JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M.TECH. IN MICROWAVE AND RADAR ENGINEERING
EFFECTIVE FROM ACADEMIC YEAR 2022-23 ADMITTED BATCH

R22 COURSE STRUCTURE AND SYLLABUS

I YEAR I – SEMESTER

Course Code	Course Title	L	T	P	Credits
Professional Core - I	Microwave Circuits and Systems	3	0	0	3
Professional Core - II	Radar Systems Engineering	3	0	0	3
Professional Elective - I	1. Advanced Electromagnetic Engineering 2. Microwave Measurements 3. Computational Techniques for Microwaves	3	0	0	3
Professional Elective - II	1. Microwave Semiconductor Devices 2. Satellite Radio Navigation 3. Optical Communications and Networks	3	0	0	3
Lab - I	Microwave Circuits and Systems Lab	0	0	4	2
Lab - II	Simulation Lab	0	0	4	2
	Research Methodology & IPR	2	0	0	2
Audit - I	Audit Course – I	2	0	0	0
	Total	**16**	**0**	8	**18**

I YEAR II – SEMESTER

Course Code	Course Title	L	T	P	Credits
Professional Core - III	Microwave Antennas	3	0	0	3
Professional Core - IV	Advanced Communications and Networks	3	0	0	3
Professional Elective - III	1. Cognitive Radio Systems 2. Phased Array Radar 3. RF Receiver Design	3	0	0	3
Professional Elective - IV	1. Radar Signal processing 2. Electromagnetic Interference and Compatibility 3. ARM Microcontrollers	3	0	0	3
Lab - III	Microwave Antenna Design Lab	0	0	4	2
Lab - IV	Advanced Communications and Networks Lab	0	0	4	2
	Mini project with Seminar	0	0	4	2
Audit - II	Audit Course – II	2	0	0	0
	Total	**14**	**0**	**12**	**18**

II YEAR I - SEMESTER

Course Code	Course Title	L	T	P	Credits
Professional Elective - V	1. RF MEMS 2. 5G and Beyond Communications 3. Microwave Imaging	3	0	0	3
Open Elective	Open Elective	3	0	0	3
Dissertation	Dissertation Work Review – II	0	0	12	6
	Total	**6**	**0**	**12**	**12**

II YEAR II - SEMESTER

Course Code	Course Title	L	T	P	Credits
Dissertation	Dissertation Work Review - III	0	0	12	06
Dissertation	Dissertation Viva-Voce	0	0	28	14
	Total	**0**	**0**	**40**	**20**

Open Electives:

1. Business Analytics
2. Industrial Safety
3. Operations Research
4. Cost Management of Engineering Projects
5. Composite Materials

Audit Course I & II:

1. English for Research Paper Writing
2. Disaster Management
3. Sanskrit for Technical Knowledge
4. Value Education
5. Constitution of India
6. Pedagogy Studies
7. Stress Management by Yoga
8. Personality Development Through Life Enlightenment Skills

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M.TECH.- I YEAR- I SEMESTER
MICROWAVE AND RADAR ENGINEERING
MICROWAVE CIRCUITS AND SYSTEMS (PC -I)

Course Objectives:

1. To become familiar with the characterization of microwave networks
2. To acquaint with theoretical analysis of the characteristics of electromagnetic waves in planar transmission lines.
3. To know impedance matching concepts
4. To become familiar with microwave passive circuit analysis and design

Course Outcomes: Students will be able to:

1. Characterize the reciprocal networks, lossless networks in terms of S-Parameters
2. Analyze the behaviour of most commonly used planar transmission lines such as microstrip line and stripline etc.
3. Design impedance matching networks, power dividers, couplers and filters
4. Know the microwave propagation in ferrites and use them in various applications

UNIT -I

Introduction to micro wave Circuit concept: one port junction, scattering matrix, Properties of [s]matrix, Relationship between [s], [z]and[y] parameters, Wave amplitude transmission matrix[A], Relation between [A] and [s].

UNIT -II

Analysis of microstrip line and strip line, Method of conformal Transformation, Characteristic parameters of Microstrip, strip lines, Introduction to slot line and coplanar waveguide.

Impedance matching: Stub matching- Single and double stub using Smith chart solutions, Quarter wave transformer, Multi section transformer design, tapered lines- Exponential taper, triangular taper.

UNIT -III

Introduction to Coupled Microstrips, Even and odd mode analysis, Theory of coupled microstrip Directional couplers, Calculations for a coupled pair of Microstrips, Branch line couplers, Eigenvalue method and its applications to branch line couplers, hybrid ring couplers and the Wilkinson power dividers/combiners.

UNIT -IV

Lumped Elements for MIC"s Design and fabrication of lumped elements, circuits using lumped elements Impedance transformers.

Microwave Planar Filters: Periodic structures, Filter design by the Image Parameter method, Filter design by the Insertion Loss method, Filter transformations, Filter implementation.

UNIT -V

Micro wave propagation in ferrites, Principles of faraday rotation, Microstrip on Ferromagnetic substrates, Microstrip circulators, Isolators and phase shifters, Applications of MIC"s.

TEXT BOOKS:

1. Collins. RE, Foundations for Microwave Engineering, McGraw Hill, 2nd edn, 1992.
2. Pozer. DM, Microwave engineering, 2nd edn., john wiley andsons, inc.,1999.

REFERENCE BOOKS:

1. Gupta KC, and Amarjit Singh, Microwave Integrated circuits, Wiley Eastern, 1974.
2. Hoffman R.K."Hand Book of Microwave integrated Circuits", Artech House, Boston, 1987.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M.TECH.- I YEAR- I SEMESTER
MICROWAVE AND RADAR ENGINEERING
RADAR SYSTEMS ENGINEERING (PC-II)

Course Objectives:

1. To introduce different types of radar systems for military and civilian applications.
2. To understand the principle of operation of different types of Radar
3. To know the working of Phased array Radar and SAR and its applications

Course Outcomes: Students will be able to:

1. Analyze the parameters of Radar
2. Distinguish different types of Radar
3. Configure the Radar receiver
4. Characterize the signals for Synthetic Aperture Radar.

UNIT -I

Radar Basics: Block diagram, Range equation, Ambiguous range, Usable range, Instrumented Range, A power approach to SNR, Radar cross section of simple shapes, Radar Loss

UNIT -II

Radar types: Block diagram and working principle of CW radar, FM-CW radar, MTI radar and Phased array radar.

UNIT -III

Radar Receiver: Single and Dual Conversion Super Heterodyne Receiver, Noise, 1-dB gain compression point, Dynamic Range, Cascade Analysis, Digital Receiver, Receiver Configurations

UNIT -IV

Synthetic Aperture Radar: Liner Array theory, Transition to SAR theory, Development of SAR specific Equations, Types of SAR, SAR signal Characterization, Practical Implementation, Down range and Cross Range imaging.

UNIT -V

Advances in Radar: MIMO Radar, Cognitive Radar, Surveillance radars, Fire control radars, Bistatic Radar, Other Advancements in Radar Theory, Hardware Advancements

TEXT BOOKS:

1. Mervin C. Budge, Jr., Shawn R. German -Basic Radar Analysis, Artech House, London, 2015
2. Merrill I. Skolnik-Introduction to Radar Systems- 2nd Ed., McGraw-Hill.

REFERENCE BOOKS:

1. Hamish Meikle- Modern Radar Systems, Second Edition, Artech House, London, 2008.
2. Levanon, N- Radar principles, John Wiley & Sons 1988.
3. Nathanson F E- Radar Design Principle, Scitech Publishing

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M.TECH.- I YEAR- I SEMESTER
MICROWAVE AND RADAR ENGINEERING
ADVANCED ELECTROMAGNETIC ENGINEERING (PE - I)

Course Objectives:

1. To solve electromagnetic field problems using analytical techniques.
2. To know the electrical properties of different materials.
3. To understand the significance the electromagnetic theorems.
4. To know the structure of spherical cavity and propagation of waves.

Course Outcomes: Students will be able to:

1. Utilize the Maxwell's equation in solving Electromagnetic problems.
2. Solve wave equation in time varying and time-harmonic fields
3. Identify the properties of different media and materials.
4. Use cylindrical and spherical cavities for transmission of wave.

UNIT -I

Time -Varying and Time-Harmonic Electromagnetic Fields: Introduction, Maxwell's Equations, constitutive parameters and relations, circuit-Field relations, Boundary conditions, power and Energy, Time-Harmonic Electromagnetic Fields.

