M. TECH. ECE (MICRO ELECTRONICS)

Total Contact Hours = 24 Total Marks = 600 Total Credits = 22

SEMESTER 1st		Contact Hrs			Marks			Credits
Subject Code	**Subject Name**	**L**	**T**	**P**	**Int.**	**Ext.**	**Total**	
MECE5-101	Hardware Description Languages and VLSI Design	4	0	0	40	60	100	4
MECE5-102	Microelectronics	4	0	0	40	60	100	4
MECE5-103	Advanced Semiconductor Physics	4	0	0	40	60	100	4
MECE5-104	Research Lab-I	0	0	4	60	40	100	2
Departmental Elective – I (Select any one)		4	0	0	40	60	100	4
MECE5-156	Nanoscale Devices and Systems							
MECE5-157	Electronic System Design							
MECE5-158	Information Theory and Coding							
MECE5-159	Digital Signal Processing							
Departmental Elective – II (Select any one)		4	0	0	40	60	100	4
MECE5-160	Sensors & Transducers							
MECE5-161	Optoelectronics							
MECE5-162	Materials Science & Engineering							
MECE5-163	Soft Computing							
Total		**20**	**0**	**4**	**260**	**340**	**600**	**22**

Total Contact Hours = 24 Total Marks = 600 Total Credits = 22

SEMESTER 2nd		Contact Hrs			Marks			Credits
Subject Code	**Subject Name**	**L**	**T**	**P**	**Int.**	**Ext.**	**Total**	
MECE5-205	Micro & Nano Electromechanical Systems (MEMS and NEMS)	4	0	0	40	60	100	4
MECE5-206	CPLD and FPGA Architectures and Applications	4	0	0	40	60	100	4
MECE5-207	Research Lab -II	0	0	4	60	40	100	2
Departmental Elective – III (Select any one)		4	0	0	40	60	100	4
MECE5-264	Satellite Communication							
MECE5-265	Testing & Fault Tolerance							
MECE5-266	MOS Integrated Circuit Modelling							
MECE5-267	Parallel Processing							
Departmental Elective – IV (Select any one)		4	0	0	40	60	100	4
MECE5-268	CAD Tools for VLSI Design							
MECE5-269	Nano Electronics							
MECE5-270	Multimedia Communication System							
MECE5-271	Low Power VLSI Design							
Open Elective – I (Select any One)		4	0	0	40	60	100	4
Total		**20**	**0**	**4**	**260**	**340**	**600**	**22**

Total Contact Hours = 26 **Total Marks = 500** **Total Credits = 22**

SEMESTER 3rd		Contact Hrs			Marks			Credits
Subject Code	**Subject Name**	**L**	**T**	**P**	**Int.**	**Ext.**	**Total**	
MREM0-101	Research Methodology	4	0	0	40	60	100	4
MECE5-308	Project	0	0	10	100	0	100	8
MECE5-309	Seminar	0	0	4	100	0	100	2
Departmental Elective – V (Select any one)		4	0	0	40	60	100	4
MECE5-372	Digital Signal Processors and Architectures							
MECE5-373	Error Control and Coding							
MECE5-374	Measurement & Characterisation Techniques							
MECE5-375	CMOS VlSI Design							
Total		**12**	**0**	**14**	**320**	**180**	**500**	**22**

Total Credits = 24

SEMESTER 4th		Contact Hrs			Evaluation Criteria	Credits
Subject Code	**Subject Name**	**L**	**T**	**P**	**Satisfactory/ Unsatisfactory**	
MECE5-410	Thesis	0	0	24		24

Overall

Semester	Marks	Credits
1st	600	22
2nd	600	22
3rd	500	22
4th	--	24
Total	**1700**	**90**

Subject Code: MECE5-101 | **L T P C 4 0 0 4** | **Duration: 45 Hrs.**

UNIT-I (11 Hrs.)

MOS TRANSISTOR THEORY: Introduction, Ideal I-V Characteristics, Second Order Effects, CMOS Logic, CMOS Fabrication and Layout, VLSI Design Flow.

CIRCUIT CHARACTRIZATION AND PERFORMANCE ESTIMATION: CMOS Inverter, DC Transfer Characteristics, Delay Estimation, Logical Effort, Power Dissipation, Scaling and Latch-up.

UNIT-II (11 Hrs.)

COMBINATIONAL AND SEQUENTIAL CIRCUIT DESIGN: Static CMOS, Ratioed Circuits, Differential Cascode Voltage Switch Logic, Dynamic Circuits, Domino Logic-Pass Transistor Circuits, CMOS D Latch and Edge Triggered Flip-flop and Schmitt trigger.

UNIT-III (12 Hrs.)

HDL PROGRAMMING USING BEHAVIORAL AND DATA FLOW MODELS: Verilog, Introduction, Typical Design Flow, Modules and Ports, Instances, Components, Lexical Conventions, Number Specification, Strings, Identifiers and Keywords, Data Types, System Tasks and Compiler Directives, Behavioural Modelling, Dataflow Modelling, RTL, Gate Level Modelling, Programs For Combinational and Sequential.

UNIT-IV (11 Hrs.)

HDL PROGRAMMING WITH STRUCTURAL AND SWITCH LEVEL MODELS: Tasks and Functions, Difference between Tasks and Functions, Switch Level, MOS Switches, CMOS Switches, Examples: CMOS NAND and NOR, MUX using Transmission Gate, CMOS Flip-Flop.

RECOMMENDED/REFERENCE BOOKS:

1. Neil H.E. Weste, David Harris and Ayan Banenjee, 'CMOS VLSI Design', 3rd Edn., Pearson, **2004.**
2. Sung Mu Kang and Yusuf Leblebici, 'CMOS Digital Integrated Circuits', 3rd Edn., Tata Mc-Graw Hill, **2002.**
3. Samir Palnitkar, 'Verilog HDL', 2nd Edn., Pearson, **2004.**

MICRO ELECTRONICS

Subject Code: MECE5-102 | **L T P C 4 0 0 4** | **Duration: 45 Hrs.**

UNIT-I (11 Hrs.)

CRYSTAL GROWTH AND WAFER PREPARATION:

Clean room concept, safety requirements, crystal growth techniques: czochralski and gradient freeze techniques, physics involved in CZ growth, Energy flow balance, pull rate-considerations, problems and solutions, defects involved in CZ method, effects due to carbon and oxygen impurities, modelling of dopant incorporation, float zone growth for high purity silicon, liquid encapsulated growth for GaAs, material characterization- wafer shaping, crystal characterization, wafer cleaning.

CURRENT ELEMENT CHARACTERISTICS:

Growth mechanism and kinetic oxidation, thin oxides, oxidation techniques and systems, oxide properties, characterization of oxide films, growth and properties of dry and wet oxidation, charge distribution during oxidation, oxide characterization, anomalies with thin oxide regime.

UNIT-II (10 Hrs.)

DIFFUSION:
The nature of diffusion, diffusion mechanisms – interstitial, substitution, interstitial-substitution combined, interstitially and grain boundary, Fick's law of diffusion, limited and constant source diffusion, models of diffusion in solid, diffusion equation, atomic diffusion mechanisms, diffusion system for silicon and gallium arsenide. Measurement techniques, experimental analysis of diffused profiles.

ION IMPLANTATION:
Introduction, physics of implantation, range theory, projected range, ion stopping mechanisms- channelling, nuclear stopping, electronic stopping, implantation damage, implantation equipment, annealing, shallow junction, application to silicon and gallium arsenide, RTA mechanism.

UNIT-III (12 Hrs.)

LITHOGRAPHY:
Pattern generation and mask making, exposure sources, photolithography, photoresists, optical lithography, electron lithography, X-ray lithography, ion lithography, mask defects, atomic force microscopy based lithography system, dip pen lithography system.

DEPOSITION:
Need for film deposition, film deposition methods- physical and chemical, deposition processes, CVD techniques for deposition of polysilicon, silicon dioxide, silicon nitride and metal films, sputter deposition, sputter unit, Epitaxy –types, techniques, advantages, vapour phase epitaxy, molecular beam epitaxy.

