Department of Electronics& Communication Engineering

Birla Institute of Technology, Mesra, Ranchi - 835215 (India)

M.E. (MICROWAVE ENGINEERING)

First Semester

Theory courses

Course No.	Course	L T P	Credits
MEC1005	Electromagnetic Interference & Electromagnetic Compatibility	3 0 0	3
MEC1021	Antennas and Diversity	3 0 0	3
MEC1131	Advanced Electromagnetic Engineering	3 1 0	4
	Elective – I	3 0 0	3
	Breadth Paper I	3 0 0	3

List of Electives –

MEC2017	Optical Wireless Communication
MEC1103	VLSI Design and Applications
MEC1019	Microelectronic devices and Circuits
MEC1035	Introduction to Software Defined Radio
MEC1137	Radar Signal Analysis
MEC1041	Satellite Based Wireless Communication

Sessional / Laboratory

MEC1022	Antenna Lab.	0 0 3	2
	Elective – II	0 0 3	2

List of Electives –

MEC1004	VLSI Design Lab.
MEC1006	EMI/EMC Lab

Total Credits 20.0

Second Semester (Microwave Engg)

Theory Courses:

No.	Title	L T P	Credits
MEC2019	Micro-Electro-Mechanical-Systems	3 0 0	3
MEC2125	Numerical Techniques in Electromagnetics	3 0 0	3
MEC2029	RF Circuit Design	3 1 0	4
	Elective-III	3 0 0	3
	Breadth Paper II	3 0 0	3

List of Electives (Choose any one from the following)

MEC2113	Real Time Embedded System Design
MEC2015	Optical Networking & DWDM
MEC2127	Microwave Integrated Circuits
MEC2137	Wireless Networks
MEC2141	Wireless Signal Propagation & Fading
MEC2171	Microwave Measurement and Materials Characterization

Sessional Courses:

MEC2026	Computational Electromagnetics Lab	0 0 3	2
	Elective – IV	0 0 3	2

List of Electives (Choose any one from the following)

MEC2014	Embedded System Lab.
MEC2028	Microwave Integrated Circuit Lab

20.0

Third Semester

Course No.	Course	Credits
MEC 3001	Thesis	15

Fourth Semester

Course No.	Course	Credits
MEC3001	Thesis	20

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75 Credits

MEC1005 Electromagnetic Interference & Electromagnetic Compatibility

Department: Electronics and Communication Engineering

Course Code & Title: MEC1005 Electromagnetic Interference & Electromagnetic compatibility

Pre-requisites: Electromagnetic Theory

Course Assessment methods: Periodic Quizzes, Assignments, Presentations and End Semester Exam

Course Objectives:

1. To explain requirement of EMI & EMC concept and impart knowledge on different units and standards used for Electromagnetic compatibility in electronic/electric system.
2. To develop an ability to analyze, measure and evaluate the radiated and conducted emissions to examine the compatibility.
3. To develop an ability to analyze and evaluate the impact of EMI mitigation techniques such as shielding and grounding.
4. To develop an ability to explain the impact of ESD and EMP on system design.
5. To review the literature related to EMI & EMC and reporting it ethically.

Course Outcomes:

1. Be able to explain the requirement of EMI & EMC concept and impart knowledge on different units and standards used for Electromagnetic compatibility in electronic/electric system.
2. Have anability to analyze, measureand evaluate radiated and conducted emissions to examine the compatibility.
3. Have an ability to analyze and evaluate the impact of EMI mitigation techniques such as shielding and grounding.
4. Be able to explain the impact of ESD and EMP on system design.
5. Be able to review the literature related to EMI & EMC and report it ethically.

Syllabus

Module-I:

Introduction: A brief history of EMI/EMC, Analysis of EMI, Type of Noise and Interference, Electromagnetic Compatibility, Radiated Emission and susceptibility, Conducted Emission and Susceptibility, Benefits of good EMC Design, Brief description of EMC regulations, Examples of EMC related problems.

Module-II:

EMC requirements for Electronic Systems: Government regulations, Requirement for Commercial products and Military products, Radiated Emission limits for Class A, Class B, FCC and CISPR, measurement of Emissions for verification of compliance: Radiated Emission and

Conducted Emissions, Typical product emissions, Additional product requirements, design constraints for products, Advantages of EMC Design.

Module-III:
Conducted Emission and Susceptibility: Measurement of Conducted emission: LISN, Common and Differential mode currents, Power supply filters: Basic properties of filters, A generic power supply filter topology, Effect of filter elements on common and differential mode currents, Separation of conducted emissions into common and differential mode components for diagnostic purpose, Power supplies: Linear and SMPS, Effect of Power Supply Components on Conducted emissions, Power Supply and Filter placement, Conducted Susceptibility.

Module-IV:
Radiated Emission and Susceptibility: Simple Emission models for wires and PCB lands: Differential mode versus Common mode currents, Differential mode current emission model, Common mode current emission model, Current probes, Simple susceptibility models for wires and PCB lands: Shielded cables and surface transfer impedance.

Module-V:
Cross talk: Three conductor transmission lines and crosstalk, Transmission line equations for lossless lines, The per unit length parameters: Homogeneous versus Inhomogeneous media, Wide separation approximation for wires, Numerical methods for other structures, The Inductive-Capacitive Coupling Approximation model: Frequency domain Inductive-Capacitive coupling model, Time domain Inductive-Capacitive coupling model, Lumped circuit approximate models. Shielded Wires: Per unit length parameters, Inductive and Capacitive Coupling, Effect of Shield grounding, Effect of pigtails, Effects of Multiple shields, MTL model predictions, Twisted wires: Per unit length parameters, Inductive and Capacitive Coupling, Effects of Twist, Effects of Balancing.

Module-VI:
Shielding: Shielding Effectiveness, Far field Sources: Exact solution, Approximate solution, Near field sources: Near field versus far field, Electric sources, Magnetic sources, Low frequency, magnetic field shielding, Effect of Apertures.

Module-VII:
System Design for EMC: Shielding and Grounding, PCB Design, System configuration and design, Electrostatic Discharge, Diagnostic tools.

Text Books:

1. Paul, C., Introduction to Electromagnetic Compatibility, John Wiley & Sons, 1992.
2. Kennedy, G., Electronic Communications Systems, McGraw-Hill, 1970.
3. Ott, H. W., Noise Reduction Techniques in Electronic Systems, John Wiley & Sons, second edition, 1988.

MEC1021 Antennas and Diversity

Department: Electronics and Communication Engineering

Course Code & Title: MEC1021 Antennas and Diversity

Pre-requisites: Electromagnetic theory

Course Assessment methods: Periodic Quizzes, Assignments, Presentations and End Semester Exam

Course Objectives:

1. To develop and apply the mathematical tools to analyze radiation characteristics of aperture antennas.
2. To design and analyze various broadband, high gain, planar antennas and antenna arrays.
3. To summarize different diversity and combining techniques.
4. To study smart antenna and algorithms.

Course Outcomes:

1. Describe various parameters and outline radiation equations.
2. Design various types of radiators for wireless communications.
3. Analyze and synthesize antenna and antenna arrays.
4. Characterize various diversity and combining techniques.
5. Describe smart antennas and algorithms.

Syllabus

Module-I:
Aperture Antennas: Radiation Equations, Rectangular Apertures: Uniform Distribution on an infinite ground plane, Uniform distribution in Space, Circular Apertures: Uniform Distribution on an infinite ground plane, Design Considerations.

Module-II:
Antennas for Wireless Communication I: Helical, Normal mode, Axial mode, Design procedure, feed design for helical antenna, Horn Antenna; E-Plane, H-Plane, Pyramidal horn, Whip antenna, Discone antenna

Module-III:
Antennas for Wireless Communication II: Microstrip antenna – Basic Characteristics, Feeding Methods, Method of analysis, Transmission line model and cavity model for rectangular patch antenna, Circular Patch Antenna, Inverted F Antenna, Planar Spiral Antenna.

Module-IV:
Antenna Arrays: Two element and N-element arrays, Linear array with uniform, Binomial distribution and Tchebyscheff distribution, Planar array, Phased array, Adaptive arrays.

Module-V:
Diversity Schemes: Macroscopic diversity scheme, Microscopic diversity scheme – Space diversity, Field diversity, Polarization diversity, Angle diversity, Frequency diversity and time diversity scheme.

Module-VI:
Combining Techniques: Combining techniques for Macroscopic diversity, Combining techniques for Microscopic diversity – Selective combining, Switched combining, Maximal ratio combining, equal gain combining and feed combining technique.

Module-VII:
Smart Antenna: Introduction, Benefits of Smart Antennas, Structures for Beamforming Systems, Strategies for the coverage and Capacity Improvement, Smart Antenna Algorithms.

Text Books:
1. Antenna Theory, Analysis and Design, 2/E, A. Balanis, John Wiley.
2. Wireless Communications, Principles and Practices, Rappaport, PHI
3. Software Radio A Modern Approach to Radio Engineering, J. H. Reed, Pearson Education.
4. Smart Antenna, T. K. Sarkar

Reference Books:
1. Antennas, J. D. Kraus, TMH
2. Microstrip Antenna Design Handbook, R. Garg, Bhal and Bhartia, Artech House

MEC1131 Advanced Electromagnetic Engineering

Department: Electronics and Communication Engineering

Course Code & Title: MEC1131 Advanced Electromagnetic Engineering

Pre-requisites: Basic knowledge of rectangular, cylindrical and spherical coordinate systems, knowledge of electromagnetic theory, plane wave propagation and microwave theory and components.

Course Assessment methods: Periodic Quizzes, Assignments, Presentations and End Semester Exam

Course Objectives:

1. To explain the plane waves functions and analyze the various rectangular shaped microwave components and their properties for different modes in rectangular coordinate system.
2. To develop an ability to analyse the cylinder wave functions and various cylindrical shaped microwave components and their properties for different modes in cylindrical coordinate systems.
3. To develop an ability to evaluate the spherical wave functions and various spherical shaped microwave components and their properties for different modes in spherical coordinate systems
4. To develop an ability to analyze some advanced spherical microwave components such as; spherically radial waveguide, hemispherical, bi-conical and conical resonators and various waveform transformation techniques.
5. To develop and ability to evaluate different parameters of microwave components using perturbational and variational techniques.

Course Outcomes:

1. Demonstrate understanding on the plane waves functions and calculation of various performance parameters of different kinds of rectangular microwave components such as; rectangular waveguide, rectangular cavity, partially filled waveguide and dielectric slab waveguide apart from the concepts of surface guided waves and modal expansion of fields
2. Have an ability to analyze the cylindrical wave functions and calculation of various performance parameters of different kinds of cylindrical microwave components such as; circular waveguide, circular cavity and parallel plate, partially filled, dielectric slab coated and corrugated radial waveguides apart from the concepts of sources of cylindrical waves, two dimensional radiation and wave transformations.
3. Have an ability to understand the spherical wave functions and evaluation of various performance parameters of spherical cavities apart from the concepts of orthogonality relationship and space as a waveguide.
4. Have an ability to analyze and evaluate the various performance parameters of different kinds of other advanced spherical microwave components such as; conical, bi-conical, coaxial, horn and wedge waveguides and hemispherical, conical, bi-conical and wedge resonators apart from the knowledge of scattering by spheres and various waveform

transformation techniques.

5. Demonstrate insight to use the perturbational and variational techniques to evaluate the different parameters due to perturbations on cavity walls, cavity materials and waveguide apart from the knowledge of stationary formulas for cavity.