Electrical properties of Matter: Dielectrics, Polarization and Permittivity, Magnetics, Magnetization and Permeability, current, conductors and conductivity, semiconductors, superconductors, Metamaterials, Linear, Homogeneous, Isotropic and Nondispersive media, AC variations in Materials.

UNIT -II

Wave Equation and its Solutions: Time-varying Electromagnetic fields, Time-Harmonic Electromagnetic Fields, Solution to the wave equation.

Wave propagation and Polarization: Transverse Electromagnetic modes, Transverse Electromagnetic modes in Lossy Media, Polarization.

UNIT -III

Reflection and Transmission: Normal incidence-lossless media, Oblique Incidence-lossless Media, Lossy media, Reflection and Transmission of Multiple Interfaces, Polarization Characteristics on Reflection.

UNIT -IV

Electromagnetic Theorems and Principles: Duality Theorem, Uniqueness Theorem, Image Theory, Reciprocity Theorem, Reaction Theorem, Volume Equivalence Theorem, Surface Equivalence Theorem, Induction Theorem.

UNIT -V

Spherical Transmission Lines and Cavities: Introduction, Construction of Solutions, Biconical Transmission Lines, Spherical Cavity. **Scattering:** Infinite Line-Source Cylindrical Wave Radiation, Plane Wave Scattering by Planar Surfaces, Cylindrical Wave Transformations and Theorems, Scattering by a Circular Cylinder, Scattering by conducting wedge.

TEXT BOOKS:

1. Constantine A. Balanis - Advanced Engineering Electromagnetics, 2nd Ed., Wiley India Pvt. Ltd., 2012

REFERENCE BOOKS:

1. Harrington, R.F- Time-harmonic Electromagnetic Fields, Wiley-IEEE Press. 2001
2. Ramo S., Whinnery J.R., and Van Duzer T - Fields and Waves in Communication Electronics, 3rd Ed., John Wiley & Sons. 1994
3. Collin, R.E - Foundations for Microwave Engineering, 2nd Ed., John Wiley & Sons, 2000

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M.TECH.- I YEAR- I SEMESTER
MICROWAVE AND RADAR ENGINEERING
MICROWAVE MEASUREMENTS (PE-I)

Course Objectives: To understand and gain knowledge about:

1. Measurement of wave length and Frequency of microwave signals.
2. The use of microwave test bench in analysing various types of microwave measurements.
3. Measurement of microwave power.
4. Measurements on passive microwave components and Network analyzer

Course Outcomes: At the end of the course students will be able to

1. Analyze the functional blocks involved in Microwave Measurements such as test sets, couplers and other components.
2. Know Network Analyser principle, Reflection and Transmission measurements using vector network Analyser.
3. Measure the Antenna radiation pattern, gain, Far-field and Near-field techniques.
4. Prioritize the methods and limitation of different microwave parameters measurement.

UNIT -I

Measurement of wave length and Frequency, equivalent circuit of cavity wave meters. Typical wave meters, Resonant cavities. Methods of frequency measurements-Direct measurement – Interpolation method.

UNIT -II

Measurement of reflection coefficient Low, high, medium VSWR measurements. Standing wave pattern, Slotted line section and its limitation. Impedance measurement techniques. Nodal shift method. Tangent method. Reflectometer.

UNIT -III

Measurement of microwave power: Typical barater elements, thermistor. Bolometer bridge circuits, extending range of bolometer devices, low and high-power measurement techniques.

UNIT -IV

Measurement of attenuation: insertion loss method. Substitution method. Measurement of S-parameters. Network Analyser principle. Reflection and Transmission measurements using vector network Analyser.

UNIT -V

Measurements on passive microwave components. Characteristics of directional coupler. Isolator, Circulator. Antenna Measurements. Measurements of radiation pattern, Antenna gain measurements. Far field and Near field techniques.

TEXT BOOKS:

1. Ginzton, EL- Microwave Measurements, McGraw Hill
2. Sucher & Fox - Microwave Measurements, Vol.I, II, III.

REFERENCE BOOK:

1. Montgemery. Cc., Techniques of Microwave Measurements, Radiation Lab Series

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M.TECH.- I YEAR- I SEMESTER
MICROWAVE AND RADAR ENGINEERING
COMPUTATIONAL TECHNIQUES FOR MICROWAVES (PE-I)

Course Objectives:

1. To give a source of basic information on applied mathematical topics.
2. To Provide an efficient and accurate formulations for electromagnetics applications and their numerical treatment
3. To solve Integral and Differential equations using the method of moments and finite-element procedures
4. To addressed the advanced computational techniques for the solution of partial differential equations and integral equations encountered in electromagnetic boundary value problems.

Course Outcomes: Students will be able to:

1. Hands on source for solution methods and techniques on applied mathematical topics.
2. Apply a Finite Difference Methods to solve different PDE
3. Solve Integral and Differential equations using method of moments and finite-elements analysis.
4. Apply a Finite Difference Time domain methods for different problems.

UNIT -I

Fundamental Concepts: Integral equations vs. differential equations, radiation and edge conditions, modal representation of fields in bounded and unbounded media, Greens functions.

UNIT -II

Finite Difference Methods: Introduction, Finite Difference Schemes, Finite differencing of Parabolic PDE, Finite Differencing of Hyperbolic PDE, Finite differencing of elliptic PDE, Accuracy and stability of Finite Difference Solutions.

UNIT -III

Integral Equations:

Formulation of typical problems integral equations: wire antennas, scattering, apertures in conducting screens and waveguides, discontinuities in waveguides and Microstrip lines

Solution of Integral Equations: General Method of Moments(MoM) for the solution of integro-differential equations, choice of expansion and weighting functions, application of MoM to typical electromagnetic problems.

UNIT -IV

Finite Element Method: Typical finite elements, Solution of two-dimensional Laplace and Poisson's equations, Solution of scalar Helmholtz equation.

UNIT -V

Finite-difference Time-domain Method: Finite difference, finite difference representation of Maxwell's equations and wave equation, numerical dispersion, Yee's finite difference algorithm, stability conditions, absorbing boundary conditions.

TEXT BOOKS:

1. Andrew F. Peterson, Scott L. Ray, Raj Mittra - Computational Methods for Electromagnetics, 1997
2. Collin, R. E.-Field Theory of Guided Waves, 2nd Ed., Wiley-IEEE Press. 1991

REFERENCE BOOKS:

1. Harrington, R. F- Field Computation by Moment Methods, Wiley- IEEE Press. 1993
2. Sadiku, M. N. O - Numerical Techniques in Electromagnetics, 2nd Ed., CRC Press 2001
3. Volakis, J. L., Chatterjee, A. and Kempel, L.C.- Finite Method for Electromagnetics, Wiley IEEE Press. 1998
4. Taflov, A. and Hagness, S.C.- Computational Electrodynamics, 3rd Ed., Artech House.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M.TECH.- I YEAR- I SEMESTER
MICROWAVE AND RADAR ENGINEERING
MICROWAVE SEMICONDUCTOR DEVICES (PE -II)

Course Objectives:

1. To understand Schottky Barrier Diode, IMPATT & TRAPATT diodes: Principles and applications as amplifiers and oscillators.
2. To understand PIN diodes working principle and its applications as Switches, limiters, phase shifters and modulators.
3. To analyse Avalanche Transit-Time Devices and its applications in microwave amplifiers and oscillators.
4. To understand operating characteristics of MISFETs , MESFETs GaAs FETs and BJTs and their applications.

Course Outcomes: After successfully completing the course students will be able to

1. Utilize Microwave solid state devices (Tunnel Diode, PIN Diode, Schottky Barrier Diode etc.)
2. Choose a suitable microwave solid state device for a particular application.
3. Recognize the importance of Microwave semiconductor devices in microwave amplifiers, oscillators, switches, limiters, phase shifters and modulators.

UNIT -I

Transient and ac behavior of p-n junctions, effect of doping profile on the capacitance of p-n junctions, noise in p-n junctions, high-frequency equivalent circuit.
Varactor diode: Equivalent circuit, static and dynamic figures of merit, Manley Rowe power relation, Parametric amplifiers. Up converter, Degeneration amplifiers, Varactor multipliers. Charge storage capacitance.

UNIT -II

Tunnel diode: equivalent circuit, Tunnel diode stability, Tunnel diode amplifiers.
Gunn devices: Volt amp. Characteristics, Small signal, Nonlinear, large signal theory, Modes of operation of Gunn diode, Gunn amplifiers-Gunn oscillators.
Avalanche transit time MW diodes, Small signal theory, Large signal operation, Noise.

