RESOLUTIONS MADE IN BOARD OF STUDIES MEETING

Resolved to adopt the following modified scheme for M.Tech (Radar & Microwave Engineering)

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING
Andhra University, Visakhapatnam

M.Tech (Radar & Microwave Engineering), Two year (Four Semester)

Scheme to be valid with effect from the admitted batch of 2007 - 2008

Semester – I

<table>
<thead>
<tr>
<th>Subject code</th>
<th>Subject title</th>
<th>Credits</th>
<th>Theory</th>
<th>Lab</th>
<th>Sessionals</th>
<th>Uni. Exam marks</th>
<th>Total</th>
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<tbody>
<tr>
<td>MTRM – 1</td>
<td>Digital Signal Processing</td>
<td>4</td>
<td>4</td>
<td>-</td>
<td>30</td>
<td>70</td>
<td>100</td>
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<tr>
<td>MTRM – 2</td>
<td>Microprocessors Systems</td>
<td>4</td>
<td>4</td>
<td>-</td>
<td>30</td>
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<tr>
<td>MTRM – 3</td>
<td>Optical Fibers and Applications</td>
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<td>MTRM – 4</td>
<td>Modern Radar Systems</td>
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<td>-</td>
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<tr>
<td>MTRM – 5</td>
<td>Microwave Components and Networks</td>
<td>4</td>
<td>4</td>
<td>-</td>
<td>30</td>
<td>70</td>
<td>100</td>
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<tr>
<td>MTRM – 6</td>
<td>Elective – I</td>
<td>4</td>
<td>4</td>
<td>-</td>
<td>30</td>
<td>70</td>
<td>100</td>
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<td>MTRM – 7</td>
<td>Microwave Engineering Laboratory</td>
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<td>MTRM – 8</td>
<td>Seminar – I</td>
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<td>-</td>
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<td>-</td>
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<td>24</td>
<td>6</td>
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Elective – I

a) EMI/EMC
b) Artificial Intelligence & Neural Networks
c) ASIC
Semester – II

<table>
<thead>
<tr>
<th>Subject code</th>
<th>Subject title</th>
<th>Credits</th>
<th>Pds/week</th>
<th>Sessionals</th>
<th>Uni. Exam marks</th>
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<tr>
<td>MTRM – 9</td>
<td>Phased Array Radars</td>
<td>4</td>
<td>4 -</td>
<td>30</td>
<td>70</td>
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<td>MTRM – 10</td>
<td>RF and Microwave Engineering</td>
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<td>MTRM – 11</td>
<td>Cellular and Mobile Communications</td>
<td>4</td>
<td>4 -</td>
<td>30</td>
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<td>MTRM – 12</td>
<td>Elective – II</td>
<td>4</td>
<td>4 -</td>
<td>30</td>
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<td>MTRM – 13</td>
<td>Elective – III</td>
<td>4</td>
<td>4 -</td>
<td>30</td>
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<td>MTRM – 14</td>
<td>GPS and Applications</td>
<td>4</td>
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<td>MTRM – 15</td>
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<td>- 4</td>
<td>100</td>
<td>-</td>
<td>100</td>
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<td>MTRM – 16</td>
<td>Seminar – II</td>
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<td></td>
<td>28</td>
<td>24 6</td>
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</table>

Elective – II

a) Stealth Technologies
b) Computer and Communication Networks
c) Remote Sensing and Sensors

Elective - III

a) Nanotechnology and Applications
b) Micro Controllers and Embedded Systems
c) Digital Image Processing

Semester – III

<table>
<thead>
<tr>
<th>Subject code</th>
<th>Subject title</th>
<th>Credits</th>
<th>Sessionals</th>
<th>Uni. Exam marks</th>
<th>Total</th>
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<td>Thesis (Part I)</td>
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<td>50</td>
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<td>100</td>
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</table>

* Project work to be submitted before the end of 3rd Semester and it will be evaluated by a committee consisting of Chairman, Board of Studies, Head of the Department and thesis guide.

Semester – IV

<table>
<thead>
<tr>
<th>Subject code</th>
<th>Subject title</th>
<th>Credits</th>
<th>Sessionals</th>
<th>Uni. Exam marks</th>
<th>Total</th>
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<td>MTRM – 18</td>
<td>Thesis (Part II)</td>
<td>20</td>
<td>30</td>
<td>70</td>
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</table>
Thesis work is for a period of SIX months in Industry/Department. The students are required to submit their thesis two/three phases. Thesis is evaluated by a committee consisting of an external member from reputed institution, HOD, Chairman BOS and thesis Guide.

**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 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

Suggested Books :

1. Theory and applications of digital signal processing by Lawrence R. Rabiner and 
   Bernard Gold, PHI


   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.


References :


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
   - 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

5. System Design and Fiber Optical Applications
   - Analog System Design, Digital System Design, Applications of Fiber Optics

Reference:
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:


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 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
   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
2. “Microwave Engineering” by Prof. GSN Raju, IK International Publishers, 2007

References Books
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 :


References:
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 : Neurons 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:**

**Reference Books:**
1. “Artificial Intelligence”, Knight, Tata McGraw Hill
3. Fundamentals of Artificial Neural Networks, Mohamad H Hassoum, PHI
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
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


Reference Books

M.Tech (Radar and Microwave Engineering) II-Semester

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:


Reference Books:

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

M.Tech (Radar and Microwave Engineering)
Syllabus for
CELLULAR AND MOBILE COMMUNICATIONS

Credits : 4
Max. Marks : 70
Sessionals : 30

II - Semester
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.

Text Book :

Recommended Books:
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**

M.Tech (Radar and Microwave Engineering)

Syllabus for

Elective II(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:


   Hall, 2007,

Reference Books:


2. J R. Prasad, W. Mohr, and W. Konhauser (Editors), "Third Generation Mobile
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, 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
• 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
  San Franscisco, 1978
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
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.


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

Credits : 4  
Exam Marks : 70  
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

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, Geodetic and Geo centric coordinate systems, ECEF coordinate world geodetic 1984 (WGS 84) system, 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, least squares method.

Unit V
GPS Errors:
GPS error sources – clock error, ionospheric error, tropospheric error, multipath, ionospheric error estimation using dual frequency GPS receiver.

Textbooks:

Reference Books:

Semester III

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Project work to be submitted before the end of 3rd Semester and it will be evaluated by a committee consisting of Chairman, Board of Studies, Head of the Department and thesis guide in the AUCE(A) and in the Affiliated Colleges Thesis (Part I) will be evaluated by concerned Head of the Department and thesis guide of their respective colleges.

Semester IV

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Thesis work is for a period of SIX months in Industry/Department. The students are required to submit their thesis two/three phases. Thesis is evaluated by a committee consisting of an external member from reputed institution, HOD/Chairman BOS and thesis Guide.