M.E (Instrumentation)

First Semester

Theory Courses

Course No.	Course	L T P	Credits
MEC1051	Optical Fibre Sensors and Instrumentation	3 0 0	3
MEC1053	Microcontroller Based System Design	3 0 0	3
MEC1057	Advanced Instrumentation System	3 1 0	4
	Elective-I	3 0 0	3
	Breadth Paper-I	3 0 0	3

List of Elective-I (Choose any one from the following)

MEC1103	VLSI Design and Applications
MEC1005	EMI and EMC
MEC1047	Sensors and Transducers
MEC1149	Applied Bioelectronic Instrumentation
MEC 1055	Applied Industrial Instrumentation
MEE1101	Modern Control Theory
MEE1119	Control System Design

Sessional/Laboratory

MEC1058	Advanced Instrumentation Lab.	0 0 3	2
	Elective-II	0 0 3	2

List of Elective-II (Choose any one from the following)

MEC1002	Fibre Optic Instrumentation Lab.
MEC1054	Microcontroller Based System Design Lab.
MEC1004	VLSI Design Lab.

Total Credits **20.0**

Second Semester

Theory Courses

Course No.	Course	L T P	Credits
MEC2001	Advanced Digital Signal Processing	3 0 0	3
MEC2161	Process Control Instrumentation	3 1 0	4
MEE1105	Optimization in Engineering Design	3 0 0	3
	Elective-III	3 0 0	3
	Breadth Elective-II	3 0 0	3

List of Elective-I (Choose any one from the following)

MEC 2011	Digital Image Processing Techniques
MEC2113	Real Time Embedded System Design
MEC2019	Micro-Electro Mechanical System
MEC2059	Artificial Intelligence and Intelligent Systems
MEC2163	Speech Processing and Recognition
MEC2067	VHDL & VERILOG
MEC 2075	Instrumentation System Design

Sessional/Laboratory

MEC2002	Advanced Digital Signal Processing Lab.	0 0 3	2
	Elective-IV	0 0 3	2

List of Elective-IV (Choose any one from the following)

MEC2014	Embedded System Lab.
MEC2020	MEMS Lab
MEC2062	Process Control Lab.

Total **20.0**

Third Semester

MEC3001	Thesis	**15.0**

Fourth Semester

MEC3001	Thesis	**20.0**

MEC 1051 OPTICAL FIBER SENSORS AND INSTRUMENTATION

Department: Electronics and Communication Engineering

Programme: PG (ECE)

Pre-requisites: Knowledge of Semiconductor Devices, Electromagnetic Theory, Modern Instruments and Measurements.

Course Objectives:

1	To demonstrate fiber fabrication methods, principle of light energy propagation, signal attenuation and dispersion effects in optical fiber.
2	To identify the types of optical sources, coupling and optical receivers in fiber optic sensor system.
3	To build an optical sensing system for measurement of different measurands using different types of optical fibers.
4	To develop distributed sensing system using Bragg grating, back scatter and forward scatter method, and sensing system with special optical techniques.

Course Outcomes :

On the completion of this course, the students will be able to:

CO1	explain the features of optical fibers, principle of light energy propagation based on ray optics and wave optics method, signal attenuation and dispersion effects in optical fiber.
CO2	select the type of optical sources like LEDs, LASER diodes and the type of photodetectors for different fiber optic sensing system.
CO3	apply the different optical components for sensor development and sensor networking.
CO4	develop optical sensing system for measurement of different measurands using single mode and multimode optical fibers.
CO5	develop quasi-distributed and fully-distributed sensing system, and Non-Destructive measurement techniques for monitoring the different physical parameters of different structures.

Module -1:

Optical Fibers:

Classifications, Fiber materials and fabrication methods; Ray Optics and Wave Optics; Representation for SI & GI fibers; Mode Theory; Goos-Hanchen Shift; Power flow in SI fibers; Attenuation mechanisms; Dispersion effects.

Module -2:

Optical Sources:

Structures and materials of LED and LD sources; Operating characteristics and modulation capabilities of the LED and LD sources; DFB lasers; Gas Lasers; Solid lasers; Source to Fiber coupling; Power launching; Lensing schemes for coupling improvement; Fiber to fiber coupling and alignment methods; Splicing techniques; Fiber Connectors.