UNIT -III

PIN diodes**:** Description, the I-layer, Equivalent circuit behavior under reverse bias and forward bias, Diode impedance, Materials, Applications - Switches, limiters, phase shifters and modulators.

UNIT -IV

Schottky Barrier Diode: Physics of Schottky barriers, Design of and performance of Schottky barrier diode, applications. IMPATT & TRAPATT diodes: Principles and applications as amplifiers and oscillators.

UNIT -V

High frequency limitations of BJT, microwave bipolar transistors, heterojunction bipolar transistors, GaAs FETs, low noise and power GaAs FETs and their applications, DC biasing and impedance matching, Microwave transistor 'S' parameters, Operating characteristics of MISFETs and MESFETs, short-channel effects, high electron mobility transistor.

TEXT BOOKS:

1. S.Y. Liao-Microwave Devices and Circuits, 3rd, Prentice Hall.
2. Watson-Microwave Semiconductor Devices and their applications, McGraw Hill, 1969.

REFERENCE BOOKS:

1. Sze, S.M., and Ng, K.K.-Physics of Semiconductor Dev ices, 3rd Ed., wiley-Interscience, 2006.
2. Golio, M.-RF and Microwave Semiconductor devices Handbook- CRC Press (2002).

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M.TECH.- I YEAR- I SEMESTER
MICROWAVE AND RADAR ENGINEERING
SATELLITE RADIO NAVIGATION (PE -II)

Course Objectives:

1. To explain the basic principle of GPS and its operation.
2. To make the students to understand signal structure, errors, coordinate systems
3. To make the students understand the GPS navigation and observation files and compute the position.
4. Highlight the importance of integrating GPS with other systems.
5. To demonstrate the principle of DGPS and to facilitate the various augmentation systems.

Course Outcomes: Student will be able to:

1. Frame various coordinate systems for estimating position.
2. Estimate the various errors and their effect on position estimation.
3. Use GPS in various fields such as navigation, GIS etc.
4. Apply DGPS principle and can also analyze various augmentation systems.

UNIT -I

GPS fundamentals: INS, Trilaiteration, Hyperbolic navigation, Transit, History of GPS, GPS principle of operation, architecture, operating frequencies, orbits, Keplerian element, Solar and Siderial days, GPS and UTC Time, basic steps involved in Satellite position determination.

UNIT -II

GPS Signals: Signal structure, C/A and P-Code, SPS and PPS services, Need of Coordinate system, Earth Centered Inertial (ECI), Earth Centered Earth Fixed (ECEF) coordinate systems and WGS 84 and Types of GPS Receivers, link budget, Selective availability

UNIT -III

GPS Errors: Ionospheric error, Tropospheric error, Ephemeris error, Clock errors, Satellite and receiver instrumental biases, multipath, Various DOPs, Spoofing and Anti-spoofing; GPS Modernization: New Signals, New Satellites and Control Segment: their benefits, Klobuchar model.

UNIT -IV

GPS data processing, DGPS and Applications: RINEX Navigation and Observation data formats, Ambiguity resolution, cycle slips, Position estimation, Principle of operation of DGPS, architecture and errors, Applications of GNSS.

UNIT -V

Other Constellations and Augmentation systems: Other satellite navigation constellations: GLONASS, GALILEO, NavIC, QZSS, BEIDOU, Comparison of various satellite navigation constellations, Types of augmentation systems, Wide area augmentation system (WAAS) architecture, GPS Aided GEO Augmented Navigation (GAGAN), Ground Based Augmentation System (GBAS): Local Area Augmentation System (LAAS) concept, Relative advantages of SBAS and GBAS.

TEXT BOOKS:

1. B. Hofmann Wollenhof, H. Lichtenegger, and J. Collins - GPS Theory and Practice, Springer Wien, New York, 2000.
2. Pratap Misra and Per Enge, - Global Positioning System Signals, Measurements, and Performance, Ganga-Jamuna Press, Massachusetts, 2001.

REFERENCE BOOKS

1. Ahmed El-Rabbany, - Introduction to GPS, Artech House, Boston, 2002.
2. Bradford W. Parkinson and James J. Spilker -Global Positioning System: Theory and Applications, Volume II, American Institute of Aeronautics and Astronautics, Inc., Washington, 1996.
3. Elliot D. Kaplan -Understanding GPS Principles and Applications, Artech House Boston, 1996.
4. A. Leick - GPS Satellite Surveying, John Wiley and sons, 1990.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M.TECH.- I YEAR- I SEMESTER
MICROWAVE AND RADAR ENGINEERING
OPTICAL COMMUNICATIONS AND NETWORKS (PE-II)

Course Objectives:

1. To know the basic geometric structures of Optical fibres, Light laws, Soliton pulses, modes of operation and losses in fibres.
2. To know the physical principles of optical sources, optical detectors and WDM.
3. To understand and design the analog and digital optical links, the noise effects and error control techniques.
4. To understand the working of various optical components and optical networks.

Course Outcomes: By the end of this course, the student will be able to

1. Analyze and design the optical links for different applications.
2. Know the working of WDM systems and various optical components for different applications.
3. Choose the optical networks for various applications.

UNIT -I

Optical Fibres: Overview of Optical fibre communications, Elements of an Optical fibre transmission Link, Nature of light, Basic optical laws and definitions, Modes and configurations, Single & Multi mode step index and Graded index Fibres , Fibre materials.

Signal degradation in Optical Fibres: Attenuation, Signal Distortion in Optical Waveguides Dispersion, Pulse broadening in graded index fibres, Mode coupling, Design optimization of single mode Fibres.

UNIT -II

Optical Sources: Semiconductors physics, LEDs and Laser diodes, Linearity of sources, Modal, Partition and reflection noise.

Photodetectors: Physical principles of PIN and APD, Photo detector noise, detector response time, Avalanche multiplication noise, Temperature effect on avalanche gain, Comparison of Photo detectors.

UNIT -III

Optical Receiver Operation: Fundamental Receiver operation, Digital receiver performance calculations, Preamplifiers types, Analog receivers.

Digital Transmission Systems: Point to point links, Line coding, Error correction, Noise effects on system performance, Overview of Analog links, Carrier-to-noise ratio.

UNIT -IV

WDM: Concepts and components, Operational principles of WDM, Passive components, Tunable sources, Tunable filters, Introduction of optical amplifiers, Soliton Pulses.

Optical Communication System: System description and design considerations of an optical fibre communication system, noise in detection process, power budgeting, rise time budgeting, maximum transmission distance.

UNIT -V

Optical Networks: Basic Networks, SONET/SDH, Broadcast and select WDM networks, Wavelength Routed Networks, Nonlinear effects on Network Performance, Performance of EDFA+WDM systems, Optical CDMA, Ultrahigh capacity Networks.

TEXT BOOKS

1. Djafar K. mynbaev Lowell l. Scheiner - Fibre Optic Communications Technology, Pearson Education Asia, 2006.
2. Senior John M. - Optical Fibre Communications Principles and Practice, Prentice Hall India, second edition, 1996.

REFERENCE BOOKS

1. Keiser Gerd - Optical Fibre Communications", Mc Graw Hill, Third edition, 1991.
2. Ghatak, A. and Thyagarajan, K.-Introduction to Fiber Optics, Cambridge University Press. 1999
3. Cheo, P.K- Fiber Optics and Optoelectronics, 2nd Ed., Prentice-Hall. 1990
4. Snyder, A.W. and Love, J.D - Optical Waveguide Theory, Chapman & Hall. 1983.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M.TECH.- I YEAR- I SEMESTER
MICROWAVE AND RADAR ENGINEERING
MICROWAVE CIRCUITS AND SYSTEMS LABORATORY (LAB -I)

List of Experiments:

1. Radio-Frequency Characteristics of Components
2. Design of Amplifier at Microwave frequencies
3. Design Low Noise Amplifier
4. Measurement of frequency of microwave signal
5. Measurement of S-matrix of Microwave components
6. Coupling mechanisms of Microwave devices
7. Design a RF band pass filter
8. Measurement of characteristics of Microstrip circulator
9. Matched loads at Microwave frequencies
10. Characteristics of different junctions at Microwave frequencies.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M.TECH.- I YEAR- I SEMESTER
MICROWAVE AND RADAR ENGINEERING
SIMULATION LABORATORY (LAB -II)

List of Experiments:

Use any Microwave simulator software (MATLAB, Computer-Aided Design lab5.mdl etc.,)

