 & \angle 180^0 & 0.51 & \angle -20^0 \end{bmatrix}$$

6. Explain different design methods of large signal (class A operation) amplifiers in detail. (14)

7. Explain the following in detail.

   a) Signal distortion due to inter modulation products under large signal conditions. (7)

   b) Two-Tone measurement technique. (7)

8. Answer the following.

   a) Explain the basic differences between Oscillators design and Amplifiers design. (4)

   b) Explain the design procedure for transistor oscillator clearly at RF / Microwave frequency. (4)

   c) Fixed frequency oscillators using lumped element circuits. (3)

   d) Frequency tunable oscillators. (3)

Modal Question Paper

M.Tech (Radar and Microwave Engineering)

2nd Semester

CELLULAR AND MOBILE COMMUNICATIONS

Subject Code : MTRM-2.3 **Max Marks : 70**

Note : Answer any **FIVE** questions

1. Discuss sequence of steps in initiating a cell from one cell user to the others.

2. (a) What is meant by frequency reuse concept and what are the important points to be considered in frequency reuse concept.

   (b) Discuss near field and far field problems in cellular systems.

3. Explain clearly forward and reverse channels for CDMA systems.

4. (a) Discuss clearly the important parameters of multipath channels.

   (b) Discuss important indoor propagation models.

5. Discuss important power control strategies used in mobile communications.

6. Discuss different methods to improve the capacity and coverage of existing cellular system.

7. (a) Discuss the advantages of space diversity antennas used at cell site.

   (b) Discuss different hand-off strategies.

8. Write short notes on the following.

   (a) Rake receiver

   (b) Personal mobile satellite communications

   (c) LEO

Modal Question Paper

M.Tech (Radar and Microwave Engineering)

2nd Semester

GPS AND APPLICATIONS

Subject Code : MTRM-2.4 & MTEI-2.5(c) **Max Marks : 70**

(Common with M.Tech (Electronic Instrumentation))

Answer any FIVE questions

1. (a) Describe the GPS Seattleite constellation with a neat diagram. (7)

   (b) How GPS aided Geo-augmented navigation (GAGAN) improves the GPS signal performance. (7)

2. Explain with a neat block diagram, the signal structure of L1 and L2 frequencies with the corresponding C/A, P- code and Navigation message (14)

3. (a) What are the important satellite orbital parameters that are used in the Satellite position computation in ECEF coordinate system (8)

   (b) What is WGS 84 system and how it is related to the GPS position computation (6)

4. (a) What is RINEX format (6)

   (b) Describe the Navigation message and Observation data files (8)

5. What are errors that are limiting the GPS system performance (7)

   (b) Describe ionospheric error with its contribution to the pseudorange estimation (7)

6. Explain with the relevant Equations, how the ionospheric error is eliminated in a two frequency GPS receiver (14)

7. (a) What is the difference between the Geo centric and Geodetic coordinate systems? (7)

   (b) Compare the GALILEO signal structure with the GPS signal structure (7)

8. Write any two of the following (14)

   (a) GPS time (b) Antispoofing (c) Selective Availability

Modal Question Paper

M.Tech (Radar and Microwave Engineering)

2nd Semester

Elective III : STEALTH TECHNOLOGIES

Subject Code : MTRM-2.5(a) **Max Marks : 70**

Note : Answer any **FIVE** questions

1. a) Discuss about low probability of Intercept systems. (7)
   b) Derive Radar and Beacon Range equations. (7)

2. a) Define Radar Cross section. How do you estimate RCS. (7)
   b) What is meant by Signature balance. How do you balance the signature with respect to Radar threat, Infrared threat and Intercept threat. (7)

3. What are the various Interceptability parameters and explain them. (14)

4. Discuss about Interceptability analysis in terms of Intercept receiver sensitivity, sidelobe intercept range, Interceptor detection probabilities, interceptability time constraints. (14)

5. What is stealth waveform criteria. Discuss about Pulse compression methods. (14)

6. a) Define Antenna parameters. (7)
   b) What are the sidelobe reduction functions for antenna arrays. (7)

7. a) How do you estimate Antenna RCS (7)
   b) Write notes on Low RCS Radomes. (7)

8. a) Write notes on Air Target Search and False alarm control. (7)
   b) Write notes on Ground MTI and MTT. (7)

Modal Question Paper

M.Tech (Radar and Microwave Engineering)

2nd Semester

Elective – III *:* COMPUTER AND COMMUNICATION NETWORKS

Subject Code :MTRM – 2.5(b) Maximum: 70 marks

Answer any **FIVE** questions
All questions carry equal marks.