UNIT-IV (12 Hrs.)

ETCHING:
Directionality and selectivity issues, wet chemical etching, wet etchants, dry physical etching, dry etchants, plasma etching, advantages and disadvantages, issues involved, dry etching systems, dry chemical etching, reactive ion etching, etching induced damage, cleaning.

METALLIZATION:
Introduction, metallization applications, metallization choices, physical vapour deposition, patterning, metallization problems.

RECOMMENDED BOOKS:
1. S.M. Sze, 'VLSI Technology', TMH.
2. S.K. Gandhi, 'VLSI Fabrication Principles'.

REFERENCE BOOKS:
1. S.M. Sze, 'Semiconductor Devices Physics and Technology'.
2. K.R. Botkar, 'Integrated Circuits'.

ADVANCED SEMICONDUCTOR PHYSICS

Subject Code: MECE5-103 | **L T P C 4 0 0 4** | **Duration: 45 Hrs.**

UNIT-I (12 Hrs.)

Preparation and Characterization of Semiconductors: Types of semiconductors, charge carrier statistics, crystal growth, preparation and doping techniques of elemental and compound semiconductors, Metallization, Lithography and Etching, Bipolar and MOS device fabrication characterization (electrical, thermoelectric, magnetic and optical properties) of semiconductor materials.

UNIT-II (10 Hrs.)

Optical Properties of Semiconductors: Dipolar elements in direct gap semiconductors, optical susceptibility of a semiconductor, absorption and spontaneous emission, bimolecular recombination coefficient, condition for optical amplification in semiconductors.

UNIT-III (12 Hrs.)

Electronic and Electric Properties of Semiconductors: Boltzmann equation, scattering mechanisms, hot electrons, recombination, transport equation in a semiconductor, Electronic and ionic conductivity, solid oxide fuel cells, ceramic semiconductors, linear dielectrics, dielectric properties, Ferroelectric materials, piezoelectrics, ferro-piezoceramics, actuators and electrostrictions, pyroelectrics, electro-optics photorefractives, thin film capacitors. Ferroic crystals, primary and secondary ferroics, proper ferroics, magnetoferroelectricity.

UNIT-IV (11 Hrs.)

Application in Semiconductor Devices: Ge, Si, GaAs, Semiconductor device: metal-semiconductor and semiconductor heterojunctions, physics of bipolar devices, fundamentals of MOS and field effect devices, basics of solar cell, photodiodes, photodetectors.

RECOMMENDED BOOKS:

1. S.M. Sze and Kwok. K. Ng, 'Physics of Semiconductor Devices', 3rd Edn., Wiley, **2008.**
2. J. Wilson and J.F.B. Hawkes, 'Optoelectronics: An Introduction'. Prentice-Hall, **1989.**
3. R.A. Smith, 'Semiconductors', Academic Press, **1963.**
4. M. Shur, 'Physics of Semiconductor Devices', Prentice Hall, **1990.**
5. A. Paul, 'Chemistry of Glasses', Chapman and Hall, **1982.**
6. Bishnu P. Pal, 'Fundamentals of Fibre Optics in Telecommunication and Sensor Systems', New Age International Publishers, **2005.**
7. Kwan Chi Kao, 'Dielectric Phenomena in Solids', Elsevier Academic Press, **2004.**
8. Vinod K. Vadhawan, 'Introduction to Ferroic Materials', Gordon and Breach Science Publications, **2000.**

RESEARCH LAB.-I

Subject Code: MECE5-104 **L T P C**
0 0 4 2

Every Subject In-charge will define atleast one project to each student of his/her (preferably different) concerned subject to be performed in Research- Lab.

NANOSCALE DEVICES AND SYSEMS

Subject Code: MECE5-156 **L T P C** **Duration: 45 Hrs.**
4 0 0 4

UNIT-I (10 Hrs.)

CMOS scaling challenges in nanoscale regimes: Moor and Koomey's law, Leakage current mechanisms in nanoscale CMOS, leakage control and reduction techniques, process variations in devices and interconnects.

UNIT-II (13 Hrs.)

Device and technologies for sub 100nm CMOS: Silicidation and Cu-low k interconnects, strain silicon – biaxial stain and process induced strain; Metal-high k gate; Emerging CMOS technologies at 32nm scale and beyond – FINFETs, surround gate nanowire MOSFETs, heterostructure (III-V) and Si-Ge MOSFETs.

UNIT-III (11 Hrs.)

Device scaling and ballistic MOSFET: Two dimensional scaling theory of single and multigate MOSFETs, generalized scale length, quantum confinement and tunnelling in MOSFTEs, velocity saturation, carrier back scattering and injection velocity effects, scattering theory of MOSFETs.

UNIT-IV (11 Hrs.)

Emerging nanoscale devices: Si and hetero-structure nanowire MOSFETs, carbon nanotube MOSFETs, Tunnel FET, quantum wells, quantum wires and quantum dots; Single electron transistors, resonant tunnelling devices.

Recommended Books:

1. M. Lundstrom, 'Nanoscale Transport: Device Physics, Modeling, and Simulation', Springer, **2005.**
2. Sandip Kundu, Aswin Sreedhar, 'Nanoscale CMOS VLSI Circuits: Design for Manufacturability', McGraw Hill, **2010.**
3. C.K. Maiti, S. Chattopadhyay and L.K. Bera, 'Strained-Si and Hetrostructure Field Effect Devices', Taylor and Francis, **2007.**
4. G.W. Hanson, 'Fundamentals of Nanoelectronics', Pearson India, **2008.**

ELECTRONIC SYSTEM DESIGN

Subject Code: MECE5-157	L T P C 4 0 0 4	Duration: 45 Hrs.

UNIT-I (10 Hrs.)

MSI and LSI Circuits and Their Applications: Review of Digital electronics concept, Arithmetic Circuits, Comparators, Multiplexers, Code Converters, XOR and AND OR INVERTER Gates, Wired Logic, Bus Oriented Structures, Tri-State Bus System, Propagation Delay.

UNIT-II (12 Hrs.)

Sequential Machines: The Concept of Memory, The Binary Cell, The Cell And The Bouncing Switch, Set/Reset, D, Clocked T, Clocked JK Flip Flop, Design Of Clock F/F, Conversion, Clocking Aspects, Clock Skew, State Diagram Synchronous Analysis Process, Design Steps For Traditional Synchronous Sequential Circuits, State Reduction, Design Steps For Next State Decoders, Design Of Out Put Decoders, Counters, Shift Registers and Memory.

UNIT-III (11 Hrs.)

Multi Input System Controller Design: System Controllers, Design Phases And System Documentation, Defining The System, Timing And Frequency Considerations, Functional, Position And Detailed Flow Diagram Development, MDS Diagram, Generation, Synchronizing Two System And Choosing Controller, Architecture, State Assignment, Next State Decoders And Its Maps, Output Decoders, Clock And Power Supply Requirements, MSI Decoders, Multiplexers In System Controllers, Indirect Addressed Multiplexers Configurations, Programmable System Controllers, ROM, PLA And PAL Based Design.

UNIT-IV (12 Hrs.)

Asynchronous Finite State Machines: Scope, Asynchronous Analysis, Design Of Asynchronous Machines, Cycle And Races, Plotting And Reading The Excitation Map, Hazards, Essential Hazards Map Entered Variable, MEV Approaches To Asynchronous Design, Hazards In Circuit Developed By MEV Method, Electromagnetic Interference And Electromagnetic Compatibility Grounding And Shielding of Digital Circuits. Interfacing digital system with different media like fiber cable, co-axial cable etc.

Recommended Books:

1. Fletcher, 'An Engineering Approach to Digital Design', PHI, **1990.**
2. 'Designing with TTL Circuits', Texas Instruments.
3. Related IEEE/IEE Publications.

INFORMATION THEORY AND CODING

Subject Code: MECE5-158 **L T P C** **Duration: 45 Hrs.**
4 0 0 4

UNIT-I (11 Hrs.)

Elements of information theory Source coding theorem, Huffman coding, Channel coding theorem, channel capacity theorem, Shenonfano theorem, entropy

UNIT-II (11 Hrs.)