1. Microstrip Transmission Lines – Characteristics
2. Characteristics of Microwave Transistor
3. Matching Network Design and circuit layout
4. Amplifier Design for Maximum Power Transfer
5. Amplifier Nonlinear Performance and Intermodulation
5. Resistive Mixer Design using Diode.
6. Detection of RF Power and Development of a Scalar Reflectometer
7. Design a RF Low Pass, High Pass and Band Pass filters
8. Characteristics of Microstrip circulator
9. Design of tunner to detect Microwave signal
10. S parameter simulation for different components

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M.TECH.- I YEAR- I SEMESTER
MICROWAVE AND RADAR ENGINEERING
RESEARCH METHODOLOGY AND IPR

Course Objectives:

- To understand the research problem
- To know the literature studies, plagiarism and ethics
- To get the knowledge about technical writing
- To analyze the nature of intellectual property rights and new developments
- To know the patent rights

Course Outcomes: At the end of this course, students will be able to

- Understand research problem formulation.
- Analyze research related information
- Follow research ethics
- Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
- Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
- Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

UNIT- I:

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem.
Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

UNIT- II:

Effective literature studies approaches, analysis, Plagiarism, Research ethics

UNIT- III:

Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

UNIT- IV:

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT- V:

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

TEXT BOOKS:

1. Stuart Melville and Wayne Goddard, “Research methodology: an introduction for science & engineering students’”
2. Wayne Goddard and Stuart Melville, “Research Methodology: An Introduction”

REFERENCE BOOKS:

1. Ranjit Kumar, 2nd Edition, “Research Methodology: A Step by Step Guide for beginners”
2. Halbert, “Resisting Intellectual Property”, Taylor & Francis Ltd ,2007.
3. Mayall, “Industrial Design”, McGraw Hill, 1992.
4. Niebel, “Product Design”, McGraw Hill, 1974.
5. Asimov, “Introduction to Design”, Prentice Hall, 1962.
6. Robert P. Merges, Peter S. Menell, Mark A. Lemley, “Intellectual Property in New Technological Age”, 2016.
7. T. Ramappa, “Intellectual Property Rights Under WTO”, S. Chand, 2008

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M.TECH.- I YEAR- II SEMESTER
MICROWAVE AND RADAR ENGINEERING
MICROWAVE ANTENNAS (PC -III)

Course Objectives:

1. To familiarize the basic concepts of antenna parameters and radiation mechanism.
2. To analyze aperture antennas with the knowledge of various theorems.
3. To study the principles of frequency independent antenna design.
4. To understand, analyze and synthesize array antennas and also know the concepts of smart antennas.

Course Outcomes: By the end of this course, the student will be able to:

1. Analyze the different types of antennas with the help of basic antenna fundamentals.
2. Utilize the various microwave antennas by understanding the principle of working of it.
3. Apply the knowledge in the design of various microwave aperture antennas.
4. Acquire basic knowledge of smart antenna design.

UNIT -I

Fundamental parameters and definitions for antennas, Theories of radiation, Image theory, Schelkunoff's equivalence theorem, Huygens' principle, Babinet's principle.

UNIT -II

Radiation from rectangular and circular apertures, design considerations, Fourier transform method in aperture antenna theory. Broadband antenna concept, Log periodic antennas, Frequency independent antennas.

UNIT -III

Linear arrays: Uniform and Non-uniform amplitude distribution, Planar arrays, Synthesis of antenna arrays using Schelkunoff polynomial method, Fourier transform method and Woodward-Lawson method.

UNIT -IV

Printed antennas: Rectangular and circular patch antenna design, Feeding techniques for micro strip antennas, Methods of analysis, Printed antenna arrays, Bandwidth enhancement techniques, Compact and Tunable microstrip antenna.

UNIT -V

Concept and benefits of smart antennas, Types of smart antennas, Beam forming techniques, Smart antenna methods, Algorithms.

TEXT BOOKS:

1. Constantine Balanis- Modern Antenna Handbook, John wiley, 2008.
2. Stutzman, W.L. and Thiele, H.A- Antenna Theory and Design", 2nd Ed., John Wiley & Sons

REFERENCE BOOKS:

1. Bahl I J, and Bhartia - Microstrip Antennas, Artech House, 1982.
2. D. G. Fang, Antenna Theory and Microstrip Antennas, CRC press 2010.
3. James. JR. Hall PS. wood.C -Micro strip Antenna-Theory and Design, Peter Peregrinu. 1981.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M.TECH.- I YEAR- II SEMESTER
MICROWAVE AND RADAR ENGINEERING
ADVANCED COMMUNICATIONS AND NETWORKS (PC -IV)

Course Objectives:

1. To understand of some fundamental techniques used to model and analyze communication networks.
2. To gain knowledge in communications and networks
3. To understand the principles of OFDM and MIMO communication system.

Course Outcomes: Students will be able to:

1. Develop a model and analyze communication networks
2. Demonstrate OFDM and MIMO Communication System
3. Critically analyze the function, properties and application of emerging communication systems and networks
4. Know the different IEEE LAN standards.

UNIT - I

Spread Spectrum Communications: Spreading sequences- Properties of Spreading Sequences, Pseudo- noise sequence, Gold sequences, Kasami sequences, Walsh Sequences, Orthogonal Variable Spreading Factor Sequences, Barker Sequence, Complementary Codes

Direct sequence spread spectrum: DS-CDMA Model, Conventional receiver, Rake Receiver, Synchronization in CDMA, Power Control, Soft handoff, Multiuser detection – Optimum multiuser detector, Liner multiuser detection.

UNIT - II

Orthogonal Frequency Division Multiplexing: Basic Principles of Orthogonality, Single vs Multicarrier Systems, OFDM Block Diagram and Its Explanation, OFDM Signal Mathematical Representation, Selection parameter for Modulation, Pulse shaping in OFDM Signal and Spectral Efficiency, Window in OFDM Signal and Spectrum, Synchronization in OFDM, Pilot Insert in OFDM Transmission and Channel Estimation, Amplitude Limitations in OFDM, FFT Point Selection Constraints in OFDM, CDMA vs OFDM, Hybrid OFDM.

UNIT - III

MIMO Systems: Introduction, Space Diversity and System Based on Space Diversity, Smart Antenna system and MIMO, MIMO Based System Architecture, MIMO Exploits Multipath, Space – Time Processing, Antenna Consideration for MIMO, MIMO Channel Modelling, MIMO Channel Measurement, MIMO Channel Capacity, Cyclic Delay Diversity (CDD), Space Time Coding, Advantages and Applications of MIMO in Present Context, MIMO Applications in 3G Wireless System and Beyond, MIMO-OFDM

UNIT - IV

Wireless LANs/IEEE 802.11x: Introduction to IEEE802.11x Technologies, Evolution of wireless LANs, IEEE 802.11 Design Issues, IEEE 802.11 Services, IEEE 802.11 MAC Layer operations, IEEE 802.11 Layer1, IEEE 802.11 a/b/g Higher Rate Standards, Wireless LAN Security, Computing Wireless Technologies, Typical WLAN Hardware

UNIT - V

Wireless PANs/IEEE 802.15x: Introduction to IEEE 802.15x Technologies: Wireless PAN Applications and Architecture, IEEE 802.15.1 Physical Layer Details, Bluetooth Link Controllers Basics, Bluetooth

Link Controllers Operational States, IEEE 802.15.1 Protocols and Host Control Interface. Evaluation of IEEE 802.15 Standards

Broad Band Wireless MANs/IEEE 802.16x: Introduction to WMAN/IEEE 802.16x Technology, IEEE 802.16Wireless MANs, IEEE 802.16 MAC Layer Details, IEEE 802.16 Physical Layer Details, IEEE 802.16 Physical Layer Details for 2-11 GHz, IEEE 802.16 Common System Operations.

TEXT BOOKS:

1. Gary J. Mullett-Introduction to Wireless Telecommunications Systems and Networks, CENGAGE
2. Upena Dalal -Wireless Communication, Oxford University Press, 2009

REFERENCE BOOKS:

1. Ke-Lin Du & M N S Swamy-Wireless Communication System, Cambridge University Press, 2010
2. Gottapu Sasibhusan Rao-Mobile Cellular Communication, PEARSON

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M.TECH.- I YEAR- II SEMESTER
MICROWAVE AND RADAR ENGINEERING
COGNITIVE RADIO SYSTEMS (PE -III)

Course Objectives:

1. To understand the concepts of Cognitive Radio
2. To know the knowledge of Spectrum sensing
3. To manage the resources of spread spectrum communication system

Course Outcomes: At the end of this course, students will be able to:

1. Design a cognitive radio networks with understanding of spectrum sensing.
2. Develop the cognitive radio, as well as techniques for spectrum holes detection that cognitive radio takes advantages in order to exploit it.
3. Use efficiently TVWS for radio communications based on two spectrum sharing business models/policies.
4. Manage the radio-resources as well as a number of optimization techniques for better spectrum exploitation.

