**SYLLABUS**

M.Tech. (RF & Microwave Engineering)

Programme Code: EPRRM 200800

**I SEMESTER**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Name of the Course</th>
<th>Credits</th>
<th>Hours per Week</th>
<th>Continuous Evaluation</th>
<th>Semester End Examination</th>
<th>Total Marks</th>
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<tbody>
<tr>
<td>EPRRM101</td>
<td>Advanced Electromagnetics</td>
<td>4</td>
<td>4L</td>
<td>40</td>
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<td>EPRRM102</td>
<td>RF Components and Circuit Design</td>
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<td>EPRRM103</td>
<td>Antenna Analysis &amp; Design</td>
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<td>EPRRM 121-126</td>
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<td>EPRRM 131-136</td>
<td>Elective –II (Group II)</td>
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<tr>
<td>EPRRM111</td>
<td>Antennas Laboratory</td>
<td>2</td>
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<td>EPRRM112</td>
<td>Microwave Measurements Laboratory</td>
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**Group -I**

EPRRM121 - Microwave Networks
EPRRM122 - Microwave Measurements

EPRVD122/
EPRDS101/
EPRRM123 - Digital Signal Processing
EPRRM124 - Advanced Microprocessors
EPRRM125 - EMI and EMC Techniques
EPRRM126 - Communication Networks

**Group -II**

EPRRM131 - Satellite Communication Systems
EPRRM132 - Radar Systems
EPRRM133 - Fiber Optic Communications
EPRRM134 - Mobile Communications
EPRRM135 - Telecommunications Switching Systems and Networks
EPRRM136 - Wireless Communication Systems

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8
## II SEMESTER

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Name of the Course</th>
<th>Credits</th>
<th>Hours per Week</th>
<th>Continuous Evaluation</th>
<th>Semester End Examination</th>
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<tr>
<td>EPRRM201</td>
<td>Computational Techniques in Electromagnetics</td>
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<td>EPRRM202</td>
<td>Microwave Devices and Integrated Circuits</td>
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<td>EPRRM221 to 224</td>
<td>Elective –III(Group III)</td>
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<td>EPRRM223 to 235</td>
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<td>EPRRM241 to 244</td>
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### Group III

- EPRRM221: Phased Array Antennas
- EPRRM222: Smart Antennas for Mobile Communication
- EPRRM223: Antennas and Propagation for Wireless Communication Systems
- EPRRM224: Computer Communication Networks

### Group IV

- EPRRM231: Global Positioning Systems
- EPRRM232: Wireless Channels and UWB Radio
- EPRRM233: Multimedia Communication Technology
- EPRRM234: Photonic Networks and Switching
- EPRRM235: RF and Microwave MEMs

### Group V

- EPRRM241: RF Receiver Design and Wireless applications
- EPRRM242: DSP Processors and Architecture
- EPRRM243: Advanced Digital Signal Processing
- EPRRM244: Radar Signature Analysis and Imaging
### III SEMESTER

<table>
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### IV SEMESTER

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Total Credits 74
M.Tech. (RF & Microwave Engineering) – I Semester
ADVANCED ELECTROMAGNETICS

Course Code: EPRRM101
Category: core
Credits: 4
Hours: 4 per week

UNIT-I
Wave equations, propagation and properties: Introduction, Time-varying electromagnetic fields, Time-harmonic electromagnetic fields, Solution to the wave equation, TEM modes, TEM in lossy media, Polarization, Normal incidence-lossless media, Oblique incidence-lossless media, Lossy media, Reflection and transmission of multiple interfaces, Polarization characteristics on reflection.

UNIT-II

UNIT-III
Rectangular cross-section waveguides and cavities: Introduction, Rectangular waveguide, Rectangular resonant cavities, Hybrid modes, Partially filled waveguide, Transverse resonance method, Dielectric waveguide, Stripline and microstrip lines, Rridged waveguide.

UNIT-IV

UNIT-V
Spherical transmission lines and cavities: Introduction, Construction of solutions, Bi-conical transmission line, Spherical cavity.

Textbooks:
UNIT-I
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.

UNIT-II
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.

UNIT-III
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.

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

UNIT-V

Text Books:
UNIT - I

UNIT –II
Radiation Integrals and Auxiliary Potential Functions: Introduction, The Vector Potential $\mathbf{A}$ for an Electric Current Source $\mathbf{J}$, The Vector Potential $\mathbf{F}$ for a Magnetic Current Source $\mathbf{M}$, Electric and Magnetic Fields for Electric ($\mathbf{J}$) and Magnetic ($\mathbf{M}$) Current Sources, Solution of the Inhomogeneous Vector Potential Wave Equation, Far-Field Radiation, Duality Theorem, Reciprocity and Reaction Theorems.