Sampling Process Base band and band pass sampling theorems reconstruction from samples, Practical aspects of sampling and signal recovery TDM

UNIT-III (11 Hrs.)

Waveform Coding Techniques PCM Channel noise and error probability DPCM and DM Coding speech at low bit rates Prediction and adaptive filters. Base band shaping for data transmission, PAM signals and their power spectra Nyquist criterion ISI and eye pattern Equalization.

UNIT-IV (12 Hrs.)

Digital Modulation Techniques Binary and M-ary modulation techniques, Coherent and non-coherent detection, Bit Vs symbol error probability and bandwidth efficiency. Bit error analysis, using orthogonal Signaling. Error Control Coding Rationale for coding Linbear block codes, cyclic codes and convolution codes Viterbi decoding algorithm and trellis codes.

Books Recommended:

1. J. Dass, S.K. Malik & P.K. Chatterjee, ,'Principles of digitals communication', Wiley-Blackwel, **1991**.
2. Vera Pless,'Introduction to the Theory of Error Correcting Codes', 3rd Edn., **1998.**
3. Robert G. Gallanger, 'Information Theory and Reliable Communication', Mc Graw Hill, **1992.**

DIGITAL SIGNAL PROCESSING

Subject Code: MECE5-159 **L T P C** **Duration: 45 Hrs.**
4 0 0 4

UNIT-I (12 Hrs.)

DISCRETE TIME SIGNALS AND SYSTEMS

Signals, Classification of signals, Signal processing, Basic elements of a digital signal processing system, Advantages of digital signal processing over analog signal processing, Sampling, Aliasing, Discrete-time systems, Analysis of discrete-time linear shift-invariant systems, Linearity, Causality and stability criterion, Discrete-time systems described by difference equations, Convolution.

UNIT-II (13 Hrs.)

DISCRETE TRANSFORMS

The Fourier transform of discrete-time signals (DTFT), Properties of the DTFT, The frequency response of an LTI discrete-time system, Frequency domain sampling and DFT: Properties of DFT, Linear filtering using DFT, Frequency analysis of signals using DFT, radix 2, Goertzel algorithm, Efficient computation of the DFT: Decimation-in-time and decimation-in frequency, Linear convolution using DFT, Fast Fourier transform algorithms, Applications of FFT algorithm, Introduction to the Z-transform & the inverse Z-transform, Properties of the Z-transform, Relationship between the Fourier transform and the Z-transform, System function, Analysis of linear time-invariant systems in the Z-domain.

UNIT-III (9 Hrs.)

IMPLEMENTATION OF DISCRETE TIME SYSTEMS:
Direct form, Cascade form, Frequency sampling and lattice structures for FIR systems. Direct forms, Transposed form, Cascade form, Parallel form. Lattice and lattice ladder structures for IIR systems.

UNIT-IV (11 Hrs.)

DESIGN OF FIR IIR FILTERS:
General considerations of digital filter design, Characteristics of practical frequency selective filters. Filters design specifications, Design of FIR filters using windows, Gibbs phenomenon, Design of FIR filters by frequency sampling method, Design of optimum equiripple FIR filters. Comparison of design methods for FIR filters. Design of IIR filters from analog filters, Design by approximation of derivatives, Impulse invariance method, Bilinear transformation method, Characteristics of Butterworth, Chebyshev and Elliptical analog filters, Frequency transformation, Least square methods.

Recommended Books:

1. John G. Proakis & Dimitris G. Manolakis, 'Digital Signal Processing: Principles, Algorithms and Applications', 2nd Edn., Pearson Education.
2. A.V. Openheim & R.W. Schafer, 'Discrete Time Signal Processing', 2nd Edn., PHI, **1998**.

Reference Books:

1. Alan V. Oppenheim & Ronald W. Schafer; 'Digital Signal Processing', 1st Edn., PHI Publication, **2007**.

SENSORS & TRANSDUCERS

Subject Code: MECE5-160 **L T P C** **Duration: 45 Hrs.**
4 0 0 4

UNIT-I (9 Hrs.)

Sensors/Transducers: Principles, Classification, Parameters, Characteristics (Static and Dynamic), Environmental Parameters (EP), Characterization.

Mechanical and Electromechanical Sensors: Introduction, Resistive Potentiometer, Strain Gauge (Resistance and Semiconductor), Inductive Sensors: Sensitivity and Linearity of the Sensor, Types-Capacitive Sensors, Electrostatic Transducer, Force/Stress Sensors Using Quartz Resonators, Ultrasonic Sensors.

UNIT –II (13 Hrs.)

Thermal Sensors: Introduction, Gas Thermometric Sensors, Thermal Expansion Type Thermometric Sensors, Acoustic Temperature Sensor, Dielectric Constant and Refractive Index Thermosensors, Helium Low Temperature Thermometer, Nuclear Thermometer, Magnetic Thermometer, Resistance Change Type Thermometric Sensors, Thermoemf Sensors, Junction Semiconductor Types, Thermal Radiation Sensors, Quartz Crystal Thermoelectric Sensors, NQR Thermometry, Spectroscopic Thermometry, Noise Thermometry and Heat Flux Sensors.

Magnetic sensors: Introduction, Sensors and the Principles Behind, Magnetoresistive Sensors (Anisotropic and Semiconductor), Hall Effect and Sensors, Inductance and Eddy Current Sensors, Angular/Rotary Movement Transducers (Synchros and Synchro-resolvers), Eddy Current Sensors, Electromagnetic Flowmeter, Switching Magnetic Sensors and SQUID Sensors.

UNIT-III (11 Hrs.)

Radiation Sensors: Introduction, Basic Characteristics, Types of Photosensistors/Photo Detectors, X-ray and Nuclear Radiation Sensors and Fiber Optic Sensors.

Electroanalytical Sensors: Introduction, The Electrochemical Cell, The Cell Potential, Standard Hydrogen Electrode (SHE), Liquid Junction and Other Potentials, Polarization (Concentration, Reactive, Adsorption and Charge Transfer), Reference Electrodes, Sensor Electrodes and Electroceramics in Gas Media.

UNIT-IV (12 Hrs.)

Smart Sensors: Introduction, Primary Sensors, Excitation, Amplification, Filters, Converters, Compensation, Information Coding/Processing, Data Communication (Standards for Smart Sensor Interface) and The Automation

Sensor's Applications: Introduction, On-board Automobile Sensors (Automotive Sensors), Home Appliance Sensors, Aerospace Sensors, Sensors for Manufacturing and Sensors for Environmental Monitoring.

RECOMMENDED/REFERENCE BOOKS:

1. D. Patranabis, 'Sensors and Transducers', 2nd Edn., PHI, **2003.**
2. W. Bolton, 'Mechatronics', 4th Edn., Pearson, **2011.**

OPTOELECTRONICS

Subject Code: MECE5-161 | **L T P C 4 0 0 4** | **Duration: 45 Hrs.**

UNIT-I (11 Hrs.)

Nature of light, light sources, black body, colour temperature, units of light, radio metric and photometric units, basic semiconductors, PN junction, carrier recombination and diffusion, injection efficiency, heterojunction, internal quantum efficiency, external quantum efficiency, double hetero junction, fabrication of heterojunction, quantum wells and super lattices.

UNIT-II (11 Hrs.)

Optoelectronic devices, Optical modulators, modulation methods and modulators, transmitters, optical transmitter circuits, LED and laser drive circuits, LED-Power and efficiency, double hereostructure LED, LED structures, LED characteristics, laser modes, strip geometry, gain guided lasers, index guided lasers.

UNIT-III (11 Hrs.)

Modulation of light, birefringence, electro-optic effect, Electro-Optic materials and applications, Kerr modulators, scanning and switching, self-electro-optic devices, Magneto-Optical devices, Acousto-Optic devices, Acousto-Optic modulators.

UNIT-IV (12 Hrs.)

Display devices, Photoluminescence, cathodoluminescence, EL display, LED display, drive circuitry, plasma panel display, liquid crystals, properties, LCD displays, numeric displays.