UNIT -I

Introduction to Cognitive Radios: Digital dividend, cognitive radio (CR) architecture, functions of cognitive radio, dynamic spectrum access (DSA), components of cognitive radio, spectrum sensing, spectrum analysis and decision, potential applications of cognitive radio.

UNIT -II

Spectrum Sensing: Spectrum sensing, detection of spectrum holes (TVWS), collaborative sensing, geo-location database and spectrum sharing business models (spectrum of commons, real time secondary spectrum market).

UNIT -III

Optimization Techniques of Dynamic Spectrum Allocation: Linear programming, convex programming, non-linear programming, integer programming, dynamic programming, stochastic programming.

UNIT -IV

Dynamic Spectrum Access and Management: Spectrum broker, cognitive radio architectures, centralized dynamic spectrum access, distributed dynamic spectrum access, learning algorithms and protocols.

UNIT -V

Spectrum Trading: Introduction to spectrum trading, classification to spectrum trading, radio resource pricing, brief discussion on economics theories in DSA (utility, auction theory), classification of auctions (single auctions, double auctions, concurrent, sequential). Research Challenges in Cognitive Radio: Network layer and transport layer issues, cross layer design for cognitive radio networks.

TEXT BOOKS

1. Ekram Hossain, Dusit Niyato, Zhu Han - Dynamic Spectrum Access and Management in Cognitive Radio Networks, Cambridge University Press, 2009.
2. Kwang-Cheng Chen, Ramjee Prasad - Cognitive radio networks, John Wiley & Sons Ltd., 2009.

REFERENCE BOOKS

1. Bruce Fette, - Cognitive radio technology, Elsevier, 2nd Ed., 2009.

2. Huseyin Arslan – Cognitive Radio, Software Defined Radio, and Adaptive Wireless Systems, Springer, 2007.
3. Francisco Rodrigo Porto Cavalcanti, Soren Andersson - Optimizing Wireless Communication Systems, Springer, 2009.
4. Linda Doyle - Essentials of Cognitive Radio, Cambridge University Press, 2009.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M.TECH.- I YEAR- II SEMESTER
MICROWAVE AND RADAR ENGINEERING
PHASED ARRAY RADAR (PE -III)

Course Objectives:

1. To understand the principle of electronic scanning and its application to a phased-array radar system.
2. To understand the concepts of cell, grid and feeding techniques.
3. To familiarize with the design of frequency scanned array and concepts of beam positioning.

Course Outcomes: At the end of this course, students will be able to

1. Analyze the basic concepts of radar beam steering and determine the direction of a resultant beam.
2. Apply the electronically scanned system in different applications
3. Use the phase shifters and feed networks in the frequency scanned array design.

UNIT -I

Conventional scanning techniques, Mechanical versus electronic scanning, Techniques of Electronic scanning, Frequency, Phase and time delay scanning principle, Hybrid scanning techniques.

UNIT -II

Array Theory, Linear and Planner arrays, various grid configuration, Concept of cell and grid, Calculation of minimum number of elements, Radiation pattern, Grating lobe formation, Rectangular and triangular grid design of arrays.

UNIT -III

Feed Networks for phased Arrays, Corporate Feed, Lens and Reflect feed Techniques, Optimum f/d ratio basic building block for corporate feed network, Series, Parallel feed networks, Comparison of various feeding techniques, Antenna Array Architecture, Brick/ Tile Type construction.

UNIT -IV

Frequency scanned array design, Snake feed, Frequency-phase scanning, Phase scanning, Digital phase shifter PIN diode and Ferrite phase shifters for phased arrays, Beam pointing errors due to digitalization, Beam pointing accuracy.

UNIT -V

Search patterns, Calculation of search frame time, Airborne phased array design, Electronic scanning radar parameter calculation, Application of phased arrays, Phased Array Radar Systems, Active Phased Array, TR/ATR Modules.

TEXT BOOKS:

1. Olliner & knittel- Phased Array Radar, Artech House, 1972.
2. Kahrilas, PJ - Electronic Scanning Radar Systems Design Handbook, Artech House, 1976.

REFERENCE BOOKS:

1. Skolnik, MI - Radar Handbook, McGraw Hill, NY, 1970.
2. Hansen, RC - Significant Phased Array Papers.
3. Galati, G -Advanced Radar Technique and Systems, Peter Peregrims Ltd, London, 1993.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M.TECH.- I YEAR- II SEMESTER
MICROWAVE AND RADAR ENGINEERING
RF RECEIVER DESIGN (PE -III)

Course Objectives:

1. To present overview of the fundamental concepts required for the design and analysis of RF stages of a modern wireless system.
2. To provide knowledge in design concepts of various stages of RF receiver
3. To know the noise reduction methods in RF receivers.

Course Outcomes: Students will be able to:

1. Choose proper operating frequencies for wireless communication systems
2. Design noise reduction methods for wireless communication systems
3. Design a Microwave amplifier, Mixer circuits, Switches etc.,

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.

TEXT BOOKS

1. Pozar, D.M.-Microwave and RF Design of Wireless Systems, John Wiley & Sons. 2001
2. Gonzalez, G., “Microwave Transistor Amplifiers: Analysis and Design”, 2nd Ed., Prentice-Hall. 1997

REFERENCE BOOKS:

1. Bahl, I. and Bhartia, P.- Microwave Solid State Circuit Design, 2nd Ed., John Wiley & Sons. 2003
2. Chang, K., Bahl, I. and Nair, V. - RF and Microwave Circuit and Component Design for Wireless Systems", Wiley Interscience. 2002
3. Rohde, U.L. and Newkirk, D.P.- RF/Microwave Circuit Design for Wireless Applications, John Wiley & Sons. 2000
4. Larson, L.E. - RF and Microwave Circuit Design for Wireless Applications, Artech House. 1996

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M.TECH.- I YEAR- II SEMESTER
MICROWAVE AND RADAR ENGINEERING
RADAR SIGNAL PROCESSING (PE -IV)

Course Objectives:

1. To review the Radar fundamentals
2. To know the sampling criteria of Pulsed radar signals
3. To learn various radars like MTI, Doppler and tracking radars and their comparison
4. To analysis the radar signals using ambiguity function.
5. To understand various technologies involved in the design of radar transmitters and receivers.

Course Outcomes: Students will be able to:

1. Know how a radar is built and understand the principles of behavior
2. Estimate the performance of a radar based on parameters provided
3. Know what type of radar is suitable for which task (choice of waveforms, frequency bands, etc.
4. Use numerical tools to calculate radar performance and to simulate the signal processing in a radar.

UNIT – I

A Preview of Basic Radar Signal Processing, Radar Literature, Signal Models, components of a Radar Signal, Amplitude Models, clutter, Noise Model and Signal -to -Noise Ratio, 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

Radar waveforms: Waveform Matched filter, Matched filter for Moving Targets, Radar Ambiguity Function and Ambiguity Diagram-Principles and Properties, Specific Cases – Ideal Case, Single Pulse of Sine Wave, Periodic Pulse Train, Single Linear FM Pulse

UNIT – IV

Doppler Processing, Alternate Forms of the Doppler Spectrum, Moving Target Indication (MTI), Pulse Doppler Processing, Pulse Pair Processing, Additional Doppler Processing Issues, Clutter Mapping and the Moving Target Detector, MTI for moving platforms

UNIT – V

Pulse Compression in Radar Signals: Introduction, Significance, Types, Frequency Modulated Pulse compression wave forms, Range side lobe control for FM waveforms, Phase modulated pulse compression wave forms, Costas Frequency codes

TEXT BOOKS:

1. Mark A. Richards - Fundamentals of Radar Signal Processing, McGraw Hill
2. M.I. Skolnik -Introduction to Radar Systems, 3rd Edition, 2001, TMH.

REFERENCE BOOKS

1. R. Nitzberg - Radar Signal Processing and Adaptive Systems, 1999, Artech House.
2. F.E. Nathanson - Radar Design Principles, 1st Ed., 1969, McGraw Hill.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M.TECH.- I YEAR- II SEMESTER
MICROWAVE AND RADAR ENGINEERING
ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY (PE -IV)

Course Objectives:

1. To study the electromagnetic interference control techniques.
2. To learn electromagnetic compatibility issues with regard to the design of PCBS.
3. To discuss electromagnetic interference measurements and standards.
4. To instil knowledge on the EMI coupling mechanism and its mitigation techniques.
5. To impart comprehensive insight about the current EMC standards and about various measurement techniques.