Syllabus

Module-I:
Plane Wave Functions I: The Wave Functions, Plane Waves, Rectangular Waveguide, Alternative Mode Sets, The Rectangular Cavity.

Module-II:
Plane Wave Functions II: Partially Filled Waveguide, Dielectric Slab Waveguide, Surface Guided Waves, Modal Expansion of Fields.

Module-III:
Cylindrical Wave Functions I: The Wave Functions, Circular Waveguide, Radial Waveguides, Circular Cavity, Other Guided Waves.

Module-IV:
Cylindrical Wave Functions II: Sources of Cylindrical Waves, Two Dimensional Radiation, Wave Transformations, Scattering by Cylinders.

Module-V:
Spherical Wave Functions I: The Wave Functions, Spherical Cavity, Orthogonality Relationships, Space as a Waveguide.

Module-VI:
Spherical Wave Functions II: Other Radial Waveguides, Other Resonators, Sources of Spherical Waves, Wave Transformations, Scattering by Spheres.

Module-VII:
Perturbational and Variational Techniques: Perturbation of Cavity Walls, Cavity Material Perturbations, Waveguide Perturbations, Stationary Formulas for Cavities.

Text Books:

1. Time Harmonic Electromagnetic Fields; By Roger F. Harrington; McGraw Hill Book Company; 1961.

Reference Books:

1. Foundations for Microwave Engineering; Second Edition; By Robert E. Collin; McGraw Hill International Edition; 1992.
2. Microwave Engineering; Second Edition; by David M. Pozar; John Wiley & Sons; Inc. Copyright 2001.

MEC2017 Optical Wireless Communication

Department: Electronics and Communication Engineering

Course Code & Title: MEC2017 Optical Wireless Communication

Pre-requisites: Knowledge of Semiconductor Devices, Data Communication, Optical Fiber Communication System.

Course Assessment methods: Periodic Quizzes, Assignments, Presentations and End Semester Exam

Course Objectives:

1. To demonstrate the characteristics of Indoor and Outdoor IR systems, performance of Wireless IR link under Atmospheric turbulence.
2. To illustrate the transmitter design considerations and receiver design considerations for optical wireless communication.
3. To apply different modulation schemes and different multiple access techniques for sharing IR medium.
4. To illustrate the standards of IrDA technology, features and the different layers of the IrDA protocols for optical wireless networking.

Course Outcomes:

1. Explain the characteristics of Indoor and Outdoor IR systems, transmission impairments and design of the optical front end of Wireless IR communication receiver.
2. Design the optical front end of Wireless IR communication receiver.
3. Develop the transmitter based on LED/Laser diode and receiver based on semiconductor photodiodes for optical wireless communication.
4. To choose a right modulation scheme for indoor & outdoor applications and the different multiple access techniques used for sharing IR medium by variety of users.
5. Apply IrDA protocols to create simple, cost-effective and low power transceivers that enable wireless IR communication in a number of devices.

Syllabus

Module-I:

Introduction to optical wireless communication, Optical Wireless channels, Light sources, Modulators, Detector, Atmospheric transmission limitations, Effect of Rain, Fog, and Mist, Scintillation.

Module-II:

Geometrical Optics and Ray Tracing. Optical Path Length and Fermat's Principle. The Etendue or Lagrange Invariant. The Edge Ray Principle, Ray Matrices, Gaussian Beam, Telescope, beam expander, Optical filter and anti-reflection coating.

Module-III:
Overview of Optical Concentrators. Wireless IR Receiver Requirements, DTIRC Characteristics. Comparison of Concentrators. Practical Issues. Other Shapes of DTIRCs. Tracking system, Laser beam steering device.

Module-IV:
Optical Wireless Transmitter Design, Transmitter Design Considerations, Optical Source Characteristics. Types of Optical Modulation. Driver Circuit Design Concepts. Current Steering Output Circuit, Back Termination Circuit, Predriver, Data Retiming, Automatic Power Control, Transmitters Linearization Techniques.

Module-V:
Optical wireless receiver design, Receiver Design Considerations, Photodetection in Reverse-biased Diodes. Choosing the Photodetector, Receiver Noise Consideration, Bit Error Rate and Sensitivity, Bandwidth, Signal Amplification Techniques, Receiver Main Amplifier (RMA). Transceiver Circuit Implementation Technologies.

Module-VI:
Modulation and Multiple Access Techniques, Modulation Techniques Comparison. Modulation Schemes in the Presence of Noise, Modulation Schemes in the Presence of Multipath Distortion. Multiple Access Techniques.

Module-VII:
IrDA PROTOCOLS. Wireless Protocol Standards. The Infrared Data Association. IrDA Standard Overview. The Physical Layer Protocol. Framer/Driver. IrLAP. IrLMP. Information Access Service and Protocol. Tiny Transport Protocol. Session and Application Layer Protocols. WIRELESS IR NETWORKING. Introduction to Wireless IR Networking. Network Architecture. Optical Wireless Network Specifications. The Ad Hoc Network. Quality of Service (QoS). MIMO Wireless optical channel, Pixelated Wireless optical channel, Future Infrared Networking.

Text Books:

1. "Optical and Wireless Communications", Sadiku, Matthew N. O. CRC Press
2. "Optical Wireless Communications: IR for Wireless Connectivity" Ramirez-Iniguez, Roberto Idrus, Sevia M., Auerbach Publications.

Reference Books:

1. "Microwave Photonics", Chi Lee, CRC Press, 2006.
2. "Wireless Optical Communication Systems" Steve Hranilovic, Springer.

MEC1103 VLSI Design and Applications

Department: Electronics and Communication Engineering

Course Code & Title: MEC1103 VLSI Design and Applications

Pre-requisites: Knowledge of Basic Electronics, Semiconductor Devices, and Digital Electronics, VLSI Design.

Course Assessment methods: Periodic Quizzes, Assignments, Presentations and End Semester Exam

Course Objectives:

1. Develop an ability to understand fundamental of VLSI, device model, small signal model current and voltage references.
2. Develop an ability to understand CMOS Operational Amplifiers and Comparators.
3. Develop an ability to understand Switched Capacitor Circuits, and digital to analog and analog to digital converters.
4. Develop an ability to understand Layout Design of CMOS Cell.
5. Develop an ability to understand VLSI Design Issues

Course Outcomes:

1. Demonstrate understanding of fundamental of VLSI, device model, small signal model current and voltage references.
2. Demonstrate understanding of design goals and procedures of CMOS amplifiers such as 1-stage and 2-stage operational amplifiers and comparators.
3. Design switched capacitor circuits such as switched capacitor amplifiers, integrators, filters, DACs and ADCs.
4. Develop layout of digital, analog, and memory circuits based on layout design rules.
5. Design digital, analog, memory circuits and subsystems keeping design issues in consideration.

Syllabus

Module-I:

Introduction to VLSI: Fundamental of VLSI, CMOS Devices Modeling, Simple MOS Large Signal Model (SPICE) Parameters, Small Signal Model for the MOS Transistor, Computer Simulation Model, Sub threshold MOS Model, MOS Switch, MOS Diode/ Active resistor, Current Sink and Sources, Current Mirrors, Current and Voltage Reference, Bandgap Reference, Differential Amps, Cascode Amps, Current Amps.

Module-II:

CMOS Operational Amplifiers and Comparators: Design of CMOS Op Amps, Compensation of Op Amps, Design of Two stage Op Amps, Power Rejection Ratio of Two Stage Op Amps, Cascode of Op Amps, Buffered Op Amps, High Speed/ Frequency Op Amps, Differential Output Op Amps, Micro Power Op Amps, Low Noise and Low Voltage Op Amp, Characteristics of

Comparator, Two stage Open Loop Comparators, Discrete Time Comparators, High Speed Comparators.

Module-III:
Switched Capacitor Circuits, D/A and A/D: Switched Capacitor Circuits, Amplifiers and Integrators, Two Phase Switched Capacitor Circuits, First and Second Order Switched Capacitor Circuits, Switched Capacitor Filters, Comparative study of D/A, Parallel and Serial Digital Analog Converters, Serial Analog-Digital Converter, Medium, High Speed Analog-Digital Converter, Over sampling Converter.

Module-IV:
Layout Design of CMOS Cell: Schematic and Layout Design of Basic Gates and Universal Gates & Flip-Flop, Layout Representation, CMOS-N-Well Rules, Design Rules, Backgrounder, Layout Assignments, Latch-Up Problems, Analogue Design Layout Considerations, Transistor Design, Centroid Design, Capacitor Matching, Resistor Layout, Noise Considerations.

Module-V:
VLSI Design Issues: Design Captures Tools, HDL Design, Schematic Design, Layout design, Floor planning, Chip Composition, Design Verification Tools, Circuit Level Simulation, and Logic Level Simulation, Mixed Mode Simulators. Timing Verification, Network Isomorphism, Netlist Comparison, Layout Extraction, Back Annotation, Design Rule Verification, Pattern Generation, Data Sheets, Pin-out, Description Operation, DC Specification, AC Specification, Package Diagram.

Module-VI:
Digital Subsystem Design: Design of Universal Gate using Pseudo-nMOS Logic, Clocked CMOS Single Bit Adder, Parallel Adder, Transmissions Gate Adders, Carry Look Ahead Adders, Other High Speed Adders, Multipliers, Asynchronous Counter, Synchronous Counter, SRAM Arrays, DRAM, ROM Array, Finite Stets Machines, Multilevel Logic.

Module-VII:
Design Economics and Testing: NRE's, Engineering Costs, Prototype Manufacturing Cost, Recurring Costs, Fixed Costs , Schedule , Processor Example, Need for Testing, Functionality Tests, Manufacturing Tests, Manufacturing Tests Principles, Fault Modules, Struck-at-Faults, SC and OC Faults, Observability, Controllability, Fault Coverage, ATPG, Delay Fault, Testing, Scan Based Techniques, BLIBO, IDDQ Testing.

Text Books:

1. "CMOS Analog Circuit Design" by Phillip E. Allen Douglas R. Holberg, Second Edition.
2. "Design of Analog CMOS Integrated Circuits" by Behzad Razavi.
3. Analogue Integrated Circuit Design, John. D. and Mortin K, John Wiley and Sons, 1997.
4. Principle of CMOS VLSI Design A System Prospective, Weste Neil, H E & Eshtaghian K, Pearson Edu. 1993.
5. Digital Integrated Circuit Design, Ken Martin, Oxford University Press, 2000.
6. "Introduction to VLSI Circuits and Systems" by John P. Uyemura, Willey Student Addition.

Reference Books:

1. "CMOS Digital Logic Design with VHDL & Verilog (Theory & Practical)," by Vijay Nath, ACM Learning, New Delhi, 2011.

MEC1019 Microelectronic Device & Circuits

Department: Electronics and Communication Engineering

Course Code & Title: MEC1019 Microelectronic Device & Circuits

Pre-requisites: Knowledge of process engineering, semiconductor devices, concept of IC technology & IC fabrication technique, idea of full custom & semicustom ICs & knowledge of physical structure of analog, digital and ASICs.

Course Assessment methods: Periodic Quizzes, Assignments, Presentations and End Semester Exam

Course Objectives:

1. Explain the IC fabrications steps & allied techniques
2. Demonstrate the impact of IC testing & verifications at different levels of design
3. Elaborate the design strategies of semicustom ICs & full custom ICs
4. Explain the concept of physical design for analog & digital ICs
5. Demonstrate the ASIC (Application Specific Integrated Circuit) design & analysis.