Module -3:

Photodetectors:

PIN; APD; Noise in Photodetectors; Sensitivity; Timing jitter; Detector response time; Photodiode materials; Optical receiver configuration and performance; Analog and Digital receiver; Photoconductors; CCD Camera.

Module -4:

Optical Sensor components:

Modulators; Wavelength filters; Polarization controllers, Polarization Splitters; Frequency shifters; Amplifiers; Birefringent fiber; D-Fibers; Hollow section fiber; Couplers; Optical Isolators; Switches; Wavelength MUX & DEMUX.

Module -5:

Optical Sensing Techniques:

Intensity Modulation Sensors: Transmissive, Reflective, Micro-bending concept;
Phase Modulation sensors: Principle; Interferometric sensors: Mach-Zehnder, Micheleson, Febry –Perot, Sagnac fiber interferometers; Low coherence interferometery; Polarimetric Sensors.

Module -6:

Grating Sensors:

Fiber Bragg Grating Sensors: Bragg Grating, Chirped grating, Long Periodic Grating, Grating fabrication, strain monitoring, Application for different measurands.
Distributed Sensors:
Fully distributed sensor, Quasi-Distributed sensor, Back scatter and forward scatter method, Raleigh Backscatter system, Raman Scattering method, Brillouin Scattering method, Applications.

Module -7:

Special Optical Techniques:

Holographic Interferometry and Nondestructive testing; Moiré method; Speckle metrology; Phase measurement interferometers.

Text Books:

1. G.Keiser, Optical Fiber Communications, 3/E., McGraw Hill.
2. J.M.Senior, Optical Fiber Communication, PHI, 2/E.
3. Ghatak &Thyagarajan, Introduction to Fiber Optics, Cambridge University press.
4. Kjell J. Gåsvik, Optical Metrology, 3/E, John Wiley & Sons.
5. Bishnu P. Pal, Fiber Optics in Telecommunication and Sensor Systems, New Age International (p) Ltd.
6. R. Kashyap, Fiber Bragg Grating, Academic Press

MEC 1053 Micocontroller Based System Design

Department: Electronics and Communication Engineering

Programme: PG (ECE)

Pre-requisite(s): Fundamentals of digital electronics, microprocessor like 8085/8086 and C language programming.

Course Objectives:

A.	To introduce microcontroller and its significance in today's life.
B.	To introduce 8051 instruction set and provide knowledge about how to write efficient programs.
C.	To provide knowledge about on-chip interrupts, timer and serial communication circuitry.
D.	To introduce the popular PIC microcontroller by the Microchip Technology focusing architecture and instruction set.

Course Outcomes:

CO1	The student will be able to appreciate the difference between microprocessor and microcontroller and will be able to identify the application areas where microcontroller should be preferred over microprocessor.
CO2	Will be able to program the microcontroller for a particular task according to the application requirement. Will be able to debug the error for its proper functioning in the future.
CO3	The students will be in a better position to understand and use the various new microcontrollers coming up in the market.
CO4	The students will be able to independently build their innovative ideas into product.
CO5	The students will be able to apply the knowledge to other interdisciplinary areas.

Module -1:

Introduction to Microcontrollers, 8051 Microcontrollers, 8051 Pin Description, I/O Ports and Memory Organization.

Module -2:

MCS-51- Addressing Modes and Instructions, 8051 Assembly Language Programming Tools, Software Development Tools for 8051.

Module -3:

Programming of 8051 Parallel I/O Ports, 8051 Interrupts and Timers/Counters, 8051 Serial Communication.8255 interfacing and programming with 8051.

Module -4:

PIC microcontroller – architecture, memory organisation, addressing modes, instruction set.

Module -5:

PIC programming in assembly and C, I/O port, RAM and ROM allocation, Timer programming, ADC, DAC and Sensor Interfacing.

Module -6:

LCD and Keyboard interfacing, Generation of Gate signals for convertor and inverters for Motor and AC appliance control. Measurement of speed and frequency.

Module -7:

Stand alone Data-acquisition system design, Microcontroller based Data logger and Digital PID controller design.

Text Books:

1. 8051 MICROCONTROLLER: HARDWARE, SOFTWARE & APPLICATIONS, V Udayashankara, M.Mallikarjunaswamy, TMH
2. MICROCONTROLLERS : THEORY AND APPLICATIONS, Ajay Deshmukh, TMH
3. PIC Microcontroller and Embedded Systems using Assembly and C for PIC 18, Muhammad Ali Mazidi, Rolin D. Mckinlay, Pearson Edu. 2008.
4. PIC Microcontroller Project Book, John Lovin, Mc Graw Hill.