UNIT - III

UNIT - IV
UNIT - V


Reference Books
M.Tech. (RF & Microwave Engineering) – I Semester
MICROWAVE NETWORKS
Course Code: EPRRM121  Category: Elective I  Credits: 4
Hours: 4 per week

UNIT-I
Microwave Circuits: One port junction, Terminal voltages and currents in multi port junctions, Poynting’s energy theorem, Normalized waves and scattering matrix, Properties of [S] matrix, Wave amplitude transmission matrix [A], Impedance matching techniques: Quarter-wave and Tapered line Impedance transformers, Two Port Networks analysis with Transmission matrices, S-Parameter and signal flow graphs

UNIT-II
Microwave Waveguide Components: Microwave junctions, Bends, Scattering matrix E and H plane tee junctions, Magic-T , Applications of Magic-T, Microwave propagation in ferrites, Principles of Faraday rotation, Gyrator, Isolator and Circulator,

UNIT-III
Waveguide Components, Mode transducers, Waveguide discontinuities, Terminations, Attenuators and Phase shifters, Rotary joints, Mechanical and gas type switches.

UNIT-IV
Microwave Passive Components: Wave meters, Attenuators, Directional coupler, Scattering matrix of directional couplers, Coaxial and Strip line components : Terminations, Connectors and Transitions, Attenuators and phase shifters, Transmission line discontinuations, DC Returns and blocks, Low pas filters, MICS.

UNIT-V

Text Books :
5. Gintton, EL, ”Microwave Measurements”, Mc Graw Hill, 1979
UNIT-I
Introduction to Radio Frequency & Microwave Measurements
Introduction to Radio Frequency Band, microwave and millimeter wave. Power Measurement-
High Power Measurement, calorimeter technique, Low power Measurement, bolometer technique, Very Low Power Measurement.

UNIT-II
Frequency Measurement
Different Technique to measure frequency, Slotted Line Technique, maxima & minima, wavelength & frequency measurement. Impedance Measurement- Measurement of unknown load impedance of a transmission line, Slotted Line Technique to measure unknown impedance. Distortion & Frequency Translation Measurement- Different types of distortion occurred at microwave frequencies, Procedures for frequency translation.

UNIT-III
Detectors & Sensors: Definition of Detectors; Different type of microwave detectors functions and applications, Sensors Definition & working principle, applications, measurement of scattering parameters.

UNIT-IV

UNIT-V
Text Books:
1. G.H. Bryant, “Principles of Microwave Measurements”, Peter Peregrinus Ltd., IEE, 1993
4. S.F. Adam, “Microwave Theory & Application”, Prentice Hall, Inc
M.Tech. (RF & Microwave Engineering) – I Semester
DIGITAL SIGNAL PROCESSING

Course Code: EPRVD122/EPRDS101/EPRRM123
Category: Elective-I
Credits: 4
Hours: 4 per week

UNIT-I

UNIT-II

UNIT-III

UNIT-IV

UNIT-V
Design Of Digital Filters: General Considerations, Design of FIR Filters, Design of IIR Filters From Analog Filters Frequency Transformations

Text Books:

Reference Books:
UNIT-I
Introduction to 16-bit processors: Intel 8086 and 8088, Architecture, Bus Interface Unit and Execution Unit, Data and Address Bus Configuration, Memory Segmentation, Memory Address generation, I/O Port addressing, Functions of all signals, Interrupt processing, Hardware and Software interrupts, Internal interrupts, Minimum and Maximum Mode.

UNIT-II
Addressing Modes: Instruction Set in detail, Assembler directives, Assembly Language Programming Tools, Programming examples, Macros, DOS functions.

UNIT-III
Peripheral chips: 8255 I/O chip, 8254 Timer, Interfacing of 8086 with Memory, 8255 and 8254. Interfacing with ADC and DAC chips. Industrial Applications, Programming examples. Peripheral chips like 8251 (USART) and 8259 (Priority Interrupt Controller), Interfacing of 825 and 8259 and with 8086, Programming examples.

UNIT-IV

UNIT-V
Text books:


UNIT-I

UNIT-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.

UNIT-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.

UNIT-IV
Grounding, shielding, bonding and EMI filters: Principles and types of grounding, shielding and bonding, characterization of filters, power lines filter design.