Photo detectors, thermal detectors, photoconductors, detectors, photon devices, PMT, photodiodes, photo transistors, noise characteristics of photo-detectors, PIN diode, APD characteristics, Design of detector arrays, CCD, Solar cells.

RECOMMENDED BOOKS:

1. John Wilson and J.F.B. Hawkes, 'Optoelectronics: An Introduction', Prentice-Hall India, **1996.**
2. J.M. Senior, 'Optical Fibre Communication', Prentice Hall India, **1985.**
3. J. Gowar, 'Optical Fibre Communication Systems', Prentice Hall, **1995.**
4. J. Palais, 'Introduction to Optical Electronics', Prentice Hall, **1988.**
5. Jasprit Singh, 'Semiconductor Optoelectronics', McGraw-Hill, **1995.**

6. P. Bhattacharya, 'Semiconductor Optoelectronic Devices', PHI, **1995.**
7. R.P. Khare, 'Fibre Optics and Optoelectronics', Oxford University Press, **2004.**

MATERIAL SCIENCE & ENGINEERING

Subject Code: MECE5-162 **L T P C** **Duration: 45 Hrs.**
4 0 0 4

UNIT-I (12 Hrs.)

Atomic Structure, Bonding Classifications, Seven Systems and Fourteen Lattices, Metal, Ceramic, Polymeric and Semiconductor Structures, X-ray Diffraction, and Defects (Point, Linear and Planar), Diffusion, Mechanical Behavior: Stress versus Strain, Elastic and Plastic Deformation, Hardness, Creep and Stress Relaxation, Viscoelastic Deformation. Thermal Behavior: Heat capacity, Thermal expansion, conductivity and shock, Failure Analysis & Prevention.

UNIT-II (13 Hrs.)

Phase Diagrams-Equilibrium Microstructural Development: Phase Rule and Diagram, Lever Rule, Heat Treatment, Metals, Ceramics and Glasses, Polymerization, Structural Features of Polymers, Thermoplastic and Thermosetting Polymers, Composites (Fiber Reinforced and Aggregate), Mechanical Properties and Processing of Composites, Electrical Behavior, Optical Behavior, Corrosion & Oxidation Semiconductor Materials, Magnetic Materials, Environmental Degradation.

UNIT-III (14 Hrs.)

Superconductivity, Band Structure, Carrier Concentration, Electrical, Mechanical and Optical properties of Gallium Nitride (GaN), Aluminum Nitride (AlN), Indium Nitride (InN), Boron Nitride (BN), Silicon Carbide (SiC), Silicon-Germanium(Si1-xGex).

UNIT-IV (6 Hrs.)

Materials of Special Applications viz. Cryogenic, High Temperature, High Frequency Application.

RECOMMENDED/REFERENCE BOOKS:

1. Michael E. Levinshtein, Sergey L. Rumyantsev and Michael S. Shur, 'Properties of Advanced Semiconductor Materials: GaN, AlN, InN, BN, SiC and SiGe', John Wiley & Sons, **2001**.
2. James F. Shackelford, 'Introduction to Materials Science for Engineers', 6^{th} Edn., Prentice Hall, **2001**.
3. 'Fundaments of Semiconductors: Physics and Materials Properties by Yu and M Cardona', Springer, **1996.**
4. K.M. Gupta, 'Materials Science & Engineering', 5^{th} Edn., Umesh Publications, **2012**.

SOFT COMPUTING

Subject Code: MECE5-163 **L T P C** **Duration: 45 Hrs.**
4 0 0 4

UNIT – I (12 Hrs.)

Soft Computing: Introduction of soft computing, soft computing vs. hard computing, various types of soft computing techniques, applications of soft computing.

Fuzzy Logic: Fuzzy set versus crisp set, basic concepts of fuzzy sets, membership functions, basic operations on fuzzy sets and its properties. Fuzzy relations versus Crisp relation,

Fuzzy rule base system: Fuzzy propositions, formation, decomposition & aggregation of fuzzy rules, fuzzy reasoning, Fuzzy Inference Systems (FIS) – Mamdani Fuzzy Models –

Sugeno Fuzzy Models – Tsukamoto Fuzzy Models, Fuzzification and Defuzzification, fuzzy decision making & Applications of fuzzy logic.

UNIT – II (13 Hrs.)

Structure and Function of a single neuron: Biological neuron, artificial neuron, definition of ANN and its applications. Neural Network architecture: Single layer and multilayer feed forward networks and recurrent networks. Learning rules and equations: Perceptron, Hebb's, Delta, winner take all and out-star learning rules. Supervised Learning Network: Perceptron Networks, Adaptive Linear Neuron, Multiple Adaptive Linear Neuron, Back Propagation Network, Associative memory networks, Unsupervised Learning Networks: Competitive networks, Adaptive Resonance Theory, Kohnen Self Organizing Map

UNIT – III (12 Hrs.)

Genetic Algorithm: Fundamentals, basic concepts, working principle, encoding, fitness function, reproduction, Genetic modelling: selection operator, cross over, mutation operator, Stopping Condition and GA flow, Constraints in GA, Applications of GA, Classification of GA.

UNIT – IV (8 Hrs.)

Hybrid Soft Computing Techniques: An Introduction, Neuro-Fuzzy Hybrid Systems, Genetic Neuro-Hybrid systems, Genetic fuzzy Hybrid and fuzzy genetic hybrid systems

Recommended Books

1. S. Rajasekaran & G.A. Vijayalakshmi Pai, 'Neural Networks, Fuzzy Logic & Genetic Algorithms, Synthesis & Applications', PHI Publication.
2. S.N. Sivanandam & S.N. Deepa, 'Principles of Soft Computing', Wiley Publications.

Reference Books

1. Michael Negnevitsky, 'Artificial Intelligence', Pearson Education, New Delhi, **2008**.
2. Timothy J. Ross, 'Fuzzy Logic with Engineering Applications', Wiley, **2010**.

MICRO & NANO ELECTRO MECHANICAL SYSTEM (MEMS & NEMS)

Subject Code: MECE5-205 | **L T P C** **4 0 0 4** | **Duration: 48 Hrs.**

Course Objectives

The course aims to give the students a basic knowledge about state-of-the-art MEMS including technology, device architecture, design and modelling, scalability, figures of merit and RF IC novel functionality and performance.

Course Outcomes:

Students will attain analytical and design oriented feature knowledge about NEMS and MEMS. Reliability and packaging are also considered as key issues for industrial applications.

Unit-1 (12 Hrs.):

Micro Electro Mechanical System (MEMS) Origins. MEMS Impetus / Motivation. Material for MEMS. The toolbox: Processes for Micro machining.

Unit-II (12 Hrs.)

MEMS Fabrication Technologies. Fundamental MEMS Device Physics: Actuation.

Unit-III (12 Hrs.)

Fundamental MEMS Devices: The Cantilever Beam. Microwave MEMS Applications: MEM Switch

Unit-IV (12 Hrs.)

Design Considerations. The Micromachined Transmission Line. MEMS-Based Microwave Circuit and System.

Recommended Books

1. Hector J. De Los Santos, 'Micro-Electromechanical (MEM) Microwave Systems', Artechhouse.
2. Nadim Maluf, 'An Introduction to Micro-Electromechanical System', Artechhouse.

CPLD AND FPGA ARCHITECTURE AND APPLICATIONS

Subject Code: MECE5-206 **L T P C** **Duration: 48 Hrs.**
4 0 0 4

Learning Objectives:

1. To learn fundamentals of Programmable Logic Devices.
2. To enrich the ideas of field programmable gate arrays.
3. To explore the ideas of SRAM programmable FPGAs
4. To facilitate the knowledge of anti-fuse programmed FPGAs.

Learning Outcomes:

1. Understanding of Programmable logic devices and its architecture.
2. Knowledge of FPGAs and its applications.
3. Fundamental understanding of SRAM and anti-fuse programmed FPGAs

UNIT-I (12 Hrs.)

Introduction to Programmable Logic Devices:

Introduction, Simple Programmable Logic Devices – Read Only Memories, Programmable Logic Arrays, Programmable Array Logic, Programmable Logic Devices/Generic Array Logic; Complex Programmable Logic Devices – Architecture of Xilinx Cool Runner XCR3064XL CPLD, CPLD Implementation of a Parallel Adder with Accumulation.