MEC1057 Advanced Instrumentation System

Department: Electronics and Communication Engineering

Programme: PG (ECE)

Pre-requisites: Fundamental knowledge on Measurements and Instrumentation, Microprocessor and Microcontroller

Course Objectives

1	To explain the concept of intelligent instrumentation and impart knowledge on automation.
2	To develop an ability to model and analyze a real time system.
3	To develop an ability to evaluate the performance of a real time system.
4	To develop an ability to design an intelligent system for industrial automation.
5	To discuss the latest technology in automation

Course Outcomes

On the completion of this course, the students will able to:

CO1	Demonstrate on the understanding of automation and functioning of various elements in a real time system.
CO2	Have an ability to identify and analyze various components of a real time system.
CO3	Have an ability to evaluate the performance of a real time system.
CO4	Have an ability to evaluate a larger for industrial automation.
CO5	Update on the recent trends in automation technologies.

Module -1:

Review of Transducer, Principles of operations and its classification, Characteristics, Technological trends in making transducers, Silicon sensors for the measurement of pressure, level, flow and Temperature. Biosensors, application and types.

Module -2:

Introduction about Instrumentation system. Types of Instrumentation system. Data acquisition system and its uses in intelligent Instrumentation system. Detail study of each block involved in making of DAS, Signal conditioners as DA, IA, signal converters (ADC), Sample and hold. Designing application for Pressure, Temperature measurement system using DAS. Data logger.

Module -3:

Introduction about Automation system. Concepts of Control Schemes, Types of Controllers. Components involved in implementation of Automation system i.e., DAS, DOS, Converter (I to P) and Actuators: Pneumatic cylinder, Relay, solenoid (Final Control Element), Computer Supervisory Control System, Direct Digital Control's Structure and Software.

Module -4:

SCADA- Remote terminal units, Master station, Communication architectures and Open SCADA protocols. DCS- Evolution of Different architecture, Local unit, Operator Interface, Displays, Engineering interface- Study of any one DCS available in market, factors to be considered in selecting DCS, case studies in DCS.

Module -5:

Introduction about Intelligent controllers, Model based controllers, Predictive control, Artificial Intelligent Based Systems, Experts Controller, Fuzzy Logic System and Controller, Artificial Neural Networks, Neuro-Fuzzy Control system.

Module -6:

Virtual Instrumentation- Introduction to LabVIEW, Block diagram and architecture of a virtual instrumentation, Graphical programming in data fow, comparison with conventional programming, Vis and sub-Vis, loops and charts, arrays, clusters and graph, case and sequence structures, formula nodes, local and global variables, string and file I/O.

Module -7:

Introduction to telemetry, Instrument interfacing, Current loop, RS232/485, Field bus, Modbus, GPIB, USB Protocol, HART communication Protocol- Communication modes and networks.

Text Books:

1. Computer Based Industrial Control – By Krishna Kant, PHI
2. Process Control Instrumentation – By Curtis D. Johnson, Pearson Education **3.** Fundamentals of Industrial Instrumentation and Process Control - William Dunn
4. National Instruments LabVIEW manual.
5. Principal of Industrial Instrumentation, D Patranabis, TMH
6. Electrical & Electronics Measurements and Instrumentation By A.K.Shawhney, Dhanpat Rai & Sons.
7. High performance Instrumentation and Aupomation, CRC Press, Taylor & Francis Group, 2005.

MEE 1001 MODERN CONTROL THEORY

Department: Electronics and Communication Engineering/ Electrical and Electronics Engineering

Programme: PG (ECE)

Pre-requisite: BE in ECE/EEE with basic course on control theory.

Course Objectives:

i. To state students with concepts of state variables, state diagrams, controllability, observability;
ii. To extend comprehensive knowledge of mathematical modeling of physical system;
iii. To illustrate basics of deigning a control problem;
iv. To summarize them on model control theory.

Course Outcomes:

At the end of the course, a student should be able to

i. apply the different ways of modeling of physical system, recommend linearization of a nonlinear system and read basics of the theory of fractional order controller;
ii. summarize the controllability & observability conditions;
iii. evaluate the functionality of Model Control;
iv. explain, formulate potential design techniques from analysis;
v. aspire for pursuing a carrier in control, recognize the need to learn, to engage and to adapt in a world of constantly changing technology and play role of team leader or supporter of team.