UNIT-V
Cables, connectors, components and EMC standards: EMI suppression cables, EMC connectors, EMC gaskets, Isolation transformers, optoisolators, National / International EMC standards.
Text Books:
UNIT- I
Basic data communication concepts: Introduction to Data communication, channel capacity, parallel and serial transmission, Asynchronous and Synchronous transmission, Simplex, Half Duplex and Full Duplex modes of transmission and their applications. Multiplexing strategies like TDM, FDM, WDM and SDM.

UNIT-II

UNIT-III

UNIT-IV
Physical and Data link layer: Error detection techniques such as Parity check, Vertical and longitudinal redundancy check, CRC code and their error detecting capabilities. Data link layer issues Point to point and multipoint links, flow control, sliding window protocol, various ARQ techniques for error and flow control and their comparison, SDLC, HDLC as bit oriented link control.

UNIT-V

Text books:
UNIT-I

UNIT-II
Satellite link design and Space craft: Basic link analysis, Attenuation and interference effects, Uplink, Downlink and Satellite link design, Space craft: Lifetime and Reliability, Subsystems of Satellite – Transponder, Antenna, Attitude Control, Propulsion system, Telemetry, Tracking & Control, Power system, Thermal Control System and Structure subsystems.

UNIT-III
Modulation and Multiplexing techniques: Introduction, Signal sources, Analog transmission systems, Frequency division multiplexing, Frequency modulation, Digital transmission systems, Source coding, Digital modulation and demodulation, TDM.

UNIT-IV
Multiple access: Introduction, FDMA, Single and Multiple channel per carrier, FDM/FM/FDMA link, TDMA, TDMA frame structure and frame efficiency, TDMA super frame structure, Frame acquisition and synchronization, CDMA, PN sequence, Direct sequence and Frequency hopped spread spectrum system, Demand assignment multiple access, Demand assignment TDMA, SCPC-DAMA, SPADE.

UNIT-V
Earth station: Design considerations, General configuration, Antenna systems, Feed system, Tracking system, High power amplifier, Low noise amplifier, Earth station equipment.
Text Books:

Reference Books:
M.Tech. (RF & Microwave Engineering) – I Semester
RADAR SYSTEMS
Course Code: EPRRM132  Category: Elective II  Credits: 4
Hours: 4 per week

UNIT-I

UNIT-II
The Theory of Target detection: Noise and faults alarm, detection of One sample of signal with Noise, Integration of Pulse Train, detection of fluctuating targets, CFAR, Optimum prediction and matched filter Theory, Loss factors in detection.

UNIT-III
Targets and Interference: Definition of radar cross section, radar cross section simple and complex objects, spatial distribution of cross section biostatic cross section, CW and FM radar: Doppler effect, CW and FMCW radar, Airborne Doppler Navigation, Multi frequency CW radar.

UNIT-IV
MTI radar: Delay Lines and delay cancellers, sub clutter visibility, MTI using Range Gates and Filters, Pulse Doppler Radar, non coherent MTI Radar, and Applications of Digital signal processing to radar system Tracking Radar: Different types of Tracking Techniques, Tracking in Range, Tracking in Doppler, Search acquisition Radar, comparison Of Trackers.

UNIT-V
Introduction to Pulse compression radar: Height finding Radar, Air Traffic control, Radar and data handling, Atmospheric effects of Radar, Electromagnetic compatibility aspects, Air borne Radars, Synthetic aperture Radar, secondary surveillance radars.

Text Books:
M.Tech. (RF & Microwave Engineering) – I Semester
FIBER OPTIC COMMUNICATIONS

Course Code: EPRRM133  Category: Elective-II  Credits: 4
Hours: 4 per week

UNIT-I
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.

UNIT-II

UNIT-III

UNIT-IV

UNIT-V

Text Books:
M.Tech. (RF & Microwave Engineering) – I Semester
MOBILE COMMUNICATIONS
Course Code: EPRRM134  Category: Elective-II  Credits: 4  Hours: 4 per week

UNIT-I
Introduction - Evolution of mobile radio communications, mobile radio systems around the world, trends in cellular radio and personal communication, first generation (1G), second generation (2G), third generation (3G) mobile cellular networks.

UNIT-II
Cellular concept – Limitations of conventional mobile system, Introduction to mobile cellular communication, concept of frequency reuse, cluster size, cellular system architecture, channel assignment strategies, call handoff strategies – hard handoff and soft handoff, prioritizing handoff; interference and system capacity, improving capacity in cellular systems – cell splitting, sectoring, microcell zone concept.