Course Outcomes:

1. Outline the fabrication steps (Wafer Preparation, Oxidation, Lithography, Etching, Diffusion, Ion-implantation, Metallization), & fabrication technique (n-well, p-well, SOI etc)
2. Analyze the IC testing & verifications at different levels of design
3. Explain the design strategies of semicustom ICs & full custom ICs
4. Design the physical structure of analog & digital ICs
5. Design & analyze the ASICs (Application Specific Integrated Circuit).

Syllabus

Module-I:

Introduction to IC Technology, Overview of MOS and BJT, Threshold Voltage, Body effect, basic DC equations, 2nd order Effect, MOS model, small-signal AC characteristics, CMOS inverter and its DC characteristics, static load MOS inverter, Silicon semiconductor technology, wafer processing, oxidation, epitaxy, deposition, ion implantation, CMOS technology, N-Well and P-Well process and SOI.

Module-II:

Fault Modeling and Simulation, Testability, Analysis Technique, Ad-hoc Methods and General guidelines, Scan Technique, Boundary Scan, Built in Self Test Analog Test Buses, Design for Electron Beam Testability, Physics of Interconnects in VLSI, Scaling of Interconnects, A Model for Estimating Wiring Density, A Configurable Architecture for Prototyping Analog Circuits.

Module-III:

Mixed signal VLSI chip basic CMOS circuits, CMOS gate transistor sizing, Power Dissipation, Scaling of MOS Transistor Dimension, MOSFET and BJT Current Mirrors and its applications, Basic Gain Stage, Gain boosting techniques, Super MOS transistor, Primitive analog cell, Linear voltage – current converters, MOS multipliers and resistors, CMOS Bipolar and low voltage, BiCMOS, Op- Amp Design, Instrumentation Design, and Low Voltage Filter, BJT and MOS current mirror circuits and its applications.

Module-IV:
CMOS Logic gate design, Fan-in and Fan-out, typical NAND and NOR delays, Transistor sizing, CMOS logic structure, DC analysis of Complementary Logic, BiCMOS logic, Pseudo NMOS, dynamic CMOS logic, Clocked CMOS logic, Pass transistor, CMOS Domino Logic, NP domino logic, Cascode voltage switch logic, source follower pull-up logic (SFPL), clocking strategy and IO structure.

Module-V:
Single-ended and differential operations, Basic differential pair: qualitative analysis and quantitative analysis, Common mode response, Differential pair with MOS loads, Gilbert Cell. General considerations, performance parameters, One-stage Op Amps, two-state Op Amps, Gain boosting, comparison, Common mode feedback, Input range limitations, Slew Rate, Power supply rejection, Noise in Op Amps, Operational Transconductance Amplifier(OTA) and its applications.

Module-VI:
Review of Statistical Concepts, Statistical Device Modeling, Statistical Circuit Simulation, Automation, Analog Circuit Design, Automatic Analog Layout, CMOS Transistor Layout, R and C Layout, Analog Cell Layout, Mixed Analog - Digital Layout.

Module-VII:
Introduction to Circuit Modeling Tools, Circuit Descriptions, DC Circuit Analysis, AC Circuit Analysis, Transient Analysis, Advance SPICE Command and Analysis, Diode, JFET and MOSFET (Model, Statement and Parameter)

Text Books:

1. Randoll L. Geiger, Phillip E. Allen, Noel K. Strader "VLSI Design Techniques for Analog and Digital Circuits", Mc Graw Hill International company, 1990.
2. Malcom R. Haskard, Lan C May, "Analog VLSI Design NMOS and CMOS", Prentice Hall, 1998.
3. R. Jacob Baker, Harry W. LI., & David K. Boyce., "CMOS Circuit Design". 3rd Indian reprint, PHI, 2000.
4. Microelectronic Circuits, 5th Edition, by Adel S. Sedra and Kenneth C. Smith, Oxford University press, 2004.
5. Philip E. Allen Douglas and R. Holberg, "CMOS Analog Circuit Design", Second Addition Oxford University Press-2003.
6. Fundamentals of Microelectronics, 1st Edition, by Behzad Razavi, Wiley Press, January 2008.
7. M.H Rashid, SPICE for Power Electronics and Electric Power, Englewood. Cliffs, N.J.

Prentice Hall, 1993.
8. PSPICE Manual, Irvine, Calif: - Micro Sim Corporation, 1992.

MEC1035 Introduction to Software Defined Radio

Department: Electronics and Communication Engineering

Course Code & Title: MEC1035 Introduction to Software Defined Radio

Pre-requisites: Understanding of wireless communication channel, communication process, interference and noise in communication process, basic propagation mechanisms, probability theory.

Course Assessment methods: Periodic Quizzes, Assignments, Presentations and End Semester Exam

Course Objectives:

1. To develop an ability to understand the need, characteristics and benefits of SDR.
2. To develop an ability to analyze the RF Chain of SDR and components for overall performance
3. To develop an ability to compare direct digital synthesis with analog signal synthesis in SDR
4. To develop an understanding of polyphase filters, digital filter banks, timing recovery in digital receivers using multirate digital filters.
5. To develop an ability to evaluate the parameters of Ideal Data Converters and Practical data Converters

Course Outcomes:

1. Demonstrate understanding of the need, characteristics and benefits of SDR.
2. Have an ability to analyze the RF Chain of SDR and components for overall performance.
3. Have an ability to compare direct digital synthesis with analog signal synthesis in SDR.
4. Demonstrate understanding of polyphase filters, digital filter banks, timing recovery in digital receivers using multirate digital filters.
5. Demonstrate insight to evaluate the parameters of Ideal Data Converters and Practical data Converters

Syllabus

Module-I:

Introduction to Software radio concepts: Introduction, need, characteristics, benefits and design principles of Software Radios. Traditional radio implemented in hardware (first generations of 2G cell phones), Software controlled radio (SCR), Software defined radio (SDR), Ideal software radio (ISR), Ultimate software radio (USR)

Module-II:

Radio frequency implementation issues : The purpose of RF Front-End, Dynamic range, RF Receiver Front-End Topologies, Enhanced Flexibility of the RF Chain with Software Radios, Importance of Components to Overall performance, Transmitter Architecture and their issues, Noise and Distortion in RF Chain.

Module-III:
Digital generation of signals: Introduction, Comparison of Direct Digital Synthesis with Analog Signal Synthesis, Approaches to Direct Digital Synthesis, Analysis of Spurious Signals, Spurious components due to Periodic Jitter.

Module-IV:
A/D & D/A Conversion : Introduction, Parameters of Ideal Data Converters, Parameters of Practical data Converters, Techniques to improve Data Converter performance, Complex ADC and DAC Architectures.

Module-V:
Multirate Signal Processing: Introduction, Sample Rate Conversion Principles, Polyphase Filters, Digital Filter Banks, Timing Recovery in Digital receivers Using Multirate Digital Filters.

Module-VI:
Antennas & Antenna Arrays: Introduction, Benefits of Smart Antennas, Structures for Beamforming Systems, Smart Antenna Algorithms.

Module-VII:
Case study in Software radio design: Introduction, SPEAKeasy, JTRS.

Text Books:

1. Software Radio: A Modern Approach to radio Engineering, Pearson Education Asia, Jeffrey H. Reed

MEC1137 Radar Signal Analysis

Department: Electronics and Communication Engineering

Course Code & Title: MEC1137 Radar Signal Analysis

Pre-requisites: A degree in and science or engineering is not required, although the material will be more readily understood if the audience has introductory college-level knowledge of:

- mathematics including the topics of algebra, trigonometry, and logarithms
- basic physics including the topics of electricity and magnetism

Course Assessment methods: Periodic Quizzes, Assignments, Presentations and End Semester Exam

Course Objectives:

1. To provide concepts and terminologies of a radar from basic radar range equation and its applications from a system point of view, with emphasis on how a radar can be used to detect a various targets, , and identify its nature under various propagation models with detailed focus on detection and estimation of information signals in practical environments.

Course Outcomes:

1. Describe radars and explain how they are used to detect remote objects with a mathematical basis on their working principle.
2. Analyze radar systems to assess performance with respect of particular application.
3. Explain the information content in radar signals from various types of objects.
4. Describe the effects of the atmosphere and interference on radar systems.
5. Identify the components and techniques required for detection and estimation of signals in various propagation models.

Syllabus

Module-I:
Radar equation, MDS, detection of signal in noise, Receiver noise and signal to noise ratio, prediction of radar range.

Module-II:
Probability density functions, probabilities of detection and false alarm rate, integration of radar pulses, radar cross section of targets, radar cross section fluctuations.

Module-III:
Detection of radar signals: matched filter, correlation receiver, detection criteria, detectors, integrators and CFAR receivers.

Module-IV:
Information from radar signals: basic radar measurements, theoretical accuracy, ambiguity diagram, pulse compression, target recognition.

Module-V:
Radar clutter : surface clutter radar equation, land clutter, sea clutter, statistical model for surface clutter, detection of targets in clutter.

Module-VI:
Estimation of signals in noise, linear mean square estimation, maximum likelihood estimation, Bays estimators of parameters of linear systems.

Module-VII:
Propagation of radar waves: Forward scattering from earth, scattering from round earth surface, atmospheric refraction, standard and non-standard propagation.

Text Books:

1. M.I. Skolnik, “Introduction to Radar Systems” 3/e, TMH, New Delhi, 2001

MEC1041 Satellite Based Wireless Communication

Department: Electronics and Communication Engineering

Course Code & Title: MEC1041 Satellite Based Wireless Communication

Pre-requisites: Knowledge of Analog Communication, Digital Communication, Antennas and Wave Propagation and Microwave Engineering.

Course Assessment methods: Periodic Quizzes, Assignments, Presentations and End Semester Exam

Course Objectives:

1. To acquire the concepts, fundamentals and importance of satellite communication, and impart knowledge on all the elements and aspects of satellite communication along with acquiring knowledge on various types of satellites used for several applications.
2. To analyze, design and evaluate the satellite link for a specific frequency band.
3. To develop the ability to acquire the knowledge of the satellite payload, satellite antennas, space platform, earth station, earth station antenna, tracking equipment along with the importance of Reliability in Satellite Comm.
4. To develop the ability to analyze both traditional and efficient communication techniques employed in satellite communication.
5. To review and refer the literature related to Satellite Communication and report it ethically.

Course Outcomes:

1. Demonstrate the concepts, fundamentals and importance of satellite communication, and impart knowledge on all the elements and aspects of satellite communication along with acquiring knowledge on various types of satellites used for several applications.
2. Have anability to analyze, design and evaluate the satellite link for a specific frequency band.
3. Acquire the knowledge of the satellite payload, satellite antennas, space platform, earth station, earth station antenna, tracking equipment along with the importance of Reliability in Satellite Communication.
4. Have an ability to analyze both traditional and efficient communication techniques employed in satellite communication.
5. Have an ability to review and refer the literature related to Satellite Communication and report it ethically.

Syllabus

Module-I:

Introduction to Satellite Communications: Origin, History, Current Technology State and Overview of Satellite System Engineering

Module-II:
Orbital Aspects of Earth Satellites: Orbital Mechanics and Orbital Elements, Azimuth and Elevation, Coverage Angle and Slant Range, Placement of a Satellite in a Geostationary Orbit.