1. Introduction
   Systems, modelling, analysis and control, continuous-time and discrete-time. (2)
2. State Variable Descriptions
   Introduction, concept of state, state equations for dynamic systems, state diagrams. (3)
3. Physical Systems & State Assignments
   Linear continuous-time and discrete-time models, non-linear models, local linearisation of non-linear model. (5)
4. Solution of State Equations
   Existence and uniqueness of solution, linear time-invariant continuous-time state equations, linear discrete-time state equations. (6)
5. Controllability & Observability
   Concept of controllability & observability, controllability and observability tests for continuous -time systems, controllability and observability of discrete-time systems, canonical forms of state models. (10)
6. State models and input-output descriptions
   Input-output maps from state model and vice-versa, transfer matrix, output controllability, reducibility. (6)
7. Stability
   Stability concepts; liapunov stability analysis of linear time-invariant and timevarying systems.
   (5)
8. Modal Control

Introduction, Effect of state feedback on controllability and observability, pole placement by state feedback; Full order observers, Reduced-order observers; deadbeat control by state feedback, deadbeat observers.

(8)

References :

1. Modern Control System Theory by M. Gopal
2. Linear Systems by Thomas Kailath.
3. Modern Control Engg. by K. Ogata.

MEE 1119 CONTROL SYSTEM DESIGN

Department: Electronics and Communication Engineering/ Electrical and Electronics Engineering

Programme: PG (ECE)

Pre-requisite(s): Fundamentals of Mathematics and Physics, Introduction to System Theory, Control Theory

Course Objectives:

i. To state the performance characterisitics of control systems with specific design requirements and design objectives;
ii. To understand the concepts of PD, PI, PID, lead, lag and lag lead controller design in time domain and frequency domain and apply it to specific real time numerical problems
iii. To apply the state feedback controller and observer design techniques to modern control problems and analyse the effects on transient and frequency domain response ;
iv. To realize and then design digital and analog compensators.

Course Outcomes:

At the end of the course, a student should be able to

i. Identify the design objectives and requirements of control systems;
ii. Interpret the concepts of PD, PI, PID, lead, lag, lag lead, and discrete data controller design and apply it to solve some design problems;
iii. Apply the state feedback controller design and techniques and outline its effects on system's performance;
iv. To develop methodologies to design real time digital and analog compensators;
v. aspire for pursuing a carrier in control, recognize the need to learn, to engage and to adapt in a world of constantly changing technology and play role of team leader or supporter of team.

Module 1:

Performance characteristics of feedback control system & design specification of control loop. Different types of control system applications and their functional requirement. Derivation of load-locus (toque/ speed characteristics of load). Selection of motors, sensors, drives. Choice of design domain & general guidelines for choice of domain. Controller configuration and choice of controller configuration for specific design requirement. Fundamental principles of control system design. Experimental evaluation of system dynamics in time domain and frequency domain.

Module 2:

Design with PD Controller: Time domain interpretation of PD controller, frequency domain interpretation of PD controller, summary of the effects of PD controller. Design with PI controller: Time domain interpretation of PI controller frequency domain interpretation of PI controller, summary of the effects of PI controller, design with PID controller, Ziegler Nichols tuning & other methods.

Module 3:
Design with lag/lead/lag-lead compensator, time domain interpretation of lag/lead/lag-lead compensator, frequency domain interpretation of lag/lead/lag-lead compensator, summary of the effects of lag/lead/lag-lead compensator.

Module 4:
Forward & feed-forward controller, minor loop feedback control, concept of robust design for control system, pole-zero cancellation design.

Module 5:
Sate feedback control, pole placement design through state feedback, state feedback with integral control, design state observer.

Module 6:
Design of Discrete Data Control System: Digital implementation of analog controller (PID) and lag-lead controllers, Design of discrete data control systems in frequency domain and Z plane.

Module 7:
Hardware and Software Implementation of Common Compensator: Physical realization of common compensator with active and passive elements, tunable PID algorithms- position and velocity algorithms.