UNIT-III
Different mobile communication systems – GSM services and features, system architecture, GSM radio subsystem, GSM channel types, location updating and call setup, WAP, SCSD, GPRS, EDGE, 3G W-CDMA; CDMA digital cellular standard, comparison between GSM and CDMA, 3G cdma2000, IMT-2000.

UNIT-IV
Radio Channel Characterisation – Free space propagation, Multipath propagation, diversity techniques, Co-channel interference, Propagation effects - scattering, ground reflection, fading, Log-normal shadowing.
Wireless networks – Advantages and applications of Wireless LAN, WLAN technology – RF and IR wireless LAN, diffuse, quasidiffuse and point-to-point IR wireless LAN, IEEE802.11, IEEE802.11 architecture, Physical layer, MAC layer, Introduction to WIFI, HIPERLAN2, Bluetooth – Bluetooth architecture.

UNIT-V
Mobile network and transport layer – Introduction to Mobile IP, requirements, IP packet delivery, Agent discovery, Registration, Tunneling and encapsulation, Optimization, Reverse tunneling; Mobile adhoc networks – Routing, Destination sequence distance vector, Dynamic source routing and Alternative metrics; Traditional TCP – Congestion control, Slow start.
Text & Reference Books:
M.Tech. (RF & Microwave Engineering) – I Semester
TELECOMMUNICATIONS SWITCHING SYSTEMS AND NETWORKS

Course Code: EPRRM135  Category: Elective-II  Credits: 4  Hours: 4 per week

UNIT-I
Telecommunication Switching Systems: Introduction, Elements of switching network configuration, strowger switching components, principles of cross bar switching, Electronic space division switching, Time division switching, Combination switching.

UNIT-II
Telephone Networks: Subscriber loop systems, switching hierarchy and routing, transmission plan, numbering plan, charging plans.

UNIT-III
Signaling Techniques: In channel signaling, common channel signaling. Network traffic parameters, grade of service and blocking probability.

UNIT-IV
Data Communication Networks: Introduction, network architecture, layered network protocols, data communications hardware, data communication circuits Public switched data networks, connection oriented & connection less service, Circuit Switching, switching and virtual circuit switching concepts, OSI reference model, LAN, WAN, MAN Repeaters, Bridges, Routers and gate ways.

UNIT-V

Text Books:
1. Thyagarajan Viswanath,” Telecommunication switching system and networks”, PHI, 2004
Reference Books:
UNIT-I

UNIT-II
Wireless Data Services: CDPD, ARDIS, RMD, Common channel signaling, ISDN, BISDN and ATM, SS7, SS7 user part, signaling traffic in SS7.

UNIT-III

UNIT-IV
Wireless LAN Technology: Infrared LANs, Spread spectrum LANs, Narrow bank microwave LANs, IEEE 802 protocol Architecture, IEEE802 architecture and services, 802.11 medium access control, 802.11 physical layer. Blue Tooth, Overview, Radio specification, Base band specification, Links manager specification, Logical link control and adaptation protocol. Introduction to WLL Technology.

UNIT-V

Text Books:
M.Tech. (RF & Microwave Engineering) – I Semester
ANTENNAS LABORATORY

Course Code: EPRRM111 Credits: 2 Hours: 3 per week

1) Study of microwave components
2) Measurement of attenuation characteristics
3) Measurement of frequency and wave length.
4) Measurement of Radiation pattern and gain of horn antenna.
5) Measurement of Radiation pattern and gain of different dipole antennas.
6) Measurement of unknown load impedance
7) Determination of Polarization of antennas.
8) Measurement of parameters of directional coupler
9) Verification of Reciprocity Characteristics of antennas.
10) Measurement of coupling factor of E-plane tee and H-plane Tee junction

M.Tech. (RF & Microwave Engineering) – I Semester
MICROWAVE MEASUREMENTS LABORATORY

Course Code: EPRRM112 Credits: 2 Hours: 3 per week

The following parameters are to be measured with X, S and Ku band microwave components.