Module-III:
Satellite Link Design: Basic Radio Transmission Theory, System Noise Temperature and G/T Ratio, Uplink and Downlink Design, Interference Analysis, Carrier-to-Noise plus Interference Ratio, Interference to and from Adjacent Satellite Systems, Terrestrial Interference, Cross-polarization Interference, Intermodulation Interference, Design of Satellite Links for Specified Carrier-to-Noise plus Interference Ratio, Digital Satellite Link.

Module-IV:
Propagation on Satellite-Earth Paths and Its Influence on Link Design: Absorbitive Attenuation Noise by Atmospheric Gases, Rain Attenuation, Noise due to Rain, Rain Depolarization, Tropospheric Multipath and Scintillation Effects.

Module-V:
Multiple Access Techniques in Satellite Communications: Frequency Division Multiple Access, FDMA, SCPC, MCPC. Time Division Multiple Access, TDMA: random (ALOHA, S-ALOHA) and time synchronized access. Code Division Multiple Access, CDMA, Fixed and On-demand Assignment.

Module-VI:
Satellite Networking: Advantages and Disadvantages of Multibeam Satellites, Interconnection by Transponder Hopping, Interconnection by On-board Switching, Interconnection by Beam Scanning, On-Board Processing, Intersatellite Links.

Module-VII:
Types of Satellite Networks: Fixed Point Satellite Network, INTELSAT, Mobile Satellite Network, INMARSAT, Low Earth Orbit and Medium Earth Orbit Satellite Systems, Very Small Aperture Terminal (VSAT) Network, Direct Broadcast Satellite Systems, Global Positioning System.

Text Books:

1. Digital Satellite Communications, 2/e, McGraw-Hill, 1990.Tri T. Ha
2. Satellite Communications, John Willey and Sons, 2000T. Pratt, C.W. Bostian
3. Satellite Communications Systems Engineering, Pearson Education, 2/e; 2003 W.L. Prichard, H.G. Suyderhoud and R.A. Nelson

MEC2019 Micro-Electro-Mechanical-Systems

Department: Electronics and Communication Engineering

Course Code & Title: MEC2019 Micro-Electro-Mechanical-Systems

Pre-requisites: Basic knowledge and understanding of Mechanical Engg,,Electrical Engg, Instrumentation Engg, Communication (Microwave & wireless), Chemistry, Physics & Material science.

Course Assessment methods: Periodic Quizzes, Assignments, Presentations and End Semester Exam

Course Objectives:

1. To develop an ability, enthusiasm critical thinking in microengineering process, materials and design issues
2. To develop the Fundamental concepts of MEMS technology & their applications in different areas
3. To develop an ability and understanding of microscale physics for use in designing MEMS devices
4. To develop an inclination towards electronics system design and manufacturing
5. To develop interest towards higher studies and research.
6. To enable to acquire practical knowledge of relevant technologies and multi-disciplinary fields, including broad social, ethical and environmental issues, within which engineering is practiced.

Course Outcomes:

1. Demonstrate knowledge on fundamental principles and concepts of MEMS Technology
2. New applications and directions of modern engineering
3. Have an ability to analyze various techniques for building micro-devices in silicon, polymer, metal and other materials
4. Have an ability to critically analyze micro-systems technology for technical feasibility as well as practicality using modern tools and relevant simulation software to perform design and analysis.
5. Have an ability to analyze physical, chemical, biological, and engineering principles involved in the design and operation of current and future micro-devices & Have an ability to evaluate limitations and current challenges in micro-systems technology

Syllabus

Module-I:

Micro electromechanical systems: Introduction, MEMS Overview, Micro fabrication of MEMS: Surface Micromachining, Bulk Micromachining, LIGA, micromachining of polymeric MEMS devices.

Module-II:
Fundamentals MEMS Device Physics: Actuation: Electrostatic Actuation, Piezoelectric Actuation, Thermal Actuation ,Magnetic Actuation, Mechanical Vibrations ,The single degree of Freedom System ,The many Degrees of freedom system, Microsensing for MEMS: Piezoresistive sensing, Capacitive sensing, Piezoelectric sensing, Resonant sensing, Surface Acoustic Wave sensors.

Module-III:
MEMS Materials and fabrication process Modelling: Metals, semiconductors, thin films for MEMS and their deposition techniques, materials for polymer MEMS. Solid modeling:Numerical Simulation of MEMS, Mechanical Simulation, Electrostatic Simulation .

Module-IV:
MEMS Switches : Switch parameters, basics of switching, Switches for RF and microwave applications, actuation mechanisms for MEMS devices, dynamics of switch operation, MEMS switch design considerations, Microwave Considerations, Material Consideration, Mechanical Considerations modeling and evaluation.

Module-V:
MEMS Inductors and Capacitors : MEMS Inductors: self and mutual inductance, micromachined inductors, modeling and design issues of planar inductors, variable inductor and polymer based inductor. MEMS Capacitors: MEMS gap tuning capacitor, MEMS area tuning capacitor, Dielectric Tunable capacitors.

Module-VI:
MEMS RF applications: Mems based RF and Microwave circuits : RF Filters, Micromachined Phase shifters, and Micromachined antenna.

Module-VII:
MEMS packaging: MEMS packaging: Role of MEMS packaging, Types of MEMS packaging, Microwave packaging Considerations, Wafer level packaging

Text Books:

1. RF MEMS & Their Applications by Vijay K. Varadan, K. J. Vinoy and K. A. Jose John Wiley & Sons, 2003
2. Introduction to Microelectromechanical Microwave Systems(2nd Edition) by Hector J.De Los Santos,Artech house
3. RF MEMS: Theory, Design, and Technology, Gabriel M. Rebeiz, John Wiley & Sons, 2003.

Reference Books:

1. Tai-Ran Hsu, “MEMS and Microsystems: Design and Manufacture,” McGrawHill, 1st edition, ISBN: 0072393912.
2. Mems Mechanical Sensors Microelectromechanical system series Srephen Beeby/Artech House

MEC2125 Numerical Techniques in Electromagnetics

Department: Electronics and Communication Engineering

Course Code & Title: MEC2125 Numerical Techniques in Electromagnetics

Pre-requisites: Electromagnetic Theory

Course Assessment methods: Periodic Quizzes, Assignments, Presentations and End Semester Exam

Course Objectives:

1. To understand the need of numerical techniques and classification of EM problems
2. To study the various numerical techniques used in analyzing EM problems
3. To solve simple EM problems using numerical techniques

Course Outcomes:

1. To classify the EM problems.
2. To acquire theoretical knowledge and explain various numerical methods of electromagnetics.
3. To formulate real life problem to mathematical model.
4. To apply various numerical methods to different static, scattering and radiation problems
5. To develop computational skills in applied electromagnetics and related disciplines and ability not only to effectively use electromagnetic software, but also to understand the foundations of various codes.

Syllabus

Module -I:

Introduction: Need for Numerical Solution of Electromagnetic problems, Selection of a numerical
method, Classification of Electromagnetic problems, Classification of Solution Region, Classification of Boundary Conditions.

Module -II:

Finite Difference (FD) Methods: Introduction, FD schemes for parabolic, hyperbolic & Elliptical partial differential equations, solving the Laplace, diffusion and wave equations by FD method. Application to Guided structures: microstrip line and rectangular waveguide.

Module -III:

Finite Difference Time Domain (FDTD) Methods: Yee's FD algorithms, Accuracy & stability, Lattice truncation condition, Initial fields, Absorbing Boundary conditions for FDTD, Scattering problems.

Module -IV:
Integral Equations: Classification of Integral Equations, Relation between Differential and Integral Equations, Green's function: definition, Green's function for free space.

Module -V:
Method of Moments (MoM): Solution of integral equations using MoM, Quasi-static problems (thin conducting wire, parallel plate capacitor), Dipole antenna current distribution & input impedance, mutual impedance of two short dipoles, Scattering from a dipole antenna.

Module -VI:
Finite Element Method: Finite Element Discretization, Element Governing Equations, Assembling of all Elements, Solving the resulting equations, Typical Applications.

Module -VII:
Monte Carlo (MC) methods: Introduction, Fixed and Floating Random Walks, Markov Chains, Solving typical electromagnetic Problems with random walk and Markov chain methods.

Text Books:

1. Numerical Techniques in Electromagnetics Mathew N. O. Sadiku (CRC Press)
2. Analytical and Computational Methods in Electromagnetics, Ramesh Garg, Artech House, 2008.

MEC2029 RF Circuit Design

Department: Electronics and Communication Engineering

Course Code & Title: MEC2029 RF Circuit Design

Pre-requisites: Electromagnetic Theory, Microwave Engineering

Course Assessment methods: Periodic Quizzes, Assignments, Presentations and End Semester Exam

Course Objectives:

1. To explain radio frequency design concept and impart knowledge on design and implementation of high frequency transceiver system.
2. To develop an ability to analyze various components of radio frequency communication system architecture.
3. To develop an ability to analyze different design parameters of transceiver circuit design, besides developing an insight to make use of several high frequency design techniques.
4. To utilize the various RF circuit design concepts in designing the RF transceiver systems.
5. To review and refer the literature related to RF Circuit design and reporting it ethically.

Course Outcomes:

1. Demonstrate understanding on the Radio frequency design concept and impart knowledge on design and implementation of high frequency Transceiver system.
2. Have an ability to analyze various components of Radio frequency communication system architecture.
3. Have an ability to analyze the impact of different design parameters in transceiver circuit design, besides developing an insight to make use of several high frequency design techniques.
4. Have an ability to utilize the various RF circuit design concepts in designing the RF transceiver systems.
5. Have an ability to review and refer the literature related to RF circuit design and report it ethically.

Syllabus

Module -I:

Introduction: Importance of RF Design, RF Behavior of Passive Components: High Frequency Resistors, High-Frequency Capacitors, High-Frequency Inductors. Chip Components and Circuit Board Considerations: Chip Resistors, Chip Capacitors, Surface-Mounted Inductors.

Module -II:

An Overview of RF Filter Design I: Basic Resonator and Filter Configurations: Filter Type and Parameters, Low-Pass Filter, High Pass Filter, Bandpass and Bandstop Filters, Insertion Loss, Special Filter Realizations: Butterworth –Type, Chebyshev and Denormalization of Standard Low-Pass Design.

Module -III:

An Overview of RF Filter Design II: Filter Implementations: Unit Elements, Kuroda's Identities and Examples of Microstrip Filter Design. Coupled Filter: Odd and Even Mode Excitation, Bandpass Filter Section, Cascading Bandpass Filter Elements, Design Examples.

Module -IV:

Matching and Biasing Network: Impedance Matching using Discrete Components: Two Component Matching Networks, Forbidden regions, Frequency Response and Quality Factor, Microstrip Line Matching Networks: From Discrete Components to Microstrip Lines, Single-Stub Matching Networks, Double-Stub Matching Networks, Amplifier Classes of Operation and Biasing Network: Classes of Operation and Efficiency of Amplifiers, Bipolar Transistor Biasing Networks, Field Effect Transistor Biasing Networks.

Module -V:

RF Transistor Amplifier Design I: Characteristics of Amplifiers, Amplifier Power Relations: RF source, Transducer Power Gain, Additional Power Relations, Stability Considerations: Satbility Circles, Unconditional Stability, Stabilization Methods.

Module -VI:

RF Transistor Amplifier Design II: Constant Gain: Unilateral Design, Unilateral Figure of Merit, Bilateral Design, Operating and Available Power Gain Circles. Noise Figure Circles, Constant VSWR Circles. Broadband, High Power and Multistage Amplifiers.