UNIT-II (12 Hrs.)

Field Programmable Gate Arrays:

Organization of FPGAs, FPGA Programming Technologies, Programmable Logic Block Architectures, Programmable Interconnects, and Programmable I/O blocks in FPGAs, Dedicated Specialized Components of FPGAs, Applications of FPGAs.

UNIT –III (12 Hrs.)

SRAM Programmable FPGAs:

Introduction, Programming Technology, Device Architecture, The Xilinx XC2000, XC3000 and XC4000 Architectures.

UNIT –IV (12 Hrs.)

Anti-Fuse Programmed FPGAs:

Introduction, Programming Technology, Device Architecture, The Actel ACT1, ACT2 and ACT3 Architectures.

RECOMMENDED BOOKS

1. Stephen M. Trimberger, 'Field Programmable Gate Array Technology', International Edition Springer.
2. Charles H. Roth Jr, Lizy Kurian John, 'Digital Systems Design', Cengage Learning.

REFERENCE BOOKS:

1. John V. Oldfield, Richard C. Dorf, 'Field Programmable Gate Arrays', Wiley India.
2. Pak K. Chan/Samiha Mourad, 'Digital Design Using Field Programmable Gate Arrays', Pearson Low, Price Edition.
3. Ian Grout, 'Digital Systems Design with FPGAs and CPLDs', Elsevier, Newnes.

4. Wayne Wolf, 'FPGA based System Design', Prentice Hall Modern Semiconductor Design Series.

RESEARCH LAB. - II

Subject Code: MECE5-207 **L T P C**
0 0 4 2

Students will be made familiar with maximum available softwares like optisystem, optsim, Matlab, Virtual instrumentation, Network simulator, HFSS etc.so that student can opt any one as per his/her interest for thesis work. Students will be advised to go through maximum research papers and conclude a particular domain to work further.

SATELLITE COMMUNICATION

Subject Code: MECE5-264 **L T P C** **Duration: 48 Hrs.**
4 0 0 4

Learning Objectives

This course provides an introduction to the fundamentals of orbital mechanics and launchers, link budgets, modulation, coding, multiple access techniques, propagation effects, and earth terminals. This course provides an understanding how analog and digital technologies are used for satellite communications networks.

Learning Outcomes:

The students will gain teaching skills in this area. They will gain skills for performance improvement for different available satellites by calculating power Budgets

UNIT I (12 Hrs.)

Introduction: Origin of Satellite Communication, Current state of Satellite Communication, Advantages of Satellite Communication, Active & Passive satellite, Orbital aspects of Satellite Communication, System Performance. Communication Satellite Link Design - Introduction, general link design equation, system noise temperature, C/N & G/T ratio, atmospheric & econospheric effects on linkdesign, complete link design, interference effects on complete link design, earth station
parameters.

UNIT II (12 Hrs.)

Satellite analog & digital communication Baseband analog (voice) signal, FDMA techniques, S/N ration, SCPC & CSSB systems, digital baseband signals & modulation techniques.

Multiple Access Techniques TDMA frame structure, burst structure, frame efficiency, superframe, frame acquisition & synchronization, TDMA vs FDMA, burst time plan, beam hopping, satellite switched, Erlang call congestion formula, demand assignment ctrl, DA-FDMA system, DATDMA.

UNIT III (12 Hrs.)

Laser & Satellite Communication Link analysis, optical satellite link Tx& Rx, Satellite, beam acquisition, tracking & pointing, cable chaanel frequency, head end equation, distribution of signal, n/w specifications and architecture, optical fibre CATV system.

UNIT IV (12 Hrs.)

Satellite Applications Satellite TV, telephone services via satellite, data Communication services, satellites for earth observation, weather forecast, military appliances, scientific studies.

Recommended Books

1. Timothy Pratt, 'Satellite Communication', Addison Wesley, **2010**.
2. D.C Aggarwal 'Satellite Communication', Willey Sons, **2010**.

TESTING & FAULT TOLERANCE

Subject Code: MECE5-265 **L T P C** **Duration: 48 Hrs.**
4 0 0 4

Course Objective: The objective of this course is to familiarize with concept of reliability. The course provides introduction to fault tolerant so that students will able to understand the testable combinational circuits.

Course Outcomes:

#1. Able to differentiate between fault, error and failure.
#2. Able to calculate reliability of a system and can use tools for reliability modelling.
#3. Comparative analysis of different tolerant design tests.
#4. Analysis of fault tolerant design for VLSI chips.

UNIT I (12 hrs)

Basic concepts of Reliability: Failures and faults, Reliability and failure rate, Relation between reliability & mean time between failure, Maintainability & Availability, reliability of series and parallel systems, Modelling of faults, Test generation for combinational logic circuits: conventional methods (path sesitisation,Boolean difference), Random testing, transition count testing and signature analysis.

UNIT II (14 hrs)

Fault Tolerant DesignI: Basic concepts,static,(NMR,use of error correcting codes), dynamic, hybrid and self-purging redundancy, Siftout Modular Redundancy (SMR), triple modular redundancy, SMR reconfiguration.

Fault Tolerant DesignII: Time redundancy, software redundancy, failsoft operation, examples of practical fault tolerant systems, introduction to fault tolerant design of VLSI chips.

UNIT III (12 hrs)

Self-checking circuits: Design of totally self-checking checkers, checkers using m-out of acode, Berger codes and low cost residue code, selfchecking sequential machines, partially selfchecking circuits. Fail safe Design: Strongly fault secure circuits, failsafe design ofsequential circuits using partition theory and Berger codes, totally self checkingPLA design.

UNITIV (10 hrs)

Design for testable combination logic circuits: Basic concepts of testability, controllability and observability, The Read Muller expansion technique, level OR-AND-OR design, use of control and syndrometesting design, Built-in-test, built-in-test of VLSI chips, design for autonomous self-test, design in testability into logic boards.

Recommended Books:

1. Parag K. Lala, Fault Tolerant & Fault Testable Hardware Design, PHI,**1985**
2. Parag K. Lala, Digital systems Design using PLD's, PHI**1990**.
3. N.N. Biswas, Logic Design Theory, PHI**1990**.
4. Konad Chakraborthy & Pinaki Mazumdar, Fault tolerance and Reliability Techniques for high – density random – access memories Reason, **2002.**

MOS INTEGRATED CIRCUIT MODELLING

Subject Code: MECE5-266 **L T P C** **Duration: 48 Hrs.**

4 0 0 4

Learning Objectives

1. To provide students with a comprehensive understanding on design of MOSFET devices.
2. To enable students to understand modelling and design of bipolar devices.
3. To understand the concept of CMOS and its characteristics.

Learning Outcomes

After successful completion of this course the students will be able to:

1. Demonstrate understanding of basic characteristics such as scaling, threshold voltage, drain current etc. of MOSFET.
2. Compute and evaluate CMOS performance factor.
3. Understand design of bipolar devices.

Unit-I (12 Hrs.)

Basic Device Physics: Energy bands in solids, p-n Junctions, MOS Capacitors, Metal-Silicon Effects, MOSFET Devices Design: Long Channel MOSFET, Short-Channel MOSFETS, MOSFET Scaling, Threshold Voltage. MOSFET DC Model: Drain Current Calculations, Pao-Sah Model, Charge Sheet Model, Piece-Wise Drain Current Model for Enhancement Devices

Unit-II (12 Hrs.)

CMOS Performance Factors: Basic CMOS Circuit Elements, Parasitic Elements, Sensitivity of CMOS delay to device parameters, Performance Factors of Advanced CMOS Devices.

Unit-III (12 Hrs.)

Bipolar Devices Design: npn & pnp Transistors, Ideal Current-Voltage Characteristics, Bipolar Device Models for Circuit and Time-Dependent Analyses, Modern Bipolar Transistor Structures, Figures of Merit of a Bipolar Transistors, Digital Bipolar Circuits.

Unit-IV (12 Hrs.)