1. Reflex Klystron Characteristics.
2. Gunn Diode Characteristics.
3. Directional Coupler Characteristics.
4. VSWR measurements.
5. Impedance, wavelength and frequency measurements.
8. Coupling Measurement of H & E – Plane and magic-Tee Junctions
11. Circulators / Isolators
M.Tech. (RF & Microwave Engineering) – II Semester
COMPUTATIONAL TECHNIQUES IN ELECTROMAGNETICS

Course Code: EPRRM201 Credits: 4 Hours: 4 per week

UNIT I

UNIT II

UNIT III

UNIT IV
Variational Methods: Introduction, Operators in Linear Spaces, Calculus of Variations, Construction of Functionals from PDEs, Rayleigh-Ritz Method,

UNIT V


Text Book:

References:
M.Tech. (RF & Microwave Engineering) – II Semester
MICROWAVE DEVICES AND INTEGRATED CIRCUITS

Course Code: EPRRM202          Credits: 4          Hours: 4 per week

UNIT-I
Microwave Transistors and FETs: Introduction, Microwave Bipolar Transistors, Heterojunction Bipolar Transistors, Junction Field Effect Transistors, Metal Semiconductor Field Effect Transistors, High electron mobility transistors, MOSFETs.

UNIT-II
Microwave O-type Tubes: High frequency limitations of conventional tubes, Reentrant cavities, Klystrons, Velocity modulation process, Bunching process, Output power and beam loading, Reflex Klystron, Velocity modulation, Power output and efficiency, Electronic admittance, Mode patterns, Slow wave structures, Traveling wave tube, Amplification process, Wave modes, Gain considerations.

UNIT-III

UNIT-IV

UNIT-V
Microwave Integrated Circuits: Thick and thin film technology, Hybrid MIC’s, Monolithic MIC technology, Analysis of Strip line and Microstrip Line: Method of conformal transformation, Charactetic parameters of Strip, Microstrip lines, Microstrip circuit design, Impedance transformers, Filters, Lumped constant microstrip circuits, Coupled Microstrip and Directional Coupler: Even and Odd Mode analyses, Theory of coupled microstrip directional coupler, Calculations for couples pair of Micro strips, Brach line
couplers, Lumped Elements : Lumped elements for MIC’s design and fabrication of Lumped elements, Circuits using lumped elements, Non Reciprocal Components: Non reciprocal components for MIC’s, Microstrip on ferrimagnetic substrates, Microstrip circulators, Isolators and phase shifters, Design of microstrip circuits, High Power and low power circuits.

**Text Books:**
M.Tech. (RF & Microwave Engineering) – II Semester
PHASED ARRAY ANTENNAS

Course Code: EPRRM221  Category: Elective-III   Credits: 4      Hours: 4 per week

UNIT-I

UNIT-II
Pattern Characteristics of Linear and Planar Arrays: Array analysis, characteristics of linear and planer arrays, scanning to end-fire, thinned arrays

UNIT-III
Pattern Synthesis for Linear and Planar Arrays: Linear Arrays and Planar Arrays with Separable Distributions, Circular Planar Arrays, Methods of Pattern Optimization/Adaptive Arrays, Generalized Patterns Using Covariance Matrix Inversion, Pattern Synthesis Using Measured Element Patterns

UNIT-IV
Patterns of Nonplanar Arrays: Introduction, Patterns of Circular and Cylindrical Arrays, Spherical and Hemispherical Arrays, Truncated Conical Arrays

UNIT-V
Elements for Phased Arrays: Array Elements, Polarization Characteristics of Infinitesimal Elements in Free Space, Electric Current (Wire) Antenna Elements, Aperture Antenna Elements, Microstrip Patch Elements, Elements for Alternative Transmission Lines, Elements and Row (Column) Arrays for One-Dimensional Scan, Elements and Polarizers for Polarization Diversity

Text books

Reference Books :
M.Tech. (RF & Microwave Engineering) – II Semester
SMART ANTENNAS FOR MOBILE COMMUNICATION

Course Code: EPRRM222       Category: Elective-III       Credits: 4       Hours: 4 per week

UNIT-I

UNIT-II
Introduction to Smart Antennas: Spatial Processing for Wireless Systems, Key Benefits of Smart Antennas, Smart antenna introduction, smart antenna configuration, SDMA, architecture of smart antenna systems.

UNIT-III

UNIT-IV
Smart Antennas Techniques for CDMA: Non-Coherent CDMA Spatial Processors, Coherent CDMA Spatial Processors and the Spatial Processing Rake Receiver, Multi-User Spatial Processing, Dynamic Re-sectoring Using Smart Antennas, Downlink Beam forming for CDMA.