Books recommended:
Text Books:

1. B.C. Kuo, "Automatic Control System", 7th Edition PHI. (T1)
2. M. Gopal, "Control Systems Principles & Design", 2nd Edition, TMH. (T2)
3. J.G. Truxal, "Automatic Feedback Control System", McGraw Hill, New York. (T3)
4. K. Ogata, "Discrete Time Control Systems", 2nd Edition, Pearson Education. (T4)

Reference Books:

1. Norman Nise, "Control System Engineering", 4th Edition. (R1)
2. M. Gopal, "Digital Control & State Variable Method", TMH. (R2)
3. B.C. Kuo, "Digital Control System", 2nd Edition, Oxford. (R3)
4. Stephanie, “Design of Feedback Control Systems”, 4th Edition, Oxford. (R4)

MEC 1103 VLSI DESIGN AND APPLICATIONS

Department: Electronics and Communication Engineering

Programme: PG (ECE)

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

Course Objectives: This course enables the students to:

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: After completion of the course, the students will be able to:

CO1	Demonstrate understanding of fundamental of VLSI, device model, small signal model current and voltage references.
CO2	Demonstrate understanding of design goals and procedures of CMOS amplifiers such as 1-stage and 2-stage operational amplifiers and comparators.
CO3	Design switched capacitor circuits such as switched capacitor amplifiers, integrators, filters, DACs and ADCs.
CO4	Develop layout of digital, analog, and memory circuits based on layout design rules.
CO5	Design digital, analog, memory circuits and subsystems keeping design issues in consideration.

Module -1:

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 -2:

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 -3:

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 AnalogDigital Converter, Medium, High Speed Analog-Digital Converter, Over sampling Converter.

Module -4:

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 -5:

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 –6 :

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 –7 :

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 Book:

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

MEC1005 ELECTROMAGNETIC INTERFERENCE AND ELECTROMAGNETIC COMPATIBILITY

Department: Electronics and Communication Engineering

Programme: PG (ECE)

Pre-requisites: Electromagnetic Theory

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 and measure radiated and conducted emissions to examine the compatibility.
3	To develop an ability to evaluate the impact of radiated and conducted interference and compatibility.
4	To develop an ability to analyze and evaluate the impact of EMI mitigation techniques such as shielding and grounding.
5	To develop and ability to explain the impact of ESD and EMP on system design.

Course Outcomes:

On the completion of this course, the students will:

CO1	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.
CO2	Have an ability to analyze and measure radiated and conducted emissions to examine the compatibility.
CO3	Have an ability to evaluate the impact of radiated and conducted interference and compatibility.
CO4	Have an ability to analyze and evaluate the impact of EMI mitigation techniques such as shielding and grounding.
CO5	Be able to explain the impact of ESD and EMP on system design.

Module -1:

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 -2 :

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 -3 :

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 -4:

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 -5 :

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 -6:

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 fielding shielding, Effect of Apertures.

Module -7:
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.

MEC 1047 SENSORS AND TRANSDUCERS

Department: Electronics and Communication Engineering

Programme: PG (ECE)

Pre-requisites: Fundamental knowledge on Measurement and Instrumentation

Course Objectives:

1	To describe the operation of various sensors and their application
2	To select an appropriate sensor for a given application
3	Design a smart sensor using conventional sensors and microcontroller
4	Compare analog and digital transducer.
5	To discuss the latest technology in sensor development

Course Outcomes

On the completion of this course, the students will:

CO1	Understand the principle of operation of different sensors and their applications
CO2	Classify sensors on different basis
CO3	Differentiate between smart sensor and conventional sensor
CO4	Demonstrate the operation of various digital transducer
CO5	Be updated on the recent trends in sensor technologies.

Module -1:

Introduction about sensors and transducers, Principles of operation and their classification, characteristics of sensors.

Module -2:

Conventional sensors Type :

Based on Resistive principles. Potentiometer and Strain Gauge.
Based on Inductive principles – Ferromagnetic Plunge type, Inductance with a Short-circuited sleeve. Transformer type, Electromagnetic Transducers.
Based on capacitive principles - The parallel plate capacitive sensor, Variable Permittivity Capacitive Sensor, Stretched Diaphragm Variable Capacitive Transducer. Electrostatic and Piezoelectric Transducers, Quartz Resonators and Ultrasonic Sensors.
Based on Magnetic principles. Magnetoresistive, Hall effect, Inductance and Eddy current sensors. Angular/Rotary movement Transducer, Electromagnetic Flowmeter, Pulse wire sensor and SQUID sensor.

Module -3:

Thermal Sensors:

Acoustic Temp Sensor, Nuclear Thermometer, Magnetic Thermometer, Resistance Change Type, Thermoemf, Junction Semiconductor Types, Thermal Radiation, Quartz Crystal, NQR, Spectroscopic Noise Thermometry, Heat flux sensors.