MOSFET DC Model: Drain Current Calculations, Pao-Sah Model, Charge Sheet Model, Piece-Wise Drain Current Model for Enhancement Devices.

Recommended Books

1. M.S. Tyagi, 'Introduction to Semiconductor Materials and Devices', Wiley.
2. Ben G. Streetman, 'Solid State Electronic Devices', Pearson Prentice-Hall.
3. Yuan Taur and T.H. Ning, 'Fundamentals of Modern VLSI Devices', Cambridge.

PARALLEL PROCESSING

Subject Code: MECE5-267	**L T P C** **4 0 0 4**	**Duration: 48 Hrs.**

Learning Objectives

This course will help students to achieve the following objectives:

1. Describe the principles of computer design and classify instruction set architectures.
2. Describe the operation of performance enhancements such as pipelines, dynamic scheduling, branch prediction, caches, and vector processors.
3. Describe the operation of virtual memory, modern architectures such as RISC, Super Scalar, VLIW (very large instruction word), and multi-core and multi-CPU systems.

Learning Outcomes

Students will have skills in RISC as well as CISC architures and can design or analyses different problems associated with this domain

Parallel computer models: The state of computing, Classification of parallel computers, Multiprocessors and multicomputer, Multivector and SIMD computers. Conditions of parallelism, Data and resource Dependences, Hardware and software parallelism, Program partitioning and scheduling, Grain Size and latency, Program flow mechanisms, Control flow versus data flow, Data flow Architecture, Demand driven mechanisms, Comparisons of flow mechanisms.

Unit II (12 Hrs.)

System Interconnect Architectures: Network properties and routing, Static interconnection Networks, Dynamic interconnection Networks, Multiprocessor system Interconnects, Hierarchical bus systems, Crossbar switch and multiport memory, Multistage and combining network. Advanced processor technology, Instruction-set Architectures, CISC Scalar Processors, RISC Scalar Processors, Superscalar Processors, VLIW Architectures, Vector and Symbolic processors.

Unit III (12 Hrs)

Pipelining: Linear pipeline processor, nonlinear pipeline processor, Instruction pipeline Design, Mechanisms for instruction pipelining, Dynamic instruction scheduling, Branch Handling techniques, branch prediction, Arithmetic Pipeline Design, Computer arithmetic principles, Static Arithmetic pipeline, Multifunctional arithmetic pipelines.

Unit III (12 Hrs)

Multiprocessor Architectures: Symmetric shared memory architectures, distributed shared memory architectures, models of memory consistency, cache coherence protocols (MSI, MESI, MOESI), scalable cache coherence, overview of directory based approaches, design challenges of directory protocols, memory based directory protocols, cache based directory protocols, protocol design tradeoffs, synchronization.

Recommended Books

1. Kai Hwang, 'Advanced Computer Architecture', 18th Reprint, TMH, **2003**.
2. D.A. Patterson and J.L. Hennessey, 'Computer Organization and Design', 4th Edn., Morgan Kaufmann.
3. J.P. Hayes, 'Computer Architecture and Organization', 2nd Edn., MGH, **1988**.
4. Harvey G. Cragon, 'Memory System and Pipelined Processors', Narosa Publication, **1996**.
5. V. Rajaranam & C.S.R. Murthy, 'Parallel Computer', PHI.
6. R.K. Ghose, Rajan Moona & Phalguni Gupta, 'Foundation of Parallel Processing', Narosa Publications.

CAD TOOLS FOR VLSI DESIGN

Subject Code: MECE5-268 | **L T P C 4 0 0 4** | **Duration: 48 Hrs.**

UNIT 1 (12 Hrs.)

An overview of OS commands. System settings and configuration. Introduction to Unix commands. Writing Shell scripts. VLSI design automation tools., Leonardo spectrum, ISE 8.1i, Quartus II, VLSI backend tools.

UNIT 2 (12 Hrs.)

Introduction to VLSI design methodologies and supporting CAD tool environment. Overview of C and Data structures, Graphics and CIF, concepts and structure and algorithm for some of the CAD tools, schematic editor, layout editor, Module generator, silicon compilers, placement and routing tools, Behavioural, functional, logic and circuit simulators, Aids for test vector generator and testing.

UNIT 3 (12 Hrs.)

Synthesis and simulation using HDLs-Logic synthesis using verilog and VHDL. Memory and FSM synthesis. Performance driven synthesis, Simulation- Types of simulation. Static timing analysis. Formal verification. Switch level and transistor level simulation.

UNIT 4 (12 Hrs.)

Circuit simulation using Spice - circuit description. AC, DC and transient analysis. Advanced spice commands and analysis. Models for diodes, transistors and opamp. Digital building blocks. A/D, D/A and sample and hold circuits. Design and analysis of mixed signal circuits.

Recommended Books

1. M.J.S. Smith, 'Application Specific Integrated Circuits,Pearson', **2002.**
2. M.H. Rashid, 'Spice for Circuits and Electronics using Pspice', 2nd Edn., PHI.
3. T. Grdtkeretal, 'System Design with System C', Kluwer, **2004**.
4. P.J. Ashendenetal, 'The System Designer's Guide to VHDL-AMS', Elsevier, **2005.**

NANO ELECTRONICS

Subject Code: MECE5-269	L T P C 4 0 0 4	Duration: 48 Hrs.

Course Objectives:

The main aim of this course is to introduce the students about Nano sciences. Actual chemistry involved in semiconductor physics will be discussed. How this will be helpful for Designing of different circuits.

Learning Outcomes:

Students learn skills for handling basic concepts of Nano sciences for different applications for various fields.

UNIT I (12 Hrs.)

Basics and Scale of Nanotechnology: Introduction – Scientific revolutions – Time and length scale in structures, Definition of a nano-system, Top down and bottom up approaches – Evolution of band structures and Fermi surface – introduction to semi conducting Nanoparticles, introduction to quantum Dots, wells, wires, Dimensionality and size dependent phenomena – Fraction of surface atoms – Surface energy and surface stress, Misconceptions of Nanotechnology.

UNIT II (12 Hrs)

The carbon age and nanotubes: New forms of carbon, Types of nanotubes, Formation of nanotubes, methods and reactants- Arcing in the presence of cobalt, Laser method, Chemical vapor deposition method, ball milling, properties of Nanotubes Electrical properties, vibrational properties, Mechanical properties, applications of Nanotubes in electronics, hydrogen storage, materials, space elevators.

UNIT III (12 Hrs.)

Characterization Techniques in Nano-electronics:

Principle, construction and working: Electron microscopy (SEM and TEM), Infrared and Raman Spectroscopy, Photoemission and X-RD spectroscopy, AFMs, Magnetic force microscope.

UNIT IV (12 Hrs)

Nano-scale Devices:

Introduction: Quantum Electron Devices; High Electron Mobility Transistor, Quantum Interference Transistor, Single Electron Transistor and Carbon Nanotube Transistor, DNA Computing; Structure of DNA, Basic Operation on DNA and DNA Computer.

Recommended Books

1. C.P. Polle and F.J. Owens, “Introduction to Nanotechnology” Willey India Pvt. Ltd, Edition 2011.
2. Daniel Minoli ‘Nanotechnology Applications to Telecommunications and Networking’, Willey India Pvt. Ltd., **2011**.

MULTIMEDIA COMMUNICATION SYSTEM

Subject Code: MECE5-270 **L T P C** **Duration: 48 Hrs.**
4 0 0 4

Learning Objectives:
The objective of this course is to get aware the students about various multimedia systems, components associated and possibilities available for this particular domain.
Learning Outcomes:
Student will acquire teaching as well as analytical knowledge to design different Multimedia oriented systems.

Unit –I (12 Hrs.)

Introduction:
Concept of Multimedia, Multimedia Applications, Hardware Software requirements, Multimedia products & its evaluation.

Unit –II (12 Hrs.)

Components of multimedia: Text, Graphics, Audio, Video. Design & Authoring Tools, Categories of Authority Tools, Types of products.

Unit –III (12 Hrs.)

Animation: Introduction, Basic Terminology techniques, Motion Graphics 2D & 3D animation.

Unit –IV (12 Hrs.)

