

## **M.Tech (Radar and Microwave Engineering)**

### **Syllabus for**

## **DIGITAL SIGNAL PROCESSING**

**Credits : 4**

**Subject Code : MTRM – 1**

**Max. Marks : 70**

**I – Semester**

**Sessionals : 30**

**Common with M.E. (Electronic Instrumentation), Digital Signal Processing (MEI-1),  
M.Tech (Communication Systems), Digital Signal Processing (MTCS-4)**

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 linear filters : forward and backward linear prediction, AR Lattice and ARMA lattice – ladder filters, Wiener 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

Suggested 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

## **M.Tech (Radar and Microwave Engineering)**

### **Syllabus for**

## **MICROPROCESSOR SYSTEMS**

**Credits : 4**

**Subject Code : MTRM – 2**

**Max. Marks : 70**

**I – Semester**

**Sessionals : 30**

**Common with M.E. (Electronic Instrumentation), Microprocessor Systems (MEI-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 Barry B. Berry, 4<sup>th</sup> Edition, PHI.
2. Microprocessors Principles and Applications by Gilmore, 2<sup>nd</sup> 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 Wiley & Sons.

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

## **M.Tech (Radar and Microwave Engineering)**

### **Syllabus for**

## **OPTICAL FIBERS AND APPLICATIONS**

**Credits : 4**

**Subject Code : MTRM – 3**

**Max. Marks : 70**

**I – Semester**

**Sessionals : 30**

**Common with M.E. (Electronic Instrumentation), Optical Fibers and Applications (MEI-3), M.Tech (Communication Systems) Optical Fibers and Applications (MTCS-5)**

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

**Reference :**

1. Fiber Optic Systems, John Powers, Irwin Publications, 1997
2. Optical Fiber Communication, Howes M.J., Morgen, D.V John Wiley

## **M.Tech (Radar and Microwave Engineering)**

### **Syllabus for**

## **MODERN RADAR SYSTEMS**

**Credits : 4**

**Subject Code : MTRM – 4**

**Max. Marks : 70**

**I – Semester**

**Sessionals : 30**

**Common with M.Tech (Communication Systems), Modern Radar Systems (MTCS-13(b))**

Fundamentals of Surveillance Radar and Design :

Bandwidth considerations, prf, Unambiguous 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. “Understanding of Radar Systems”, Simon Kingsley and Shaun Quegan, McGraw Hill, 1993.
2. Radar Handbook by Skolnik.

**M.Tech (Radar and Microwave Engineering)**  
**Syllabus for**  
**MICROWAVE COMPONENTS AND NETWORKS**

**Credits : 4**

**Subject Code : MTRM – 5**

**Exam Marks : 70**

**I – Semester**

**Sessionals : 30**

**Common with M.Tech (Communication Systems) Microwave Components and Networks (MTCS-6(b))**

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  $\pi$ -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  
Rectangular 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 Engineering" by Prof. GSN Raju, IK International Publishers, 2007

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

## **M.Tech (Radar and Microwave Engineering)**

### **Syllabus for**

### **Elective I (a) : EMI / EMC**

**Credits : 4**

**Subject Code : MTRM – 6(a)**

**Max. Marks : 70**

**I – Semester**

**Sessionals : 30**

**Common with M.E. (Electronic Instrumentation), EMI / EMC (MEI-6a), M.Tech (Communication Systems) EMI / EMC (MTCS-6a)**

- 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.

#### **References :**

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

## **M.Tech (Radar and Microwave Engineering)**

### **Syllabus for**

### **Elective I(b) : ARTIFICIAL INTELLIGENCE AND NEURAL NETWORKS**

**Credits : 4**

**Subject Code : MTRM – 6(b)**

**Max. Marks : 70**

**I – Semester**

**Sessionals : 30**

**Common with M.E. (Electronic Instrumentation), Artificial Intelligence and Neural Networks (MEI-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, 4<sup>th</sup> 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

## **M.Tech (Radar and Microwave Engineering)**

### **Syllabus for**

### **Elective I(c) : APPLICATION SPECIFIC INTEGRATED CIRCUITS (ASIC)**

**Credits : 4**

**Subject Code : MTRM – 6(c)**

**Max. Marks : 70**

**I – Semester**

**Sessionals : 30**

#### **Common with M.E. (Electronic Instrumentation), Application Specific Integrated Circuits (ASIC) (MEI-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, Douglas 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, Addison – 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. Dobbeph, 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.