UNIT-V
CDMA System Range and Capacity Improvement Using Spatial Filtering: Range Extension in CDMA, Single Cell Systems with Spatial Filtering at the IS-95 Base Station, Reverse Channel Performance of Multi-cell Systems with Spatial Filtering at the Base Station, Reverse Channel Spatial Filtering at the WLL Subscriber Unit, Range and Capacity Analysis Using Smart Antennas – A Vector Based Approach.
Text Books:
M.Tech. (RF & Microwave Engineering) – II Semester
ANTENNAS AND PROPAGATION FOR WIRELESS COMMUNICATION SYSTEMS

Course Code: EPRRM223   Category: Elective-III   Credits: 4   Hours: 4 per week

UNIT-I
Introduction to Wireless Communications: Concept of a wireless channel, system types, cellular system concept and networks, Traffic, Multiple Access schemes and Duplexing: FDMA, TDMA, CDMA: Available data rates.

UNIT-II
Antenna Arrays: Introduction, Linear and planar arrays, The uniform linear array, Yagi-Uda antennas, Monopole antennas, Corner reflectors, Parabolic reflector, Horn antenna, Loop antenna, Helical antenna, Patch antenna, Basic Propagation Model.

UNIT-III
Fixed Links: Terrestrial fixed links: Path profile, Tropospheric refraction, Obstruction loss, Diffraction over the objects of finite size, influence of clutter, Satellite Fixed Link: Tropospheric effects, Ionospheric effects, satellite earth station antennas.

UNIT-IV

UNIT-V
Mega cells: Shadowing and fast fading, Outdoor measurements, indoor measurements, Future development in wireless communication channel: Physical channel modeling, intelligent antennas.

Text books:

Reference books
M.Tech. (RF & Microwave Engineering) – II Semester
COMPUTER COMMUNICATION NETWORKS

Course Code: EPRRM224  Category: Elective-III  Credits: 4  Hours: 4 per week

UNIT-I
Introduction: Internet, the network edge, the network core, network access and physical media, ISPS and internet backbones, delay and locs in packet switched networks, protocol layers and their service models, history of computer networking and the internet.

UNIT-II
Application layer: Principles of application layer protocols, the web and HTTP, file transfer (FTP), electronic mail in the internet, DNS, socket programming with TCP, socket programming with UDP.

UNIT-III
Building a simple web server: Content distribution. Transport layer introduction and transport layer, services multiplexing and demultiplexing, connectionless transport UDP, principle of reliable data transfer. Connection oriented transport TCP, principles of congestion control, TCP congestion control. Network layer and routing introduction and network service models, routing principles, hierarchical routing.

UNIT-IV
The Internet protocol: Routing in the internet, inside a router, IPV6, multicast routing, mobility and the network layer. Link layer and local area networks Data link layer, error detection and correction technique. Multiple access protocols, LAN addresses. ARP, Ethernet, hubs, bridges and switches, wireless links, PPP.

UNIT-V

Text Books:

Reference Books:
GLOBAL POSITIONING SYSTEMS: PREREQ: (EPRRM124)

Course Code: EPRRM231  Category: Elective IV  Credits: 4  Hours: 4 per week

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 Geocentric 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:

Reference Books:
UNIT-I

UNIT-II
Multiple Antenna and Space-Time Communications: Narrowband MIMO Model, Parallel Decomposition of MIMO Channel, MIMO Diversity Gain: Beam forming, Space-Time Modulation and Coding: ML detection, rank and determinant criteria, space-time trellis and block codes (Alamouti code; orthogonal designs; linear space-time codes; trellis space-time codes; linear interfaces: ZF, MMSE; nonlinear interfaces: ZF-V-BLAST, MMSE-V-BLAST, diagonal BLAST; iterative interface), Frequency-Selective MIMO Communications, Smart Antennas, MIMO Channel Capacity.

UNIT-III
Multi-Carrier Modulation and OFDM: Data Transmission using Multiple Carriers, Multicarrier Modulation with Overlapping Sub channels, Mitigation of Subcarrier Fading: frequency equalization, pre coding, adaptive loading, OFDM: generation of subcarriers using the IFFT, guard time and cyclic extension, windowing, choice of OFDM parameters, OFDM signal processing, implementation complexity of OFDM versus single-carrier modulation, OFDM system model, channel modeling for OFDM systems, applications of OFDM (DAB, DVB, WLANs), Vector Coding, Challenges in Multicarrier Systems.

UNIT-IV
Adaptive modulation and Coding for Wireless Channels: Linear Block Codes, Convolutional Codes and Concatenated Codes, Turbo Codes and LDPC Codes, Coded Modulation, Coding with Interleaving, Unequal Error Protection, Adaptive Techniques, Variable-Rate Variable-Power MQAM: adaptive rate and
power techniques, channel inversion with fixed rate, discrete-rate adaptation, exact versus, approximate bit error probability, channel estimation and error delay, Adaptive Coded Modulation, Adaptive Techniques in Combined Fast and Slow Fading.