Module -VII:

RF Oscillators and Mixers: Basic Oscillator Model: Negative Resistance Oscillator, Feedback Oscillator Design, Design Steps, Quartz Oscillators. High Frequency Oscillator Configuration: Fixed Frequency Oscillators, Dielectric Resonator Oscillators, YIG-Tuned Oscillators, Voltage Controlled Oscillators, Gunn Element Oscillator. Basic Characteristics of Mixers: Basic Concepts, Frequency Domain Considerations, Single-Balanced Mixer Double-Balanced Mixer.

Text Book:

1. RF Circuit Design Theory and Application, Reinhold Ludwig and Pavel Bretchko, Ed. 2004, Pearson Education

MEC2113 Real Time Embedded System Design

Department: Electronics and Communication Engineering

Course Code & Title: MEC2113 Real Time Embedded System Design

Pre-requisites: Knowledge of different types of microcontroller and microprocessors, Data acquisition system, programming concept in assembly language, C, C++ and System C and semi-custom & full custom ICs design.

Course Assessment methods: Periodic Quizzes, Assignments, Presentations and End Semester Exam

Course Objectives:

1. Demonstrate the important components of Embedded System
2. Explain the design strategy of embedded processors
3. Explain the design methods for semiconductor memories
4. Demonstrate the embedded system input-output peripheral devices, timer and interrupt services
5. Evaluate the utility of interfacing circuits in embedded systems with real time devices

Course Outcomes:

1. Define the important components of embedded systems.
2. Apply the design strategy of embedded systems for creating applications.
3. Design semiconductor compact memories for embedded systems.
4. Illustrate the utility of interfacing circuits in embedded systems with example of digital camera.
5. Develop a system using embedded system peripherals and verify the system performance with real time data.

Syllabus

Module -I:

Introduction to Embedded Systems: Embedded system overview, Design challenges, Common design metrics, Time-tomarket design metric, NRE and unit cost design metrics, Performance design metric, Processor technology, General purpose processors – software and hardware, Application specific processors, IC technology, Semi-custom ASIC.

Module – II:

Embedded System Processors: Combinational logic and transistors, RT-level combinational and sequential components, Custom single purpose processor design. RT-level custom single– purpose processor design, Optimization, Optimization of FSMD, Optimization of data path.

Module-III:
Memory: Write ability and data permanence, memory devices type of memory and basic form, EEPROM, flash memory, SRAM and DRAM, basic DRAM characteristics, memory selection for embedded systems, allocation of memory to the program segment blocks.

Module – IV:
Device and Interrupt service: Bus models, time multiplexed bus, strobe and handshake protocols, strobe handshake compromise priority arbiter multilevel bus, and architecture.

Module -V:
Embedded System Peripherals: Timers, Counters, Watch-dog timers, Example of reaction timer, Watchdog timer, UART, PWM, Controlling a dc motor using a PWM. General purpose processor, ASIP's and ASIC's, semiconductor IC's programmable logic devices of CGD, Processor selection for embedded systems, special purpose processor.

Module – VI:
Interfacing: Communication basics, Basic protocol concepts, ISA bus protocol, Microprocessor interfacing, I/O addressing, Interrupts, Example of DMA I/O and ISA Bus protocol, Arbitration, Priority arbiter, Daisy-chain arbiter, Parallel, Serial and Wireless communication, infrared-TRDA, radio frequency, error detection, CAN, USB, Blue tooth, IEEE 802-II, shared memory models

Module – VII:
Digital Camera and Systems: Simple digital camera, User's perspective, Designer's perspective, Requirement specification, Design, Micro controller alone, Micro controller and CCDPP Digital thermometer, handhold computer, navigation system, IP phone, software defined-radio, smart card.

Text Book:

1. "Embedded System Design A Unified HW.SW Introduction", by Vahid G Frank and Givargis Tony, John Wiley & Sons, 2002.
2. "Embedded Systems Architecture, Programming and Design", by Raj Kamal, TMH-2003

Reference Book:

1. "Fundamental of Embedded System Design & Applications" by Vijay Nath, K.S. Yadav, L.K. Singh, ACM Learning, New Delhi.
2. Introduction to Embedded Systems, K. Shibu, TMH Edition.

MEC2015 Optical Networking and DWDM

Department: Electronics and Communication Engineering

Course Code & Title: MEC2015 Optical Networking and DWDM

Pre-requisites: Knowledge of Data Communication, Optical Fiber Communication System, Computer Networking.

Course Assessment methods: Periodic Quizzes, Assignments, Presentations and End Semester Exam

Course Objectives:

1. To illustrate the different optical network elements required to establish the WDM/DWDM optical networks.
2. To analyze the performance of ring networks as well as broadcast and select optical networks.
3. To build wavelength routing networks for supporting multicast connections and evaluate the penalty due to fiber nonlinearities.
4. To develop ultra-high speed optical network using photonic packet switching and optical soliton.

Course Outcomes:

1. Explain the features of the optical components / devices that can be used to create broadcast networks for LAN and WRON networks for wide area deployment.
2. Analyze SONET ring networks, single hop and multihop broadcast networks where thousands of users are connected with wide range of transmission capacities and speeds.
3. Evaluate wavelength reuse, wavelength conversion in broadcast and select networks, and the non-linear effects that contribute to signal impairment.
4. Develop the switching network and provide packet switched service at the optical layer using Optical Time Division Multiplexing.
5. Develop terabit data rate, repeater less data transmission over very large distances using soliton system.

Syllabus

Module-I:

Optical Network Elements: Passive Components, 2x2 fiber couplers, Scattering Matrix representation, star Couplers, Mach-Zehnder multiplexers, Phase-array-based WDM devices, Fiber Grating, Tunable

Sources, Tunable filters, Circulators, Isolators, Wavelength Converters, Switching Elements, Wavelength Routers.

Module-II:

Optical Amplifiers: Types, Semiconductor Optical Amplifiers, Erbium doped fiber amplifier, amplification mechanism, Conv. efficiency, Gain, Noise, Applications, Power amplifiers, In-line amplifiers, Preamplifiers, Application to Optical Video distribution, Long Span Transmission, Repeaterless Transmission, Under Sea Transmission system.

Module -III:
Optical Networks: Topological performance, SONET/SDH, Broadcast and select WDM networks, Single-hop networks, Multi-hop Networks, Testbeds.

Module -IV:
Wavelength Routed networks, Wavelength Routing Testbeds, Nonlinear effects on network performances, SRS,SBS,SPM,XPM,FWM, Optical CDMA networks.

Module -V:
Dispersion Management: Need for dispersion management, pre-compensation and post compensation technique, Broadband dispersion compensation, Tunable dispersion compensation, Higher order
dispersion management, PMD compensation.

Module-VI:
Optical Switching: Photonic packet switching, Bit interleaving, Packet interleaving, OTDM Testbeds.

Module-VII :
Soliton communication: Solitons, Soliton Pulses, Soliton parameters, Transmission for ultrafast (UF) OTDM signal using Soliton.

Text Book:

1. Optical Fiber Communications"G.Keiser,3/E, McGraw Hill.

Referece Books:

1. B.Mukherjee , Optical Communication Networks, McGraw Hill.
2. R. Ramaswami and K.N. Sivarajan, Optical Networks: A Practical Perspective, Morgan Kaufmann
3. G.P.Agrawal, Fiber Optic Communication Systems, John Wiley & Son (Asia) Pvt. Ltd.
4. J. H. Franz & V. K. Jain, Optical Communications, Narosa Publishing House.

MEC2127 Microwave Integrated Circuits

Department: Electronics and Communication Engineering

Course Code & Title: MEC2127 Microwave Integrated Circuits

Pre-requisites: Basic knowledge of microwave theory and components.

Course Assessment methods: Periodic Quizzes, Assignments, Presentations and End Semester Exam

Course Objectives:

1. To explain the monolithic microwave integrated circuits, its applications, advantages over discrete circuit and different fabrication techniques apart from encapsulation and mounting of active devices.
2. To develop an ability to analyze the microstrip transmission lines and slot lines.
3. To develop an ability to evaluate and analyze the various fin lines and coplanar waveguides apart from the various uses of lumped elements in microwave integrated circuits.
4. To develop an ability to analyze the functionality of various microwave solid state active devices for microwave integrated circuits.
5. To develop an ability to evaluate the performance of microwave integrated circuits by using different measurements and testing techniques.

Course Outcomes:

1. Demonstrate understanding on the Monolithic Microwave Integrated Circuits their applications, advantages, various fabrication techniques such as thin and thick films technologies, encapsulation and mounting of active devices and performance of microstrip on semiconductor substrate.
2. Have anability to analyze the method of conformal transformation for microstrip analysis, transverse resonance method and approximate analysis for slot lines, concepts of effective dielectric constant and various losses associated in microstrip lines.
3. Have an ability to understand the concept, types, applications and various analysis techniques form different fin lines and coplanar waveguides apart from the various uses of lumped elements in microwave integrated circuits.
4. Have an ability to analyse the structure, characteristics , operation, equivalent circuit, gain expression, output power efficiency and applications of various microwave solid state active devices such as; Schottky barrier diode, PIN diode, varactor diode bipolar, MESFETs and HEMTs for microwave integrated circuits.
5. Demonstrate insight to develop an ability to evaluate the performance of microwave integrated circuits by using different measurements and testing techniques.

Syllabus

Module -I:
Introduction to Monolithic Microwave Integrated Circuits (MMICs), their advantages over discrete circuits, MMIC fabrication techniques, Thick and Thin film technologies and materials, encapsulation and mounting of active devices. Microstrips on semiconductor substrates.

Module -II:
Planar transmission lines for MICs. Method of Conformal transformation for microstrip analysis, concept of effective dielectric constant, Effective dielectric constant for microstrip, Losses in Microstrip.

Module -III:
Slot Line Approximate analysis and field distribution, Transverse resonance method and evaluation of slot line impedance, comparison with microstrip line.

Module -IV:
Fin lines & Coplanar Lines. Introduction, Analysis of Fin lines by Transverse Resonance Method, Conductor loss in Fin lines. Introduction to coplanar wave guide and coplanar strips.

Module -V:
Lumped Elements for MICs: Use of Lumped Elements, Capacitive elements, Inductive elements and Resistive elements

Module -VI:
Microwave Solid – State Active Devices for MICs: Schottky Barrier diode, Pin diode, Varactor diode – structure, characteristics, operation, equivalent circuit, gain expression and output power efficiency and applications. Bipolars, MESFETs and HEMTs

Module -VII:
MIC Measurement,Testing and Applications: MIC measurement system, measurement techniques – S parameter measurement, noise measurement, MIC applications.

Text Book:

1. Microwave Integrated circuit, K. C. Gupta.
2. Microwave Devices & Circuits 3/e, Samuel Y. Liao.
3. Microstrip lines and Slot lines, K.C. Gupta, R. Garg. , I. Bahl, P. Bhartia, Artech House, Boston, 1996.

Reference Books:

1. Stripline-like Transmission lines for Microwave Integrated circuits, B. Bhat, S. K. Koul, Wiley Eastern Ltd., New Delhi.
2. Microwave Integrated Circuits, By Ivan Kneppo, J. Fabian, P. Bezousek

MEC2137 Wireless Networks

Department: Electronics and Communication Engineering

Course Code & Title: MEC2137 Wireless Networks

Pre-requisites: Knowledge of Networking fundamentals, and basic idea of Digital and Data Communication.