**M.Tech (Radar and Microwave Engineering)**

**Syllabus for  
PHASED ARRAY RADARS**

**Credits : 4**

**Subject Code : MTRM – 9**

**Max. Marks : 70**

**II – Semester**

**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 Books :**

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

**M.Tech (Radar and Microwave Engineering)**  
**Syllabus for**  
**RF AND MICROWAVE ENGINEERING**

Credits : 4

Subject Code : MTRM – 10

Max. Marks : 70

II – Semester

Sessionals : 30

Common with M.Tech (Communication Systems) RF and Microwave Engineering  
(MTCS-9)

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 :**

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

**References**

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

## **M.Tech (Radar and Microwave Engineering)**

### **Syllabus for**

## **CELLULAR AND MOBILE COMMUNICATIONS**

**Credits : 4**

**Subject Code : MTRM – 11**

**Max. Marks : 70**

**II – Semester**

**Sessionals : 30**

**Common with M.Tech (Communication Systems) Cellular and Mobile Communications (MTCS-10)**

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 .

### **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.

## **M.Tech (Radar and Microwave Engineering)**

### **Syllabus for**

### **Elective II(a) : STEALTH TECHNOLOGIES**

**Credits : 4**

**Subject Code : MTRM – 12(a)**

**Max. Marks : 70**

**II – Semester**

**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](http://www.scitechpub.com)

## **M.Tech (Radar and Microwave Engineering)**

### **Syllabus for**

### **Elective I(b) : COMPUTER AND COMMUNICATION NETWORKS**

**Credits : 4**

**Subject Code : MTRM – 12(b)**

**Max. Marks : 70**

**II – Semester**

**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.

W.C.Y. Lee, "Mobile Communication Engineering, Theory and Applications", Second Edition, McGraw-Hill, 1998.

## **M.Tech (Radar and Microwave Engineering)**

### **Syllabus for**

### **Elective II(c) : REMOTE SENSING AND SENSORS**

**Credits : 4**

**Subject Code : MTRM – 12(c)**

**Max. Marks : 70**

**II – Semester**

**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, IKONOS,

#### **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. Speckle radiometric calibration.
- Radar - Geometry - 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 Travelet, 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 Francisco, 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

## **M.Tech (Radar and Microwave Engineering)**

### **Syllabus for**

### **Elective III(a) : NANOTECHNOLOGY AND APPLICATIONS**

**Credits : 4**

**Subject Code : MTRM – 13(a)**

**Exam Marks : 70**

**II – Semester**

**Sessionals : 30**

#### **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.

## **M.Tech (Radar and Microwave Engineering)**

### **Syllabus for**

## **Elective III(b) : MICRO CONTROLLERS AND EMBEDDED SYSTEMS**

**Credits : 4**

**Subject Code : MTRM – 13(b)**

**Exam Marks : 70**

**II – Semester**

**Sessionals : 30**

#### 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: FSM/D, 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 Primer By Simon.
3. The 8051 Microcontroller: Architecture, Programming & Applications. By Kenneth J. Ayala Penram International. 2<sup>nd</sup> edn.

**M.Tech (Radar and Microwave Engineering)**  
**Syllabus for**  
**Elective III(c) : DIGITAL IMAGE PROCESSING**

**Credits : 4**

**Subject Code : MTRM – 13(c)**

**Exam Marks : 70**

**II – Semester**

**Sessionals : 30**

**Common with M.E. (Electronic Instrumentation), Digital Image Processing (MEI-14(c)), M.Tech (Communication Systems), Digital Image Processing (MTCS-13(c))**

1. Digital Image Fundamentals  
An image model – sampling & quantization – basic relation between pixels : imaging geometry.
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 differentiation, 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.

## **M.Tech (Radar and Microwave Engineering)**

### **Syllabus for**

## **GLOBAL POSITIONING SYSTEM AND APPLICATIONS**

**Credits : 4**

**Subject Code : MTRM – 14**

**Max. Marks : 70**

**II – Semester**

**Sessionals : 30**

**Common with M.E. (Electronic Instrumentation), Global Positioning System and Applications (MEI-13(c)), M.Tech (Communication Systems) Global Positioning System and Applications (MTCS-11)**

### 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. B. Hoffman – Wellenhof, H. Liechtenegger and J. Collins, 'GPS – Theory and Practice', Springer – Wien, New York (2001).

Reference Books :

James Ba – Yen Tsui, 'Fundamentals of GPS receivers – A software approach', John Wiley & Sons (2001).