1. a) Define Time Division Multiplexing.
   b) Write a note on TCP protocol.
   c) Distinguish between packet and circuit switching.
   d) Write a note on HDLC.
   e) Write a note on sliding window ARQ.
   f) What is data transparency?
   g) What is PCS?
2. Explain OSI model in detail.
3. Explain the process of Analog .vs. digital transmission.
4. Explain GSM.
5. a) Write a note on various wireless LANs applications (IEEE 802.11 a, b, c, g).
   b) What are the advantages of biphase scheme?
6. Explain error control techniques with an example.
7. Write a short note on:
   a) LAP – B
   b) ARPANET DLC
8. Explain the following:
   a) Virtual circuits and datagrams.
   b) X.25
   c) Frame and cell relay.

Modal Question Paper

M.Tech (Radar and Microwave Engineering)

2nd Semester

Elective IV: MICROCONTROLLERS AND EMBEDDED SYSTEMS

Subject Code : MTRM-2.6(b) & MTEI-2.6(b) **Max Marks : 70**

(Common with M.Tech. (Electronic Instrumentation))

Answer any **FIVE** questions

1. (a) List and define the three main characteristics of embedded systems that distinguish such systems from other computing system. (2)

   (b) List and define the three IC technologies. What are the benefit of using each of the three different IC technologies. (4)

   (c) What is a Single-Purpose Processor? Design a custom Single-Purpose Processor? Explain with an example. (8)

2. (a) Explain the software development process of an embedded system. (7)

   (b) Enumerate the similarities and differences between a Microcontroller and Digital Signal Processor. (7)

3. (a) Given a 100MHz Crystal-Controlled Oscillator and a 32-bit and any number of 16-bit terminal counters. Design a relative clock that outputs the date and time down to milliseconds. You can ignore leap years. Draw a diagram and indicate terminal-count values for all counters. (9)

   (b) A watchdog timer uses two cascaded 16-bit up-counters is connected to an 11.981MHz oscillator. A time out should occur if the function watchdog-reset is not called within 5 minutes. What value should be loaded into the up-counter pair when the function is called. (5)

4. (a) Explain the cache impact on system performance with an example. (7)

   (b) Given the following three cache designs, find the one with best performance by calculating the average cost of access. Show all calculations.

   i. 4 Kbyte, 8-way set-associative cache with a 6% miss rate cache hit costs one cycle, cache miss cost 12 cycles.

   ii. 8 Kbyte, 4-way set-associative cache with a 4% miss rate cache hit costs two cycle, cache miss cost 12 cycles.

   iii. 16 Kbyte, 2-way set-associative cache with a 2% miss rate cache hit costs three cycle, cache miss cost 12 cycles. (7)

5. (a) Draw the timing diagram for a bus protocol that is handshaked non-addressed and transfers 8-bits of data over a 4-bit data bus. (7)

(b) Explain the benefits an interrupt address table over fixed and vector interrupt methods. (7)

6. List the modifications made in Implementation: 2 (Microcontroller and CCDPP) and Implementation: 3 Microcontroller and CCDPP/ Fixed –Point DCT and discuss why each was beneficial in terms of performance. (14)

7. (a) Define the following terms: (7)

(i) Finite-state machines concurrent processor,

(ii) Real-time systems, and

(iii) Real-time operating systems.

(b) List three requirements of real-time systems and briefly describe each. Give examples of actual Real-time systems to support your arguments. (7)

8. Write notes on the following.

(a) Common Memory Types. (7)

(b) Stepper Motor Controllers. (7)