Course Assessment methods: Periodic Quizzes, Assignments, Presentations and End Semester Exam

Course Objectives:

1. To explain Networking concept and impart knowledge on the various wireless technologies applied for mobile data networking and wireless communication.
2. To develop an ability to analyze various protocol architecture and system architecture of different type of wireless networks.
3. To develop an ability to evaluate the impact of wireless medium and mobility in the network performance, security, applications and system capacity.
4. To develop an ability to analyse the technology and various mobile networking aspects of current and next in wireless personal , local and wide area networks.
5. To develop an ability to design wireless network with modified protocols and for different applications.

Course Outcomes:

1. Demonstrate understanding on the functioning of networking concept, besides demonstrating knowledge on various wireless technologies applied for mobile data networking and wireless communication
2. Have anability to analyze various protocol architecture and system architecture of different type of wireless networks.
3. Have an ability to evaluate the impact of wireless medium and mobility in the network performance, security, applications and system capacity.
4. Have an ability to analyze the technology and various mobile networking aspects of current and next in wireless personal, local and wide area networks.
5. Demonstrate insight to evaluate and design wireless network with modified protocols and for different applications.

Syllabus

Module –I:

Wireless Personal Area Networks: Bluetooth-IEEE 802.15.1: Bluetooth Protocol Stack, Bluetooth Link Type, Bluetooth Security. Network Connection establishment in Bluetooth ZigBee Technology: ZigBee Components & Network Topologies Ultra-Wideband-IEEE 802.15.3a

Module -II:
Wireless Local Area Networks: WLAN Technologies, Protocol architecture, Physical layer, Data link layer, Medium access control layer, Interference between Bluetooth and IEEE 802.11, Security of 802.11 systems

Module -III:
Wireless Wide Area Networks: GSM Evolution for data, 3G Wireless Systems, cdmaOne Evolution, Evolution of cdmaOne to cdma2000 & Differences between cdma2000 & WCDMA.

Module -IV:
TCP over wireless network: Overview of traditional TCP, Impact on the performance of TCP over wireless environment, Link Layer Scheme (Snoop Protocol), The I-TCP protocol, The mobile TCP protocol.

Module –V:
IPv6: IPv4 vs. IPv6, IPv6 addressing, IPv6 header format, IPv6 extension, IPv6 routing architecture, QoS capabilities, IPv6 transition mechanism

Module -VI:
Mobile IP: Mobile IP: New architecture entities, Operation of Mobile IP, Message Format, Agent Discovery, Agent advertisement, Registration, Authentication, Route optimisation, Mobility support for IPV6

Module -VII:
Wireless ATM: WATM services, Reference model, Functions, Radio access layer, Handover, Location management, Access Point Control Protocol.

Text Book:

1. Wireless Communication & Networking by Vijay K. Garg, Elsevier

Reference Books:

1. Mobile communication by J.Schiller, Pearson Education
2. Data Communications and Networking by B. Forouzan
3. www.ietf.org
    i. rfc 3513.txt : IPv6 addressing architecture
    ii. rfc 2460.txt : IPv6 specification

MEC2141 Wireless Signal Propagation and Fading

Department: Electronics and Communication Engineering

Course Code & Title: MEC2141 Wireless Signal Propagation and Fading

Pre-requisites: Understanding of wireless communication channel, communication process, interference and noise in communication process, basic propagation mechanisms, probability theory.

Course Assessment methods: Periodic Quizzes, Assignments, Presentations and End Semester Exam

Course Objectives:

1. To develop an ability to understand nature of wireless signal propagation and models describing wireless signal propagation.
2. To develop an ability to analyze different characteristics of wireless communication channels.
3. To develop an ability to analyze MIMO and other techniques to enhance data rate performance.
4. To develop an understanding of the various causes of channel impairments and the removal techniques.
5. To develop an ability to evaluate capacity of wireless communication systems under different channel conditions.

Course Outcomes:

1. Demonstrate understanding of the nature of wireless signal propagation and models describing wireless signal propagation.
2. Have an ability to analyze different characteristics of wireless communication channels.
3. Have an ability to analyze MIMO and other techniques to enhance data rate performance.
4. Demonstrate understanding of various causes of channel impairments and the removal techniques.
5. Demonstrate insight to evaluate capacity of wireless communication systems under different channel conditions.

Syllabus

Module-I:

Radio Propagation and Path Loss Models: Free space attenuation, attenuation over reflecting surface, effects of earth curvature, radio wave propagation, propagation path loss models (Okumura model, Hata model, COST 231 model), indoor propagation models.

Module-II:

Statistical Multipath Channel Models: Time varying channel impulse response, characteristics of wireless channels, signal fading statistics (Rician distribution, Rayleigh distribution, Lognormal distribution) level crossing rate and average duration of fades, wideband fading models (power delay profile, coherence bandwidth, Doppler spread).

Module-III:
Capacity of Wireless Channels: Capacity in AWGN, Capacity of flat fading channels, capacity of frequency selective channels, time invariant channels, time varying channels.

Module-IV:
Adaptive Modulation and Coding: Adaptive transmission systems, adaptive techniques (variable rate technique, variable power, variable error probability, variable coding technique, hybrid techniques.

Module-V:
Diversity and Equalization Techniques: Realization of independent fading paths, receiver diversity, transmitter diversity, equalizer noise enhancements, equalizer types, folded spectrum and ISI free transmission, linear equalizers, adaptive equalizers.

Module-VI:
Multicarrier Modulation: Data transmission using multiple carriers, mitigation of subcarrier fading, discrete implementation of multicarrier modulation, OFDM, challenges in multicarrier modulation.

Module-VII:
Multiple Antennas and Space Time Communications: MIMO channel capacity, MIMO diversity gain, Beam forming, diversity-multiplexing trade-off, space time modulation and coding, frequency selective MIMO channel, smart antennas.

Text Book:

1. Andrea Goldsmith, “Wireless Communications”, Cambridge University Press, 2005.

Reference Books:

1. Vijay K Garg, “Wireless Communications and Networks”, Morgan Kaufmann Publishers an Imprint of Elsevier, USA 2009 (Indian reprint).
2. Simon Haykin and Michael Moher, “Modern Wireless Communications”, Pearson Education, Delhi, 2005.

MEC2171 Microwave Measurement and Materials Characterization

Department: Electronics and Communication Engineering

Course Code & Title: MEC2171 Microwave Measurement and Materials Characterization

Pre-requisites: Electromagnetic Theory, Microwave Theory.

Course Assessment methods: Periodic Quizzes, Assignments, Presentations and End Semester Exam

Course Objectives:

1. To understand the general properties of electromagnetic materials and their underlying physics at microwave frequency
2. To provide the principles of various microwave methods for material characterization.

Course Outcomes:

1. To discuss the parameters describing the electromagnetic properties of materials at microscopic and macroscopic scales.
2. To categorize electromagnetic materials.
3. To identify suitable method for material characterization.
4. To apply various methods to characterize materials at microwave frequencies.
5. Acquire the capability to modify basic material characterization techniques.

Syllabus

Module -I:
Electromagnetic Properties of Materials: Materials Research and Engineering at Microwave Frequencies, Physics for Electromagnetic Materials ,General Properties of Electromagnetic Materials, Intrinsic Properties and Extrinsic Performances of Materials

Module -II:
Reflection Methods: Introduction, Coaxial-Line Reflection Method, Free-Space Reflection Method, Measurement of Both Permittivity and Permeability Using Reflection Methods, Surface Impedance Measurement.

Module -III:
Transmission/Reflection Methods: Theory for Transmission/Reflection Methods , Coaxial Air-Line Method ,Hollow Metallic Waveguide Method, Surface Waveguide Method , Free-Space Method, Transmission/Reflection Methods for Complex Conductivity Measurement

Module -IV:
Resonator Methods: Introduction, Dielectric Resonator Methods, Coaxial Surface-Wave Resonator Methods, Split-Resonator Method, Dielectric Resonator Methods Measurement for Surface Impedance

Module -V:
Resonant Perturbation Methods: Basic Theory, Cavity-Perturbation Method, Dielectric Resonator Perturbation Method, Measurement of Surface Impedance.

Module -VI:
Planar-Circuit Methods: Introduction, Stripline Methods, Microstrip Methods, Coplanar-Line Methods

Module -VII:
Measurement of Permittivity and Permeability Tensors: Introduction, Measurement of Permittivity Tensors, Measurement of Permeability Tensors, Measurement of Ferromagnetic Resonance, Measurement of Ferromagnetic Materials.

Text Book:

1. Microwave Electronics: Measurement and Materials Characterization, L. F. Chen, C. K. Ong, C. P. Neo, V. V. Varadan, Vijay K. Varadan, John Wiley , ISBN: 978-0-470-84492-2

MEC1022 Antenna Lab.

Department: Electronics and Communication Engineering

Course Code & Title: MEC1022 Antenna Lab.

Pre-requisites: Electromagnetic Theory, Antenna Theory

Course Assessment methods: Regularity/Punctuality, Report presentation, Viva, Day-to-day assessment, Lab quiz and Lab performance

Course Objectives:

1. To understand important and fundamental antenna engineering parameters.
2. To develop the basic skills to learn software and apply in the design varieties of antennas.
3. To develop the basic skills necessary to measure antenna performance parameters.
4. To apply the concepts learnt through theory

Course Outcomes:

1. Have the ability to implement the theoretical knowledge.
2. Apply numerical modelling tools (software) to design antennas, with particular reference to low profile printed antennas.
3. Have the ability to perform antenna measurements.
4. Understand the radiation characteristics and its limitations and provide the environment friendly solutions in terms of antenna design.
5. Have the ability to prepare the reports and present the results.

List of Experiments

1. Design of a rectangular microstrip patch antenna for operating frequency 1.88GHz with ε_r =4.4, h=31 mils with inset feed. (IE3D)
2. Design of a rectangular microstrip patch antenna for operating frequency 1.88GHz with ε_r =4.4, h=31 mils with coaxial feed. (IE3D)
3. Design of a rectangular microstrip patch antenna for operating frequency 5 GHz with ε_r =3.2, h=0.762mm & transformer coupled microstrip feed. (IE3D)
4. Design of a circular microstrip patch antenna for circular polarization with dual feed. Assume resonant frequency =2.78GHz, ε_r =2.33, h=2.184mm, $\tan\delta$=0.0012. (IE3D)
5. Design of a rectangular microstrip patch antenna for operating frequency 1.88GHz with ε_r =4.4, h=31 mils & inset feed. (HFSS)
6. Design of a rectangular microstrip patch antenna for operating frequency 1.88GHz with ε_r =4.4, h=31 mils & transformer coupled microstrip feed. (HFSS)
7. To plot the radiation pattern of a directional antenna. (SIGNET)
8. To plot the radiation pattern of an omnidirectional antenna. (SIGNET)
9. To calculate the resonant frequency and estimate the VSWR of an antenna. (SIGNET)
10. The gain measurement of an antenna under test. (FALCON)
11. Characterization of a linearly polarized antenna. (FALCON)
12. Characterization of a circularly polarized antenna. (FALCON)

Text Books:

1. Antenna Theory, Analysis and Design, 3/E,. A. Balanis, John Wiley.
2. Antennas, J. D. Kraus, TMH

Reference Books:

1. Microstrip Antenna Design Handbook, R. Garg, Bhal and Bhartia, Artech House.

MEC1004 VLSI Design Lab.