Course Outcomes: After completion of the course students will be able to:

1. Find solution to EMI Sources, EMI problems in PCB level design
2. Find solution to EMI Sources, EMI problem in Subsystem and system level design.
3. Measure emission immunity level from different systems to couple with the prescribed EMC standards.

UNIT - I

Introduction and History of EMI-EMC, Sources & effects of EMI, Intersystem & Intrasystem, Electromagnetic Environment Effects (E3), Common EMI measurement units. Time domain & frequency domain representation of periodic, non-periodic and digital waveforms.

UNIT - II

Conducted Emission & Susceptibility, Radiated Emission & Susceptibility, ESD, Introduction of Commercial & Military EMI Standards, Measurement of EMI, Shielded Enclosure, Antennas, Probes Equipment & Accessories used in EMI measurement.

UNIT - III

EMI Mitigation Techniques, Grounding, Shielding, Filtering & Bonding, EMI Suppression Components like EMI Filters (DC/AC), RFI Filters, EMI Gaskets, RF absorbing material, Transient Voltage Suppressors, Honey-comb vents etc., Cables, Connectors.

UNIT - IV

Sub-system and System level EMC, EMC Design of analog and digital Sub-systems, Mixed Signal PCB layout for better EMC, Analog and Digital grounds, EMC of A/D & D/A Converters, EMC of DC-DC Converters and Power Supplies, EMC Design Guidelines , Introduction to Signal Integrity.

UNIT - V

Introduction to Numerical EMI & EMC Simulation Techniques, Survey of Commercially available EMC Software, Introduction to Intentional EMI, EMP, Electromagnetic Weapons.

TEXT BOOK:

1. Clayton R. Paul **-** Introduction to Electromagnetic Compatibility**,** Wiley Publication.

REFERENCE BOOKS:

1. Dr. V.P. Kodali - Engineering Electromagnetic Compatibility, IEEE Press, 1996.
2. Henry W. Ott - Electromagnetic Compatibility Engineering**,** Wiley Publication**.**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M.TECH.- I YEAR- II SEMESTER
MICROWAVE AND RADAR ENGINEERING
ARM MICROCONTROLLERS (PE -IV)

Prerequisite: Microprocessors and Microcontrollers

Course Objectives:

1. Explore the architecture and instruction set of ARM processor.
2. To provide a comprehensive understanding of various programs of ARM Processors.
3. Learn the programming on ARM Cortex M.

Course Outcomes: After completing this course the student will be able to:

1. Explore the selection criteria of ARM processors by understanding the functional level trade off issues.
2. Explore the ARM development towards the functional capabilities.
3. Work with ASM level program using the instruction set.
4. Programming the ARM Cortex M.

UNIT - I

ARM Embedded Systems: RISC design philosophy, ARM design philosophy, Embedded system hardware, Embedded system software.

ARM Processor Fundamentals: Registers, Current Program Status Register, Pipeline, Exceptions, Interrupts and Vector Table, Core Extensions, Architecture Revisions, ARM Processor Families.

Architecture of ARM Processors: Introduction to the architecture, Programmer's model- operation modes and states, registers, special registers, floating point registers, Behaviour of the application program status register(APSR)-Integer status flags, Q status flag, GE bits, Memory system-Memory system features, memory map, stack memory, memory protection unit (MPU), Exceptions and Interrupts-what are exceptions, nested vectored interrupt controller(NVIC), vector table, Fault handling, System control block (SCB), Debug, Reset and reset sequence.

UNIT - II

Introduction to the Arm Instruction Set: Data processing instructions, branch instructions, load-store instructions, software interrupt instructions, program status register instructions, loading constants, ARMv5E extensions, Conditional execution.

Introduction to the Thumb Instruction Set: Thumb Register Usage, ARM-Thumb Interworking, Other Branch Instructions, Data Processing Instructions, Single-Register Load-Store Instructions, Multiple-Register Load-Store Instructions, Stack Instructions, Software Interrupt Instruction.

UNIT - III

Technical Details of ARM Cortex M Processors General information about Cortex-M3 and cortex M4 processors-Processor type, processor architecture, instruction set, block diagram, memory system, interrupt and exception support, Features of the cortex-M3 and Cortex-M4 Processors- Performance, code density, low power, memory system, memory protection unit, interrupt handling, OS support and system level features, Cortex-M4 specific features, Ease of use, Debug support, Scalability, Compatibility.

UNIT - IV

Instruction SET of ARM Cortex M Background to the instruction set in ARM Cortex-M Processors, Comparison of the instruction set in ARM Cortex-M Processors, understanding the assembly language syntax, Use of a suffix in instructions, Unified assembly Language (UAL), Instruction set, Cortex-M4-specific instructions, Barrel shifter, Accessing special instructions and special registers in Programming.

UNIT -V

Floating Point Operations About Floating Point Data,Cortex-M4 Floating Point Unit (FPU)- overview, FP registers overview, CPACR register, Floating point register bank, FPSCR, FPU->FPCCR, FPU-> FPCAR, FPU->FPDSCR, FPU->MVFR0, FPU->MVFR1. ARM Cortex-M4 and DSP Applications: DSP on a microcontroller, Dot Product example, writing optimized DSP code for the CortexM4-Biquad filter, Fast Fourier transform, FIR filter.

TEXT BOOKS:

1. Andrew N. SLOSS, Dominic SYMES, Chris WRIGHT- ARM System Developer's Guide Designing and Optimizing System Software, Elsevier Publications, 2004.
2. Joseph Yiu, The Definitive Guide to ARM Cortex-M3 and Cortex-M4 Processors by Elsevier Publications, 3rd Ed.,

REFERENCE BOOKS:

1. Steve Furber - Arm System on Chip Architectures –Edison Wesley, 2000.
2. David Seal - ARM Architecture Reference Manual, Edison Wesley, 2000.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M.TECH.- I YEAR- II SEMESTER
MICROWAVE AND RADAR ENGINEERING
MICROWAVE ANTENNA DESIGN LAB (LAB -III)

SECTION –A

Design and testing of microwave Antennas operations:

1. Pyramidal Horn- Antenna
2. Conical Horn –Antenna
3. Rectangular Microstrip patch Antenna
4. Circular Microstrip patch Antenna
5. Microstrip Monopole Antenna.

SECTION –B

Software Simulation (using HFSS/IE3D/FEKO or Equivalent) and Testing of:

1. Rectangular Microstrip Antenna, Circular Microstrip antenna.
2. Micro strip Monopole
3. Microstrip Tee
4. Cylindrical Horn antenna, Pyramidal Horn antenna
5. Microstrip Filters
6. Microstrip power Dividers, Passive Components
7. Radar Signals

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M.TECH.- I YEAR- II SEMESTER
MICROWAVE AND RADAR ENGINEERING
ADVANCED COMMUNICATIONS AND NETWORKS LAB (LAB-IV)

Note: Below experiments are to be performed using MATLAB

List of Experiments:

1. Implementation of Matched Filters.
2. Optimum receiver for the AWGN channel.
3. Design FIR (LP/HP/BP) filter using Window method.
4. Measurement of effect of Inter Symbol Interference.
5. Generation of constant envelope PSK signal wave form for different values of M.
6. Simulation of PSK system with M=4
7. Simulation of DPSK system with M=4
8. Design of FSK system
9. Simulation of correlation type demodulation for FSK signal
10. BPSK Modulation and Demodulation techniques
11. QPSK Modulation and Demodulation techniques
12. DQPSK Modulation and Demodulation techniques
13. 8-QAM Modulation and Demodulation techniques
14. DQAM Modulation and Demodulation techniques
15. Verification of Decimation and Interpolation of a given signal
16. Power spectrum estimation using AR models

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M.TECH.- II YEAR- III SEMESTER
MICROWAVE AND RADAR ENGINEERING
RF MEMS (PE -V)

Course Objectives:

1. To understand the MEMS based technologies in Microwave and millimeter system.
2. To known the use of RF switches, tunable capacitors and micro inductors
3. To understand the principle of Phase shifters, Micromechanical filters.

Course Outcomes: Students will be able to:

1. Known high precision technologies for which micromachining offers a vible route
2. Utilize the RF switches, tunable capacitors and micro inductors.
3. Design a MEMS based Phase shifters, Micromechanical filters
4. Choose Proper Micromachined antennae.