Introduction to MAYA (Animating Tool): Fundamentals, Modelling: NURBS, Polygon, Organic, animation, paths & boxes, deformers. Working with MEL: Basics & Programming Rendering & Special Effects: Shading & Texturing Surfaces, Lighting, Special effects.

Recommended Books:

1. David Hillman, ‘Multimedia Technology & Applications’, Galgotia Publications.
2. Rajneesh Agrawal, ‘Multimedia Systems’, Excel Books.
3. Nigel Chapman & Jenny Chapman, ‘Digital Multimedia’, Wiley Publications.
4. D.P. Mukherjee, ‘Fundamentals of Computer Graphics and Multimedia’, PHI.

LOW POWER VLSI DESIGN

Subject Code: MECE5-271 **L T P C** **Duration: 48 Hrs.**
4 0 0 4

Unit 1 (12 Hrs.)

Introduction
Hierarchy of limits of power, Sources of power consumption, power estimation

Unit 2 (12 Hrs.)

Analysis and Synthesis Approach
Synthesis for low power, Voltage scaling approaches, Design and test of low power circuits

Unit 3 (12 Hrs.)

Switching Techniques

Adiabatic switching, Minimizing switched. Capacitance, low power static RAM architecture, Low energy computing using energy recovery techniques,

Unit 4 (12 Hrs.)

Power Computation

Low power programmable computation, Software design for low power.

Recommended Books:

1. Kaushik Roy and Sharat Parsad, 'Low Power CMOS VLSI Circuit Design', John Wiley & Sons, **1998**.
2. A.P. Chandrakasan and R.W. Broadersen, 'Low power Digital CMOS Design', Kluwer Academic Publishers, **1995**.
3. J.M. Rabaey and M. Pedram, 'Low Power Design Methologies', Kluwer Academic Publishers, **2001**.
4. Dimitrios Soudris, Christian Piguet and Costas Goutis, 'Designing CMOS Circuits for Low Power', Kluwer Academic Publishers, **2000**.

RESEARCH METHODOLOGY

Subject Code – MREM0-101	**L T P C** **4 0 0 4**	**Duration – 45 Hrs.**

UNIT–I (11 Hrs)

Introduction to Research: Meaning, Definition, Objective and Process

Research Design: Meaning, Types - Historical, Descriptive, Exploratory and Experimental

Research Problem: Necessity of Defined Problem, Problem Formulation, Understanding of Problem, Review of Literature

Design of Experiment: Basic Principal of Experimental Design, Randomized Block, Completely Randomized Block, Latin Square, Factorial Design.

Hypothesis: Types, Formulation of Hypothesis, Feasibility, Preparation and Presentation of Research Proposal

UNIT–II (10 Hrs)

Sources of Data: Primary and Secondary, Validation of Data

Data Collection Methods: Questionnaire Designing, Construction

Sampling Design & Techniques – Probability Sampling and Non Probability Sampling

Scaling Techniques: Meaning & Types

Reliability: Test – Retest Reliability, Alternative Form Reliability, Internal Comparison Reliability and Scorer Reliability

Validity: Content Validity, Criterion Related Validity and Construct Validity

UNIT–III (13 Hrs)

Data Process Operations: Editing, Sorting, Coding, Classification and Tabulation

Analysis of Data: Statistical Measure and Their Significance, Central Tendency, Dispersion, Correlation: Linear and Partial, Regression: Simple and Multiple Regression, Skewness, Time series Analysis, Index Number

Testing of Hypothesis: T-test, Z- test, Chi Square, F-test, ANOVA

UNIT – IV (11 Hrs)

Multivariate Analysis: Factor Analysis, Discriminant Analysis, Cluster Analysis, Conjoint Analysis, Multi Dimensional Scaling

Report Writing: Essentials of Report Writing, Report Format

Statistical Software: Application of Statistical Softwares like SPSS, MS Excel, Mini Tab or MATLAB Software in Data Analysis

**Each Student has to Prepare Mini Research Project on Topic/ Area of their Choice and Make Presentation. The Report Should Consists of Applications of Tests and Techniques Mentioned in The Above UNITs*

Recommended Books

1. R.I. Levin and D.S. Rubin, 'Statistics for Management', 7th Edn., Pearson Education New Delhi.
2. N.K. Malhotra, 'Marketing Research–An Applied Orientation', 4th Edn., Pearson Education New Delhi, Donald Cooper, 'Business Research Methods', Tata McGraw Hill New Delhi
3. Sadhu Singh, 'Research Methodology in Social Sciences', Himalaya Publishers.
4. Darren George & Paul Mallery, 'SPSS for Windows Step by Step', Pearson Education New Delhi.
5. C.R. Kothari, 'Research Methodology Methods & Techniques', 2nd Edn., New Age International Publishers.

PROJECT

Subject Code: MECE5-308 **L T P C**

Learning Objectives

1. To propose engineering based project in a clear and concise manner.
2. Allow students to develop problem solving, analysis, synthesis and evaluation skills.

Learning Outcomes

1. Synthesis of knowledge.
2. To demonstrate the aptitude of applying the own knowledge to solve a specific problem.
3. To mature the knowledge.
4. Able to organize, compile and record all work details in an efficient manner.

Each student will be required to complete a Project and submit a Project Report on a topic on any of the areas of modern technology related to Electronics & Communication Engineering including interdisciplinary fields.

SEMINAR

Subject Code: MECE5-310 **L T P C**
0 0 4 4

Learning Objectives

1. To identify, understand and discuss current advanced research topic.
2. To gain experience in the critical assessment of the available scientific literature
3. To practice the use of various resources to locate and extract information using offline & online tools, journals

Learning Outcomes:

1. An ability to utilize technical resources
2. An ability to write technical documents and give oral presentations related to the work completed.
3. To learn preparation and presentation of scientific papers in an exhaustive manner

Each student will be required to prepare a Seminar Report and present a Seminar on a topic in any of the areas of modern technology related to Electronics & Communication Engineering including interdisciplinary fields.

DIGITAL SIGNAL PROCESSORS & ARCHITECTURES

Subject Code: MECE5-372 **L T P C** **Duration: 45 Hrs.**
4 0 0 4

Learning Objectives: The objective of this course is to familiarize the students with signal processing system. The students will study digital signal processors and will introduce about programming in digital signal processors.

Learning Outcomes

1. Design of digital filters.
2. Develop a programme for interfacing of external peripheral to digital processors.
3. Design and develop programme on different general purpose digital signal processors.
4. Develop a programme to interface external devices with signal processors.

UNIT-I (11 Hrs)

Introduction to Digital Signal Processing: Introduction, A Digital signal-processing system, The sampling process, Discrete time sequences. Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT), Linear time-invariant systems, Digital filters, Decimation and interpolation.

UNIT-II (11 Hrs)

General purpose digital signal processors – fixed point DSP's, Architecture of first generation fixed point DSP processors, Architecture of second generation fixed point DSP's, Architecture of third generation fixed point DSP's, Architecture of fourth generation fixed point processors, floating point digital signal processors.

UNIT-III (10 Hrs)

Programmable Digital Signal Processors: Digital signal-processing Devices, TMS320C54XX DSP: Its Addressing modes, Memory space, Program Control, instructions and Programming, On-Chip Peripherals, Interrupts and Pipeline operation of processors.

UNIT-IV (13 Hrs)

Interfacing Memory and I/O Peripherals to Programmable DSP Devices: Memory space organization, External bus interfacing signals, Memory interface, Parallel I/O interface, Programmed I/O, Interrupts and I/O, Direct memory access (DMA).