Department: Electronics and Communication Engineering

Course Code & Title: MEC1004 VLSI Design Lab.

Pre-requisites: Knowledge of Basic Electronics, Semiconductor Devices, Digital Electronics.

Course Assessment methods: Regularity/Punctuality, Report presentation, Viva, Day-to-day assessment, Lab quiz and Lab performance

Course Objectives:

1. Design CMOS digital circuits at transistor level and verify its performance in a standard circuit simulation platform (Cadence).
2. Design CMOS analog amplifier at transistor level using Virtuoso Analog Design Environment of Cadence and verify its performance.
3. Design basic combinational and sequential digital circuits using hardware description language (HDL) on Xilinx ISE platform.
4. Build a bigger digital module by integrating smaller digital circuits using hardware description language (HDL) on Xilinx ISE platform.
5. Develop an ability to understand VLSI Design Issues

Course Outcomes:

1. Realize digital circuits at transistor level.
2. Realize analog amplifiers at transistor level.
3. Design and model the basic digital circuits using HDL.
4. Design bigger digital module by integrating basic blocks using HDL.
5. Design digital, analog, memory circuits and subsystems keeping design issues in consideration.

List of Experiments

1. Design a CMOS inverter having equal t_{pLH} (low to high) (or positive) output transition and t_{pHL} (high to low) (or negative) transition. Take readings of t_{pLH} and t_{pHL} and tabulate the same against WP (width of PMOSFET) (take $L_n = L_p = 45$ nm) for estimation of t_p (propagation delay), power, PDP, and EDP.
2. Design a 2-input NAND gate having minimum t_p (propagation delay). Tabulate the t_p versus aspect ratio of MOSFETs to find out the aspect ratio at which minimum t_p is achieved.
3. Design a 1-bit full adder with minimum number of MOSFETs. Estimate its t_p (propagation delay), power dissipation, PDP (power-delay product and EDP (energy-delay product).
4. Design a CS (common source) amplifier with resistive load (RD) and default device size for achieving maximum output swing and find out its gain. Carry out dc operating point analysis, ac analysis and transient analysis for the same. Tabulate values of RD and gain in dB and magnitude.
5. Design a CS (common source) amplifier with optimum resistive load (RD) (obtained in experiment 4) and optimum device size for achieving maximum output swing and find out its gain. Carry out dc operating point analysis, ac analysis and transient analysis for the

same. Tabulate device width (W), Length (L) and gain in dB and magnitude.

6. Design a CS (common source) amplifier with active load and optimum device size for achieving maximum output swing and find out its gain. Tabulate device width (W), Length (L) and gain in dB and magnitude
7. Design a circuit to compute factorial of a single digit decimal number using Verilog on Xilinx ISE 8.1i. Synthesize the circuit, download the configuration file to the prototyping board (use Spartan-3E Starter kit) and verify its operation.
8. Design a 4-bit Johnson counter using Verilog on Xilinx ISE 10.1i. Synthesize the circuit, download the configuration file to the prototyping board (use Spartan-3E Starter kit) and verify its operation.
9. Design a circuit to display your name using Verilog on Xilinx ISE 10.1i. Synthesize the circuit, download the configuration file to the prototyping board (use Spartan-3E Starter kit) and show the same on LCD.
10. Design a 2-bit adder using System Generator on Xilinx ISE 10.1i. Synthesize the circuit, download the configuration file to the prototyping board (use Spartan-3E Starter kit) and verify its operation without Chip Scope Pro.
11. Design a 2-bit adder using System Generator on Xilinx ISE 10.1i. Synthesize the circuit, download the configuration file to the prototyping board (use Spartan-3E Starter kit) and verify its operation with Chip Scope Pro.
12. Design 1-bit full adder using structural modeling style and System Verilog. Simulate the same using test bench and ModelSim.

Text Book:

1. CMOS Analog Circuit Design, 2/e, Phillip E. Allen and Douglas R. Holberg, Oxford University Press, ISBN: 0-19-511644-5, 2002.
2. Analog Integrated Circuits Deisgn, Johns Dand Martin K, John Wiley & Sons, 1997. (TB3)
3. Verilog HDL: A Guide to Digital Design and Synthesis by Samir Palnitkar, Publisher: Prentice Hall PTR, Pub Date: February 21, 2003, ISBN: 0-13-044911-3 (TB4)

Reference Book:

1. Design Of Analog CMOS Integrated Circuits, Behzad Razavi,Mcgraw Hill Education, 1st Edition. (RB1)

MEC1006 EMI/EMC Lab.

Department: Electronics and Communication Engineering

Course Code & Title: MEC1006 EMI/EMC Lab.

Pre-requisites: Electromagnetic Theory

Course Assessment methods: Regularity/Punctuality, Report presentation, Viva, Day-to-day assessment, Lab quiz and Lab performance

Course Objectives:

1. To understand importance of EMI & EMC in the current communication scenario.
2. To develop an ability to analyze, measure and evaluate radiated and conducted emissions to examine the compatibility.
3. To understand the impact of crosstalk, placement of components etc. on EMI.
4. To develop an ability to analyze and evaluate the impact of EMI mitigation techniques such as shielding.
5. To develop the ability to prepare the reports and present the results correctly.

Course Outcomes:

1. Understand and illustrate the importance of EMI & EMC.
2. Measure and analyze the conducted emission, radiated emission and crosstalk and determine the compatibility of the device.
3. Understand the impact of crosstalk, placement of components etc. on EMI.
4. Analyze and evaluate the impact of EMI mitigation techniques such as shielding.
5. Prepare the reports and present the results correctly.

List of Experiments

1. To study electrostatic discharge.
2. To study the different crosstalk in the cable and its reduction technique.
3. To measure crosstalk in a three conductor transmission line using VNA.
4. To study the characteristics of Current Probe.
5. To measure the conducted emission using Current Probe.
6. To measure radiated emission from mobile tower.
7. To measure radiated emission from mobile phone.
8. To measure the performance parameter of an EMI sensor.
9. To measure of Shielding Effectiveness of conducting material.
10. Measuring board level emission using Magnetic Field loop Probes.
11. To design and simulate an EMI Sensor.
12. To design and simulate EMI Filter

Text Book:

1. Paul, C., Introduction to Electromagnetic Compatibility, John Wiley & Sons, 1992.
2. Ott, H. W., Noise Reduction Techniques in Electronic Systems, John Wiley & Sons, second edition, 1988.

MEC2026 Computational Electromagnetics Lab.

Department: Electronics and Communication Engineering

Course Code & Title: MEC2026 Computational Electromagnetics Lab.

Pre-requisites: Electromagnetic Theory, MATLAB

Course Assessment methods: Regularity/Punctuality, Report presentation, Viva, Day-to-day assessment, Lab quiz and Lab performance

Course Objectives:

1. To justify the need of numerical techniques for solving the complex EM problems.
2. To understand the basics of numerical techniques to be used in solving complex EM problems.
3. To develop codes for various numerical techniques.
4. To apply developed code to solve complex EM problems.

Course Outcomes:

1. Implement the theoretical knowledge acquired.
2. Justify the need of a specific numerical technique to solve a particular EM problem.
3. Formulate complex EM problems to mathematical model.
4. Apply various numerical methods to different static, scattering and radiation problems
5. Prepare reports and present the results ethically.

List of Experiments

1. Solve the differential equation

   $d^2y/dx^2+4x=3$, for $0\leq x\leq 1$

   Given $y(0)=y(1)=1$, by finite difference method
2. Solve the one dimensional Diffusion Equation. (Heat equation.)

   $\partial^2\Phi/\partial x^2= \partial\Phi/\partial t$, $0\leq x\leq 1$

   having the boundary conditions

   $\Phi(0,t)=0= \Phi(1,t)=0$, $t>0$

   and the initial condition

   $\Phi(x,0)=100$

   by finite difference method in time domain
3. Solve the one dimensional wave eqn.

   $\Phi_{tt}=\Phi_{xx}$, $0<x<1$, $t\geq 0$

   having the boundry conditions

   $\Phi(0,t) = 0 = \Phi(1,t)$, $t\geq 0$

   and the initial conditions

   $\Phi(x,0)= \sin\pi x$, $0<x<1$,

   $\Phi_t(x,0) = 0$, $0<x<1$

   by finite difference method in time domain

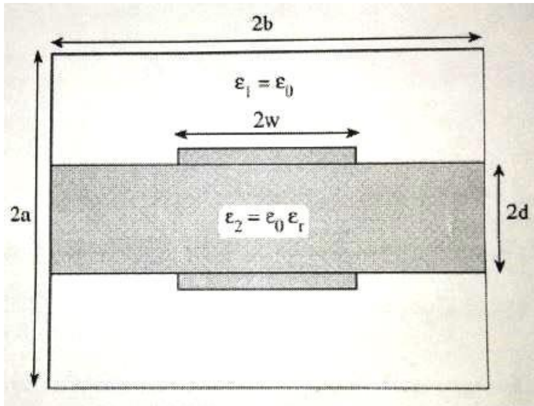
4. Solve the two dimensional Laplace equation

$$\nabla^2 V = 0, \quad 0 \le x, y \le 1$$

With $V(x,1) = 45x(1-x)$, $V(x,0)=0= V(0,y) = V(1,y)$

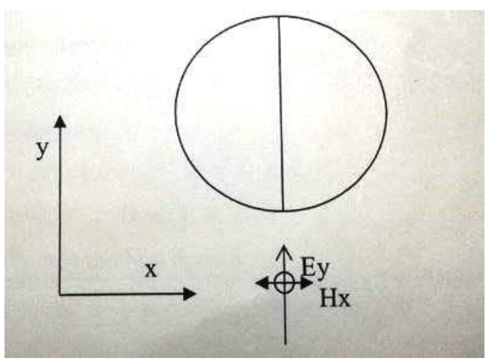
by finite difference method

5. Find the characteristics impedance of a shielded double strip transmission line as shown in the figure.

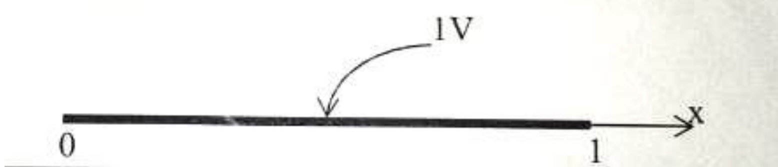


Where $a = b = 2.5cm$, $d=0.5$, $\omega=1cm$, $\varepsilon_1 = \varepsilon_0$, $\varepsilon_2 = 2.35\varepsilon_0$
and the thickness of the strip is neglected . The potential difference applied between the outer metal shield and the inner strips is V_d =100mV.

6. Consider the scattering of **a + y** directed plane wave by a dielectric cylinder which is infinite along the Z-axis .The incident plane wave is Z – polarised and has amplitude 1 mV. The cross section of the cylinder is circular of radius 6cm. The geometry is shown in the figure. Find the variation of $\mathbf{E_z}$ along the diameter shown by the solid line in time domain by Yee's FDTD method.