UNIT-V Ultra Wideband (UWB) Systems: Origin of UWB Technology, UWB signal generation: direct-sequence, measurement of UWB signals, UWB in WLANS.

Text Books:
M.Tech. (RF & Microwave Engineering) – II Semester
MULTIMEDIA COMMUNICATION TECHNOLOGY

Course Code: EPRRM233  Category: Elective IV  Credits: 4  Hours: 4 per week

UNIT-I
Multimedia communications: Introduction, multimedia information representation, multimedia networks, multimedia applications, media types, communication modes, network types, multipoint conferencing, network QoS application QoS.

UNIT-II

UNIT-III
Audio and video compression: introduction, audio compression, DPCM, ADPCM, APC, LPC, video compression, video compression principles, H.261, H.263, MPEG, MPEG-1,MPEG-2, and MPEG-4.

UNIT-IV
Multimedia information networks: introduction, network performance parameters, throughput, networking delay, delay variance, error rate, quality of service.

UNIT-V
QoS: QoS perspectives, QoS processing, multimedia transmission, requirements, transmission over WANs, Multimedia Transmission over LANs, ATM networks, Wireless LANs, Multimedia transport protocols: RTP and RTCP. Multimedia management protocols: H.323, SIP, SDP, SA.

Text books:

Reference Books:
M.Tech. (RF & Microwave Engineering) – II Semester
PHOTONIC NETWORKS AND SWITCHING

Course Code: EPRRM234  Category: Elective IV  Credits: 4  Hours: 4 per week

UNIT-I
Optical communications: Introduction to basic optical communications and devices. Optical multiplexing techniques - Wavelength division multiplexing, Optical frequency division multiplexing, time division multiplexing, code division multiplexing.

UNIT-II

UNIT-III
WAVELENGTH ROUTING NETWORKS: The Optical layer, Node Designs, Optical layer cost tradeoffs, Routing and wave assignment, Virtual topology design, wave length routing test beds, Architectural variations.

UNIT-IV

UNIT-V

Text Books:

Reference books
M.Tech. (RF & Microwave Engineering) – II Semester
RF AND MICROWAVE MEMS

Course Code: EPRRM235  Category: Elective IV  Credits: 4  Hours: 4 per week

UNIT-I
Introduction: Introduction to wireless systems, personal communication systems, High frequency effects in circuits and systems.

UNIT-II
Transmission lines: Review of Transmission line Theory, terminated transmission lines, smith chart, impedance matching, Micro strip and Coplanar waveguide implementations, microwave network analysis, ABCD parameters, S parameters.

UNIT-III
Networks: Behavior of passive IC components and networks, series and parallel RLC circuits, resonant structures using distributed transmission lines, components and interconnects at high frequencies.

UNIT-IV
High frequency system design: Basics of high frequency amplifier design, device technologies, biasing techniques, simultaneous tuning of 2 port circuits, noise and distortion, Feedback systems, phase locked loops, LNA design, designs based on impedance match noise performance, linearity, noise and large signal performance, Power amplifier design, Various classes of power amplifiers, Oscillators, linear oscillators, tuned oscillators, negative resistance oscillators Systems aspects in wireless trans-receiver design.

UNIT-V
MEMS technologies and components for RF applications: RF MEMS switches, varactors, inductors and filters .Introduction to microwave antennas, definitions and basic principles.

Text books

Reference Books:
UNIT-I
**Introduction to Wireless Systems**: Classification of wireless systems; Design and performance issues: Choice of operating frequency, multiple access and duplexing, circuit switching versus packet switching, propagation, radiated power and safety; Cellular telephone systems and standards.

UNIT-II
**Noise and Distortion in Microwave Systems**: Basic threshold detection, noise temperature and noise figure, noise figure of a lossy transmission line; Noise figure of cascade systems: Noise figure of passive networks, two-port networks, mismatched transmission lines and Wilkinson power dividers; Dynamic range and inter-modulation distortion.

UNIT-III
**Microwave Amplifier Design**: Comparison of active devices such as BJT, MOSFET, MESFET, HEMT, and HBT; Circuit models for FETs and BJTs; Two-port power gains; Stability of transistor amplifier circuits; Amplifier design using S-parameters: Design for maximum gain, maximum stable gain, design for specified gain, low-noise amplifier design, design of class-A power amplifiers.