Recommended Books

1. Avtar Singh and S. Srinivasan, 'Digital Signal Processing', Thomson Publications, **2004.**
2. Ananthi, S.K. Padmanabhan, R. Vijayarajeswaran, 'A Practical Approach to Digital Signal Processing', New Age International, **2006/2009.**
3. B. Venkataramani and M. Bhaskar, Digital Signal Processors, Architecture, Programming and Applications', TMH, **2002**
4. John G. Proakis, Dimitris Manolakis, Digital Signal Processing – Principles, Algorithms and Applications, Pearson Education, **2006**.
5. R. Chassaing, D.W. Horning, 'Digital Signal Processing with the TMS320C2S', Wiley Publications, **1990.**

ERROR CONTROL AND CODING

Subject Code: MECE5-373 **L T P C** **Duration: 45 Hrs.**
4 0 0 4

Learning Objectives: The objective of this course is to familiarize the students with concept of Block Codes and Maximum Likelihood Decoding. They will be able to understand Generator Matrix, Parity-Check Matrix and Error-Correcting Capability of a Linear Code

Learning Outcomes

1. Describe the model and calculate the capacity of typical digital communication channels.
2. Analyze the encoding and decoding procedures of various error control codes.
3. Compare the error correction capability of different error control codes and their performances.
4. Apply error control coding to achieve error detection and correction in digital transmission systems
5. Design an error detecting and correcting system for semiconductor memory system to meet given system specification.

UNIT-I (11 Hrs.)

Review of Random Process: Review of Probability Theory, Basic concepts of random processes, random variables, basicconcepts from systems theory and stochastic processes, Stationary and non stationary process, correlation function, Ergodicity and power spectral density, transformation random process by linear system, Special random process: white Gaussian noise, Wiener levy, Shot noise, Markov Process

UNIT-II (11 Hrs.)

Hypothesis Testing: Simple binary hypothesis test, Decesion Criteria, Neyman Pearson tests, Bayes Criteria Multiple hypothesis testing, Composite hypothesis testing

UNIT-III (11 Hrs.)

Detection Theory: Sequential detection Walds test Detection of known signals in white noise, Detection of known signal in colored noise, Maximum SNR Criteria, Detection of signals with unknown parameters

UNIT-IV (12 Hrs.)

Coding: Error Control coding for wireless fading channels, Channel Estimation and Adaptive channel coding, Joint Source and Channel coding. Non binary Linear Block Codes, Hard and soft decision decoding, Coding and Decoding of BCH, Reed Solomon Codes, Convolution codes: Coding and Decoding , Distance bounds, Performance bounds Turbo codes: Coding, Decoding Algorithms, Performance comparison, Interleaver design Trellis coded Modulation, TCM Decoders, TCM for AWGN and Fading Wireless Channels, Performance comparison.

Recommended Books

1. C.W. Helstrom, 'Elements of Signal Detection and Estimation', Prentice Hall, NJ, **1995.**
2. H.L. Van Trees, 'Detection, Estimation, and Modulation Theory', Wiley, **1971.**
3. H.V. Poor, 'An Introduction to Signal Detection and Estimation'. 2^{nd} Edn., Springer-Verlag, New York.
4. Stephen G. Wilson, 'Digital Modulation & Coding', Prentice Hall Inc.
5. Ranjan Bose, 'Information Theory Coding and Cryptography, TMH.
6. J.G. Proakis, 'Digital Communication', Pearson Education.

MEASUREMENT & CHARACTERISATION TECHNIQUES

Subject Code: MECE5-374 **L T P C** **Duration: 45 Hrs.**
4 0 0 4

Learning Objectives The objective of this course is to study about different measurement techniques and introduction to X-ray diffraction techniques.

Learning Outcomes

1. Analysis of UV and visible spectrum.
2. Determination of crystal structure.
3. Electron diffraction analysis using electron microscopy.
4. Differentiate between scanning tunneling microscope & atomic force microscope and their applications.

UNIT-I (11 Hrs.)

Spectroscopy: Basics of UV and visible Spectroscopy: Electronic transitions, Beer-Lambert Law, visible spectrum and colour; Infrared Spectroscopy: Instrumentation and sample handling, overtones, applications of FT-IR and IR Spectroscopy

UNIT-II (12 Hrs.)

X-ray Diffraction Techniques: Production of X-rays, its properties and hazards, X-ray Diffraction and Bragg's law, Laue techniques, Debye-Scherrer techniques. Determination of crystal structure of powder sample, line broadening, particle size, residual stress measurement, Phase identification, phase quantification, introduction to pole figure and texture analysis; chemical/elemental analysis by X-ray Fluorescence.

UNIT-III (12 Hrs.)

Electron Microscopy: Electron diffraction, Principles and operation of scanning electron microscope. Geometry of electron microscopes, Electron Sources, Production of Vacuum, Pressure measurement, Specimen Handling and preparation, Secondary electron image, Backscattered electron image,

UNIT-IV (10 Hrs.)

Scanning Probe Microscopy: Principles and operation of scanning probe microscopes: Scanning Tunnelling Microscope, Atomic Force Microscope

Recommended Books

1. Antony R. West, Solid State Chemistry & Its Applications, Wiley Student Edition.
2. V.A., 'Modern Metallographic Techniques and their Applications', Wiley Interscience, **1971.**
3. B.D. Cullity, 'Elements of X-ray Diffraction, 4^{th} Edn., Addison Wiley, **1978.**
4. M.H. Loretto, 'Electron Beam Analysis of Materials', Chapman and Hall, **1984.**
5. Dawn Bonnell, 'Scanning Probe Microscopy and Spectroscopy: Theory, Techniques, and Applications', Wiley-VCH.

CMOS VLSI DESIGN

Subject Code: MECE5-375	L T P C 4 0 0 4	Duration: 45 Hrs.

Learning Objectives in this course the students will be able to understand the MOS designing process. They will be familiarizing with MOS Combinational & Sequential Circuits and understand about semiconductor memories.

Learning Outcomes

1. Designing of CMOS Inverter logic and analysis of parameters like rise time, fall time etc.
2. Realization of Combinational circuits using MOS gates and its analysis
3. Analysis of sequential circuits using MOS gates.
4. Design & analysis of semiconductor memories.

UNIT-I (10 Hrs.)

MOS Design: Pseudo NMOS Logic – Inverter, Inverter threshold voltage, output high voltage, Output Low voltage, gain at gate threshold voltage, Transient response, Rise time, Fall time, Pseudo NMOS logic gates, Transistor equivalency, CMOS Inverter logic.

UNIT-II (11 Hrs.)

Combinational MOS Logic Circuits: MOS logic circuits with NMOS loads, Primitive CMOS logic gates – NOR & NAND gate, Complex Logic circuits design – Realizing Boolean expressions using NMOS gates and CMOS gates, CMOS full adder

UNIT-III (12 Hrs.)

Sequential MOS Logic Circuits: Behavior of bistable elements, SR Latch, clocked latch and flip flop circuits, CMOS D latch and edge triggered flip-flop.

UNIT-IV (12 Hrs.)

Semiconductor Memories: Types, RAM array organization, DRAM – Types, Operation, Leakage currents in DRAM cell and refresh operation, Flash Memory- NOR flash and NAND flash.

Recommended Books

1. Ken Martin, 'Digital Integrated Circuit Design', Oxford University Press, **2011**.
2. Sung-Mo Kang, Yusuf Leblebici, CMOS Digital Integrated Circuits Analysis and Design, TMH, 3rd Edn., **2011.**
3. Ming-BO Lin, Introduction to VLSI Systems: A Logic, Circuit and System Perspective, CRC Press, **2011.**
4. Jan M. Rabaey, Anantha Chandrakasan, Borivoje Nikolic, Digital Integrated Circuits – A Design Perspective, 2nd Edn., PHI.

DISSERTATION

Subject Code: MECE5-411

Learning Objectives: To learn, practice, and critique effective scientific writing and to formulate the research objectives clearly, state claims and evidence clearly, assess validity of claims, evidence, outcomes, and results.

Learning Outcomes:

1. Design and execute a meaningful research project that demonstrates spatial thinking and uses the knowledge and skills.
2. Define and analyze a problem in latest research areas.
3. Formulate and write a research proposal.
4. Able to learn effectively record data and experiments so that others can understand them.
5. Communicate the findings by means of a thesis, written in the format specified by the department/institute.

Each student will be required to complete a Dissertation and submit a written Report on the topic on any of the areas of modern technology related to Electronics & Communication Engineering including interdisciplinary fields in the Final semester of M.Tech. Course.

Papers accepted in UGC approved journals will be given 10 marks as special incentive. It will be mandatory to publish one paper in conference/journal.