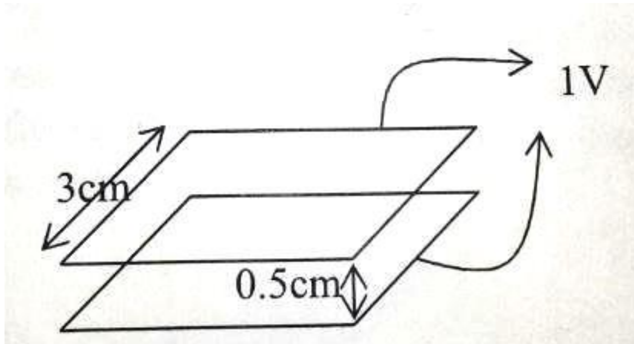


7. A metal rod of length 1m is placed along the X -axis.it is maintained at 1V potential. Find the charge distribution induced over the rod by Method of Moments (MoM).

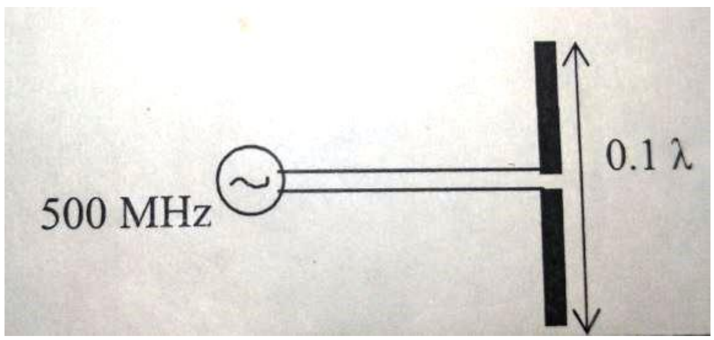


8. A parallel plate capacitor with air as dielectric is given a potential difference 1V across its plates .The area of each square plate is $A=9cm^2$ and they are $d=0.5cm$ apart. Find its capacitance by method of moments (MoM).Compare your result with the formula C=

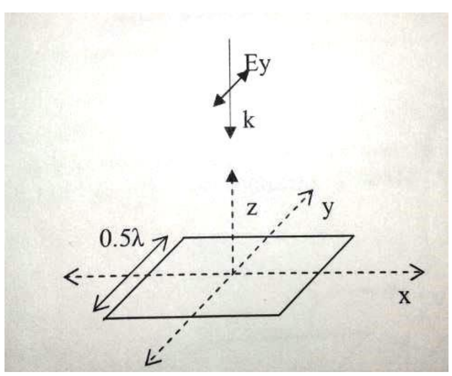
$\varepsilon_0 A/d$.



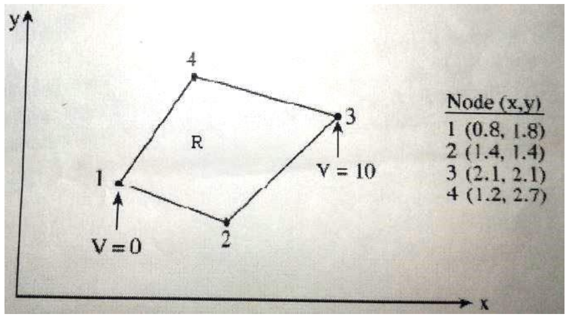
9. A cylindrical dipole antenna of length 0.01λ and radius 0.001λis fed at the centre by a signal generator of frequency 500MHz and amplitude 1mV as shown. Find the current distribution and the input impedance of the dipole by solving Electric Field Integral Equation (EFIE) by Method of Moments (MoM).



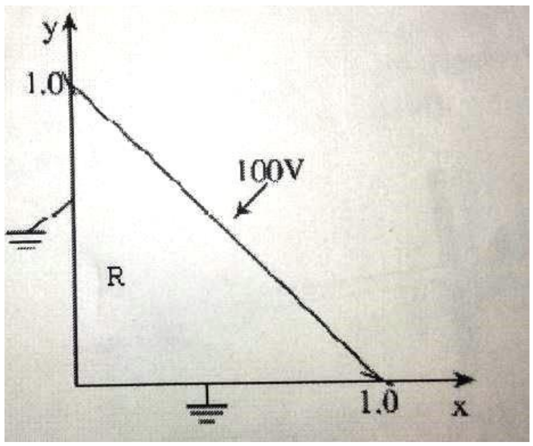
10. A plane wave of frequency 1 GHz and amplitude 1mV with electric field polarized along y-axis is incident upon a conducting square plate of dimension 0.5 λ along the –z direction. The plate is situated over the X-Y plane with origin at the centre. Find the current distribution induced over the plate by solving Electric Field Integral Equation (EFIE) by method of moments (MoM).



11. Find the potential in the region R Shown in the figure by Finite Element Method (FEM). The coordinates of the four nodes and the potential at nodes 1 and 3 are specified.



12. Solve La Place equation inside the region R as shown in the figure by Finite Element Method (FEM).



Text Book:

1. Numerical Techniques in Electromagnetics by Mathew N. O. Sadiku (CRC Press)

Reference Book:

1. Principles of Electromagnetics Mathew N. O. Sadiku, 3rd Ed.

MEC2014 Embedded System Lab.

Department: Electronics and Communication Engineering

Course Code & Title: MEC2014 Embedded System Lab.

Pre-requisites: Fundamental knowledge of Transducers/Sensors, Actuators, Detectors and Control strategies.

Course Assessment methods: Regularity/Punctuality, Report presentation, Viva, Day-to-day assessment, Lab quiz and Lab performance

Course Objectives:

1. Demonstrate the sensing of different physical parameters.
2. Explain the calibration of parameters measured and displayed.
3. Design a measurement and control set-up on LabVIEW using data acquisition.
4. Demonstrate PLC based controls on simulations module.
5. Evaluate the data transfer

Course Outcomes:

1. Define the arithmetical and logical assembly language program for microcontroller AT89S51.
2. Know the downloading procedure on hardware into flash ROM of AT89S51 and show the testing data on defined port and wish board.
3. Construct the circuits & write circuits compatible Verilog code to display & rotate roll number on display board
4. Synthesize & download the 4-bit binary counter, 4bit LFSR(linear feedback shift register), & calculation of factorial of single digital decimal number using Verilog@HDL
5. Competent to evaluate the data transfer response of XC9572CPL & Spartan3E on Xilinx's ISE 80.1i & ISE10.0 platform

List of Experiments

Part I: Experiments using Verilog on Xillinx (ISE 8.1i and ISE 10.1i) and Xilinx XC9572 CPLD trainer Kit:

1. Design a 4:1 MUX using Verilog on Xilinx ISE 8.1i. Synthesize the circuit, download the configuration file to the prototype board (use Xilinx XC9572 CPLD in Milman VLSI Trainer Kit) and verify its operation.
2. Implement a Half Adder circuit using basic gates on Xilinx ISE 8.1i. Synthesize the circuit, download the configuration file to the prototype board (use Xilinx XC9572 CPLD in Milman VLSI Trainer Kit) and verify its operation.
3. Design a 2-bit full adder using System generator on Xilinx ISE 10.1i. Synthesize the circuit, download the configuration file to the prototype board (use Xilinx XC9572 CPLD in Milman VLSI Trainer Kit) and verify its operation.

4. Design an ALU using IP core on Xilinx ISE 8.1i. Synthesize the circuit, download the configuration file to the prototype board (use **Spartan-3E Starter Kit**) and verify its operation.
5. Design a 4-bit Johnson counter using Verilog on Xilinx ISE 10.1i. Synthesize the circuit, download the configuration file to the prototype board (use **Spartan-3E Starter Kit**) and verify its operation.
6. Design a circuit to display your name using Verilog on Xilinx ISE 10.1i. Synthesize the circuit, download the configuration file to the prototype board (use **Spartan-3E Starter Kit**) and show the same on LCD.
7. Design a 4-bit LFSR (linear feedback shift register) using Verilog on Xilinx ISE 8.1i. Synthesize the circuit, download the configuration file to the prototype board (use Xilinx XC9572 CPLD in Milman VLSI Trainer Kit) and verify its operation.
8. Implement 3:8 decoder using Verilog on Xilinx ISE 8.1i. Synthesize the circuit, download the configuration file to the prototype board (use Xilinx XC9572 CPLD in Milman VLSI Trainer Kit) and verify its operation.

Part II: Experiments related to ARM processor implementation (Nuvoton):

1. Write a program to blink a LED provided on the Nuvoton NU-LB_002.
2. Write a program to display your name, Roll No. and the Institute name on the LCD provided on the Nuvoton NU-LB_002.
3. Write a program to sound police and ambulance siren on the buzzer provided on the Nuvoton NU-LB_002.
4. Write a program to realize a decimal counter and show the result on the Nuvoton NU-LB_002.
5. Write a program to map the keypad with
    a) The seven segment display.
    b) The LCD

   And show the result on the Nuvoton NU-LB_002.

Text Book:

1. PIC Microcontroller and Embedded Systems by Muhammad Ali Mazidi, Pearson
2. Verilog@HDL, A Guide to Digital Design and Synthesis, 2nd Edition, IEEE 1364-2001 by Samir Palnitkar

Reference Book:

1. INTRODUCTION TO EMBEDDED SYSTEMS, by K. Shibu, TMH Edition. 3. “Embedded Systems Architecture, Programming and Design”, by Raj Kamal, TMH-2003.
2. VERILOG HDL, A Guide to Digital Design and Synthesis, by Prabhu Goel, MULTI-D

MEC2028 Microwave Integrated Circuit Lab.

Department: Electronics and Communication Engineering

Course Code & Title: MEC2028 Microwave Integrated Circuit Lab.

Pre-requisites: Basic Knowledge of Microwave and RF Design.

Course Assessment methods: Regularity/Punctuality, Report presentation, Viva, Day-to-day assessment, Lab quiz and Lab performance

Course Objectives:

1. Knowledge of the concept of microstrip transmission line and its application in the analysis and design of distributed microstrip circuits
2. Design and analysis of Low Noise Amplifier, Oscillator and Active Device Integrated antenna
3. Fabrication and measurement of MIC devices will be covered in order to understand the major MIC fabrication and testing techniques and how they interact with system design strategies

Course Outcomes:

1. Design of distributed microstrip filters
2. Design of microstrip couplers, phase shifter and interdigital capacitor
3. Design of microwave active devices, oscillator and amplifier.
4. Fabrication of the MIC devices
5. Measurement of the MIC devices

List of Experiments

1. Design and simulation of a 50Ω microstrip line using SONNET.
2. Design and simulation of a Low Pass Filter using SONNET
3. Design and simulation of a microstrip Band Pass Filter using SONNET
4. Design and simulation of a Branch Line Coupler using SONNET
5. Design and simulation of a 450 or 900 Phase Shifter using SONNET
6. Design and simulation of an Interdigital Capacitor using SONNET.
7. Fabrication and testing of any of the designed filters.
8. Fabrication and testing of any of the designed circuit component (BLC/Power Divider).
9. Design and simulation of a Low Noise Amplifier using Microwave Office.
10. Design and simulation of an Oscillator using Microwave Office.
11. Design and simulation of a Low Pass Filter using Microwave Office.
12. Design and simulation of an Active Device Integrated antenna using Microwave Office.

Text Book:

1. Microwave Integrated circuit, K. C. Gupta, John Wiley,Newyork, 1974
2. Microstrip lines and Slot lines, K.C. Gupta, R. Garg. , I. Bahl, P. Bhartia, Artech House, Boston, 1996.

Reference Book:

1. Stripline-like Transmission lines for Microwave Integrated circuits, B. Bhat, S. K. Koul, Wiley Eastern Ltd., New Delhi.
2. Microwave Integrated Circuits, By Ivan Kneppo, J. Fabian, P. Bezousek