UNIT-IV
**Mixers**: Mixer characteristics: Image frequency, conversion loss, noise figure; Devices for mixers: p-n junctions, Schottky barrier diode, FETs; Diode mixers: Small-signal characteristics of diode, single-ended mixer, large-signal model, switching model; FET Mixers: Single-ended mixer, other FET mixers; Balanced mixers; Image reject mixers.

UNIT-V
**Switches**: Devices for microwave switches: PIN diode, BJT, FET; Device models; Types of switches; Switch configurations; Basic theory of switches; Multi-port, broad-band and isolation switches. **Oscillators and Frequency Synthesizers**: General analysis of RF oscillators, transistor oscillators, voltage-controlled oscillators, dielectric resonator oscillators, frequency synthesis
methods, analysis of first and second order phase-locked loop, oscillator noise and its effect on receiver performance.

**Textbooks:**
M.Tech. (RF & Microwave Engineering) – II Semester

DSP PROCESSORS AND ARCHITECTURE

Course Code: EPRRM242  Category: Elective-V  Credits: 4  Hours: 4 per week

UNIT-I
FUNDAMENTALS OF PROGRAMMABLE DSPs: Multiplier and Multiplier accumulator – Modified Bus Structures and Memory access in PDSPs – Multiple access memory – Multi-port memory – VLIW architecture – Pipelining – Special Addressing modes in P-DSPs – On chip Peripherals.

UNIT-II
TMS320C5X PROCESSOR: Architecture – Assembly language syntax - Addressing modes – Assembly language Instructions - Pipeline structure, Operation – Block Diagram of DSP starter kit – Application Programs for processing real time signals.

UNIT-III
TMS320C3X PROCESSOR: Architecture – Data formats - Addressing modes – Groups of addressing modes- Instruction sets - Operation – Block Diagram of DSP starter kit – Application Programs for processing real time signals – Generating and finding the sum of series, Convolution of two sequences, Filter design.

UNIT-IV
ADSP PROCESSORS: Architecture of ADSP-21XX and ADSP-210XX series of DSP processors- Addressing modes and assembly language instructions – Application programs – Filter design, FFT calculation.

UNIT-V

References:
2. User guides Texas Instrumentation, Analog Devices, Motorola.
UNIT-I

UNIT-II

UNIT-III
Adaptive Filters - Applications of Adaptive Filters, Adaptive Direct-Form FIR Filters-The LMS Algorithm, Adaptive Direct-Form FIR Filters-RLS Algorithms.

UNIT-IV

UNIT-V
Wavelet Theory: Introduction to time frequency analysis, Short-time Fourier transform, Continuous time wavelet transform, discrete wavelet transform, Construction of wavelets. Multi resolution analysis, Application of wavelet theory to signal denoising, image and video compression.

Text Books

Reference Books
UNIT-I
Elements review of selected signal processing concepts and operations:
Resolution, spatial frequency, Fourier transforms, sampling theorem and spectrum replication, vector representation of signals, data integration, correlation, components of a radar signal, amplitude models, clutter, noise model and SNR, jamming, Frequency models: the Doppler shift, spatial models, spectral model.

UNIT-II
Sampling and quantization of pulsed radar signals: domains and criteria for sampling radar signals, sampling in the fast time dimension, sampling in slow time: selecting the pulse repetition interval, sampling the Doppler spectrum, sampling in the spatial and angle dimensions, quantization, i/q imbalance and digital i/q.

UNIT-III
Introduction: Waveform matched filter, matched filtering of moving targets, the ambiguity function, the pulse burst waveform, frequency-modulated pulse compression waveforms, range side lobe control for fm waveforms, the stepped frequency waveform, phase-modulated pulse compression waveforms, Costas frequency codes.

UNIT-IV
Alternate forms of the doppler spectrum: Moving target indication (MTI), pulse Doppler processing, dwell-to-dwell stagger, pulse pair processing, additional Doppler processing issues, clutter mapping and the moving target detector, mti for moving platforms: adaptive displaced phase center antenna processing.

UNIT-V
Detection fundamentals: radar detection as hypothesis testing, threshold detection in coherent systems, threshold detection of radar signals constant false alarm rate (CFAR) detection, the effect of unknown interference power on false alarm probability, cell averaging cfar, the effect of varying pfa, analysis of cell-averaging cfar, ca cfar limitations

Textbook:

References:
Simulation of experiments using Microwave office software

1. Design of Mixer
2. Design of low noise amplifier
3. Design of IF amplifier
4. Design of Power amplifier
5. Design of Microwave components and passive circuits