UNIT- I

Microelectromechanical systems (MEMS) and Radio Frequency MEMS: Introduction, Microfabrications for MEMS, Electromechanical transducers, Microsensing for MEMS, Materials for MEMS

MEMS material: Thin films for MEMS and their deposition techniques, Materials for polymer MEMS

UNIT -II

RF MEMS switches and Micro relays: Switch parameters, Basics of switching, Switches for RF and Microwave Applications, Actuation mechanisms for MEMS devices, Bistable micro relays and microactuators, Dynamics of the switch operation, MEMS switch design, modeling and evaluation, MEMS switch design considerations, MEMS inductors, MEMS capacitors.

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UNIT - III

Micromachined RF filters: Modeling of mechanical filters, Micromechanical filters, Surface acoustic wave filters, Bulk acoustic wave filters, Micromachined filters for millimeter wave frequencies

Micromachined Phase Shifters: Types and limitations, MEMS phase shifters, Ferroelectric Phase Shifters.

UNIT- IV

Micromachined transmission lines and components: Micromachined transmission lines, Design, fabrication and measurement

Micromachined antennae: Overview of Microstrip antennae, Micromachining techniques to improve antenna performance, Micromachining as a fabrication process for small antennae, Micromachined reconfigurable antennae.

UNIT- V

Integration and packaging for RF MEMS devices: Role of MEMs packages, types of MEMS packages, Flip-flop assembly, Multichip module packaging, RF MEMS packaging., Thermal issues.

TEXT BOOK:

1. Vijay K. Varadan, K.J. Vinoy, K.A.Jose - RF MEMS and Their Applications, John Wiley & Sons

REFERENCE BOOKS:

1. Rebeiz, G.M. -MEMS: Theory Design and Technology, John Wiley & Sons.2002
2. De Los Santos, H.J.-RF MEMS circuit Design for Wireless Communications, Artech House, 1999
3. An introduction to MEMS, PRIME Faraday Partnership, Loughborough University 2002

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M.TECH.- II YEAR- III SEMESTER
MICROWAVE AND RADAR ENGINEERING
5G AND BEYOND COMMUNICATIONS (PE -V)

Course Objectives:
1. To understand the principles of MIMO Communications
2. To provide exposure to advanced research topics in the field of Beyond 5G/6G wireless systems
3. To know the various requirements beyond 2020 communications

Course Outcomes: Students will be able to:
1. Design MIMO Communication system
2. Utilize the Mobile Wireless Technology Generations
3. Know the propagation of mm waves
4. Face the challenges of beyond 2020 wireless communication

UNIT - I
Multiple Input Multiple Output (MIMO) Communications:
Spatial Multiplexing, Spatial Diversity, Beamforming in MIMO systems, Hybrid Precoding, 5G Communication Landscape, Related work on 5G.

UNIT- II
Introduction to Mobile Wireless Technology Generations:
5G, WISDOM, GIMVC, Requirements of 5G, standardization of WISDOM, Vision of 5G, WISDOM Concept and Challenges, Cellular D2D Communication, D2D Using Physical Layer Network Coding, Using FFR and Using Cognitive Radio.
SMNAT: Introduction, Network Architecture and the Process, Implementation of SMNAT for In-Band-D2D and Interoperability with WISDOM, Description of Network elements of SMNAT and Call Flow for Session Establishment.

UNIT - III
Radio Wave Propagation for Mm Wave:
Introduction, Large-scale Propagation Channel Effects, Small-Scale Channel Effects, Spatial Characterization of Multipath and Beam Combing, Outdoor Channel Models, Indoor Channel Models.

UNIT- IV
Higher layer Design Considerations for Mm Wave:
Challenges when Networking Mm Wave Devices, Beam Adaptation Protocols, Relaying for Coverage Extension, Support for Multimedia Transmission, Multiband considerations, Performance of Cellular networks, Mm Wave Standardization: ECMA-387, IEEE 802.11ad.

UNIT - V
BEYOND 2020
Major Challenges Surrounding Future Cyber Security, Users Awareness, Spectrum Related Security Issues in CRNs. Challenges for 2020 and beyond, Future Mobile Technologies, High Altitude Stratospheric Platform Station Systems, Human Bond Communications, CONASENSE.

TEXT BOOKS
1. Ramjee Prasad, 5G: 2020 and Beyond, River Publishers
2. T. S. Rappaport, R. W. Heath Jr., R. C. Daniels, and J. M. Murdock, Millimeter Wave Wireless Communication, Pearson Education, 2015.

REFERENCE BOOKS
1. M. Manish, G. Devendra, P. Pattanayak, and N. Ha, 5G and Beyond Wireless Systems PHY Layer Perspective, Springer Series in Wireless Technology
2. M. Vaezi, Z. Ding, and H. V. Poor, Multiple Access techniques for 5G Wireless Networks and Beyond, Springer Nature, Switzerland, 2019

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M.TECH.- II YEAR- III SEMESTER
MICROWAVE AND RADAR ENGINEERING
MICROWAVE IMAGING (PE -V)

Course Objectives:

1. To familiarize the Microwave imaging in the fields of Civil and Industrial Engineering.
2. To understand the Qualitative deterministic, static, hybrid reconstruction methods.
3. To know the Microwave imaging applications.

Course Outcomes: Students will be able to:

1. Use a Microwave imaging technique in sensing a given scene by means of interrogating microwaves
2. Use microwaves for diagnostic purposes in a wide range of applications
3. Model qualitative deterministic, stochastic and hybrid reconstruction Methods.

UNIT - I

Imaging Configurations and Model Approximations: Objectives of the Reconstruction, Multi-illumination Approaches, Tomographic Configurations, Scanning Configurations, Configurations for Buried-Object Detection, Born-Type Approximations, Extended Born Approximation, Rytov Approximation, Kirchhoff Approximation, Green's Function for Inhomogeneous Structures.

UNIT - II

Qualitative Reconstruction Methods: Introduction, Generalized Solution of Linear Ill-Posed Problems, Regularization Methods, Singular Value Decomposition, Singular Value Decomposition for Solving Linear Problems, Regularized Solution of a Linear System Using Singular Value Decomposition, Qualitative Methods for Object Localization and Shaping, The Linear Sampling Method, Synthetic Focusing Techniques,, Qualitative Methods for Imaging Based on Approximations, Diffraction Tomography, Inversion Approaches Based on Born-Like Approximations, Born Iterative Method, Reconstruction of Equivalent Current Density.

UNIT - III

Quantitative Deterministic Reconstruction Methods: Inexact Newton Methods, Truncated Landweber Method, Inexact Newton Method for Electric Field Integral Equation Formulation, Inexact Newton Method for Contrast Source Formulation, Distorted Born Iterative Method, Inverse Scattering as an Optimization Problem, Gradient-Based Methods.

Quantitative Stochastic Reconstruction Methods: Simulated Annealing, Genetic Algorithm, Differential Evolution Algorithm, Particle Swarm Optimization, Ant Colony Optimization, Code Parallelization.

Hybrid Approaches: Memetic Algorithm, Linear Sampling Method and Ant Colony Optimization.

UNIT- IV

Microwave Imaging Apparatuses and Systems: Scanning Systems for Microwave Tomography, Antennas for Microwave Imaging, Modulated Scattering Technique and Microwave Cameras.

Applications of Microwave Imaging: Civil and Industrial Applications, Medical Applications of Microwave Imaging, Shallow Subsurface Imaging.

UNIT - V

Microwave Imaging Strategies, Emerging Techniques, and Future Trends: Potentialities and Limitations of Three-Dimensional Microwave Imaging, Amplitude-Only Methods, Support Vector Machines, Metamaterials for Imaging Applications, Through-Wall Imaging.

TEXT BOOKS:

1. Matteo Pastorino - Microwave Imaging, Wiley & Sons 2010
2. V. C. Chen and H. Ling -Time-Frequency Transforms for Radar Imaging and Signal Analysis, Artech House 2002

REFERENCE BOOKS:

1. Bernard D. Steinberg - Microwave Imaging Techniques, Wiley & Sons 1991
2. Taylor, D.J.- Introduction to Ultra-wideband Radar Systems, CRC Press. 1995
3. D. R. Wehner - High-Resolution Radar, 2nd Ed., Artech House 1994

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech. (MICROWAVE AND RADAR ENGINEERING)

ENGLISH FOR RESEARCH PAPER WRITING (Audit Course - I & II)

Prerequisite: None

Course objectives: Students will be able to:

- Understand that how to improve your writing skills and level of readability
- Learn about what to write in each section
- Understand the skills needed when writing a Title Ensure the good quality of paper at very first-time submission

UNIT-I:
Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

UNIT-II:
Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction

UNIT-III:
Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

UNIT-IV:
key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature,

UNIT-V:
skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions. useful phrases, how to ensure paper is as good as it could possibly be the first- time submission

TEXT BOOKS/ REFERENCES:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book.
4. Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech. (MICROWAVE AND RADAR ENGINEERING)

DISASTER MANAGEMENT (Audit Course - I & II)

Prerequisite: None

Course Objectives: Students will be able to

- learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- critically understand the strengths and weaknesses of disaster management approaches,
- planning and programming in different countries, particularly their home country or the countries they work in

UNIT-I:

Introduction:

Disaster: Definition, Factors and Significance; Difference Between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

Disaster Prone Areas in India:

Study of Seismic Zones; Areas Prone to Floods and Droughts, Landslides and Avalanches; Areas Prone to Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post-Disaster Diseases and Epidemics

UNIT-II:

Repercussions of Disasters and Hazards:

Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.

UNIT-III:

Disaster Preparedness and Management:

Preparedness: Monitoring of Phenomena Triggering A Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological and Other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT-IV:

Risk Assessment Disaster Risk:

Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival.

UNIT-V:

Disaster Mitigation:

Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs of Disaster Mitigation in India.

TEXT BOOKS/ REFERENCES:

1. R. Nishith, Singh AK, “Disaster Management in India: Perspectives, issues and strategies “’New Royal book Company.
2. Sahni, Pardeep Et. Al. (Eds.),” Disaster Mitigation Experiences and Reflections”, Prentice Hall of India, New Delhi.
3. Goel S. L., Disaster Administration and Management Text and Case Studies”, Deep &Deep Publication Pvt. Ltd., New Delhi.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech. (MICROWAVE AND RADAR ENGINEERING)

SANSKRIT FOR TECHNICAL KNOWLEDGE (Audit Course - I & II)

Prerequisite: None

Course Objectives:

- To get a working knowledge in illustrious Sanskrit, the scientific language in the world
- Learning of Sanskrit to improve brain functioning
- Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power
- The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature

Course Outcomes: Students will be able to

- Understanding basic Sanskrit language
- Ancient Sanskrit literature about science & technology can be understood
- Being a logical language will help to develop logic in students

UNIT-I:
Alphabets in Sanskrit,

UNIT-II:
Past/Present/Future Tense, Simple Sentences

UNIT-III:
Order, Introduction of roots,

UNIT-IV:
Technical information about Sanskrit Literature

UNIT-V:
Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

TEXT BOOKS/ REFERENCES:

1. “Abhyaspustakam” – Dr. Vishwas, Samskrita-Bharti Publication, New Delhi
2. “Teach Yourself Sanskrit” Prathama Deeksha-Vempati Kutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. “India’s Glorious Scientific Tradition” Suresh Soni, Ocean books (P) Ltd., New Delhi.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech. (MICROWAVE AND RADAR ENGINEERING)

VALUE EDUCATION (Audit Course - I & II)

Prerequisite: None

Course Objectives: Students will be able to

- Understand value of education and self- development
- Imbibe good values in students
- Let the should know about the importance of character

Course outcomes: Students will be able to

- Knowledge of self-development
- Learn the importance of Human values
- Developing the overall personality

UNIT-I:
Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non- moral valuation. Standards and principles. Value judgements

UNIT-II:
Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism. Love for nature, Discipline

UNIT-III:
Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline, Punctuality, Love and Kindness.

UNIT-IV:
Avoid fault Thinking. Free from anger, Dignity of labour. Universal brotherhood and religious tolerance. True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature

UNIT-V:
Character and Competence –Holy books vs Blind faith. Self-management and Good health. Science of reincarnation, Equality, Nonviolence, Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively

TEXT BOOKS/ REFERENCES:

1. Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press, New Delhi

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech. (MICROWAVE AND RADAR ENGINEERING)

CONSTITUTION OF INDIA (Audit Course - I & II)

Prerequisite: None

Course Objectives: Students will be able to:

- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

Course Outcomes: Students will be able to:

- Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
- Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
- Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
- Discuss the passage of the Hindu Code Bill of 1956.

UNIT-I:
History of Making of the Indian Constitution: History Drafting Committee, (Composition & Working), **Philosophy of the Indian Constitution:** Preamble**,** Salient Features.

UNIT-II:
Contours of Constitutional Rights & Duties: Fundamental Rights Right to Equality**,** Right to Freedom**,** Right against Exploitation**,** Right to Freedom of Religion**,** Cultural and Educational Rights**,** Right to Constitutional Remedies, Directive Principles of State Policy**,** Fundamental Duties.

UNIT-III:
Organs of Governance: Parliament**,** Composition**,** Qualifications and Disqualifications**,** Powers and Functions**,** Executive**,** President**,** Governor**,** Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualification, Powers and Functions.

UNIT-IV:
Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. Pachayati raj: Introduction, PRI: Zila Pachayat. Elected officials and their roles, CEO Zila Pachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy.

UNIT-V:
Election Commission: Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.

TEXT BOOKS/ REFERENCES:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

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M. Tech. (MICROWAVE AND RADAR ENGINEERING)

PEDAGOGY STUDIES (Audit Course - I & II)

Prerequisite: None

Course Objectives: Students will be able to:

- Review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers.
- Identify critical evidence gaps to guide the development.

Course Outcomes: Students will be able to understand:

- What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?
- What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
- How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

UNIT-I:

Introduction and Methodology: Aims and rationale, Policy background, Conceptual framework and terminology Theories of learning, Curriculum, Teacher education. Conceptual framework, Research questions**.** Overview of methodology and Searching.

UNIT-II:

Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education.

UNIT-III:

Evidence on the effectiveness of pedagogical practices, Methodology for the indepth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the scho curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.

UNIT-IV:

Professional development: alignment with classroom practices and follow-up support, Peer support, Support from the head teacher and the community. Curriculum and assessment, Barriers to learning: limited resources and large class sizes

UNIT-V:

Research gaps and future directions: Research design**,** Contexts**,** Pedagogy**,** Teacher education**,** Curriculum and assessment**,** Dissemination and research impact.

TEXT BOOKS/ REFERENCES:

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.

4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

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STRESS MANAGEMENT BY YOGA (Audit Course - I & II)

Prerequisite: None

Course Objectives:

- To achieve overall health of body and mind
- To overcome stress

Course Outcomes: Students will be able to:

- Develop healthy mind in a healthy body thus improving social health also
- Improve efficiency

UNIT-I:
Definitions of Eight parts of yog. (Ashtanga)

UNIT-II:
Yam and Niyam.

UNIT-III:
Do`s and Don't's in life.
i) Ahinsa, satya, astheya, bramhacharya and aparigraha
ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

UNIT-IV:
Asan and Pranayam

UNIT-V:
i) Various yog poses and their benefits for mind & body
ii) Regularization of breathing techniques and its effects-Types of pranayam

TEXT BOOKS/ REFERENCES:

1. 'Yogic Asanas for Group Tarining-Part-I": Janardan Swami Yogabhyasi Mandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

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PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS
(Audit Course - I & II)

Prerequisite: None

Course Objectives:

- To learn to achieve the highest goal happily
- To become a person with stable mind, pleasing personality and determination
- To awaken wisdom in students

Course Outcomes: Students will be able to

- Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
- The person who has studied Geeta will lead the nation and mankind to peace and prosperity
- Study of Neetishatakam will help in developing versatile personality of students

UNIT-I:

Neetisatakam-Holistic development of personality

- Verses- 19,20,21,22 (wisdom)
- Verses- 29,31,32 (pride & heroism)
- Verses- 26,28,63,65 (virtue)

UNIT-II:

Neetisatakam-Holistic development of personality

- Verses- 52,53,59 (dont's)
- Verses- 71,73,75,78 (do's)

UNIT-III:

Approach to day to day work and duties.

- Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48,
- Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35,
- Chapter 18-Verses 45, 46, 48.

UNIT-IV:

Statements of basic knowledge.

- Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68
- Chapter 12 -Verses 13, 14, 15, 16,17, 18
- Personality of Role model. Shrimad Bhagwad Geeta:

UNIT-V:

- Chapter2-Verses 17, Chapter 3-Verses 36,37,42,
- Chapter 4-Verses 18, 38,39
- Chapter18 – Verses 37,38,63

TEXT BOOKS/ REFERENCES:

1. "Srimad Bhagavad Gita" by Swami Swarupananda Advaita Ashram (Publication Department), Kolkata.
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.