Radiation Sensors:

Basic Characteristics, Photo-emissive Cell and Photomultiplier, Photoconductive Cell - Photovoltaic and Photojunction Cell, Position-Sensitive Cell, X-ray and Nuclear Radiation Sensors. Fibre, PHI Optic Sensors.

Module -4:

Electroanalytical Sensors:

Introduction, Electro-chemical Cell, Cell potential, Sd. Hydrogen Electrode (SHE), Liquid Junction and Other potentials, Polarization, Reference Electrodes, Sensor Electrodes, ElectroCeramics in Gas Media.

Module -5:

Smart Sensors:

Introduction, Primary Sensors Excitation, Amplification, Fitters, Converters, Compensation, Information Coding/Processing, Data Communication and Automation.

Module -6:

Digital Transducers:

Digital Encoder, Shaft Encoder, Switches: Pressure, Level, Flow, Temperature, Proximity Switches, Limit Switches and its types, Isolators (or Barriers).

Module -7:

Recent trends in sensor Technologies :

Introduction, Film Sensors, Semiconductor IC Technology, Microelectromechanical System (MEMS), Nano Sensors, Application of Sensors : Automotive Sensors, Home Appliance Sensors, Aerospace Sensors, Sensors for manufacturing, Medical Diagnostic Sensors, Sensors for Environmental Monitoring.

Text Books:

1. "Sensors and Transducers", 2/E By D. Patranabis
2. Electrical & Electronics Measurements and Instrumentation By A.K.Shawhney, Dhanpat Rai & Sons.
3. Electronics instrumentation By H. S. Kalsi [TMH]

MEC 1149 APPLIED BIOELECTRONIC INSTRUMENTATION

Department: Electronics and Communication Engineering

Programme: PG (ECE)

Pre-requisites: Knowledge in Sensors

Course Objectives: The objectives of this course are to give students:

1	An introduction to the signals generated within the body and which can be measured by the physiologist.
2	The principles of the biomedical instrumentation used to record and analyze these signals.
3	A basis of the structure and function of biomedical instrumentation used by the clinical physiologist in the evaluation of organ function when assessing cardiac, vascular, respiratory and sleep disorders.
4	An understanding of the instrumentation and principles of physics of the equipment, transducers, the interactions of the "energy" with the body, signal processing, display and storage.

Course Outcomes:

On the completion of this course, the students will have:

CO1	An ability to understand the various signals generated in the body and the way they can be measured by the physiologist.
CO2	An ability to understand the principles behind various biomedical instrumentation systems and an understanding of the signals
CO3	An ability to identify various disorders in the body based upon the recorded signals
CO4	An ability to understand the functionality of various biomedical instrumentation system
CO5	Students capable to apply science and engineering concepts to solve problems at the man machine interface

Module -1:

INTRODUCTION TO BMI & MEASUREMENTS:

Physiological system & measurable variables, Human & equipment safety, Physiological effects of electricity, Micro & Macro-shock.

Module -2:

MODELLING & SIMULATION IN BMI:

Model based analysis of action potential, Cardiac output, Respiratory mechanism, Blood Glucose regulation.

Module -3:

BIOMEDICAL SYSTEMS & ACQUISITION:

Recording schemes and analysis of biomedical signals with typical examples of ECG, EMG, EEG, Wavelet transform, signal compression, Biomedical DSP.

Module -4:

BMI FOR DIAGNOSOS & MONITORING:

CT, PET, MRI, Thermal imaging, Ultrasound imaging, Diagnosis,Telemedicine & Telemonitoring. Antenna for biomedical application.

Module -5:

BMI MICROSYSTEM:

Implantable medical devices, Microsystem for clinical application, Microsensors.

Module -6:

DIATHERMY & RADIOLOGY:

Microwave, SW & UHF diathermy, LASER & X-RAY applications, Other radioactive rays.

Module -7:

SPECIAL TOPICS:

MedIcal informatics, Bio-neuro-fuzzy network, Blood gas & Pulmonary function analyzer.

Text Books:

R.S.Khandpur, Handbook for BMI, TMH Publisher.

1. Webster, Medical instrumentation application & design, John willey & sons.
2. Webster, Bioinstrumentation, John willey & sons.
3. Cromwell, BMI & Measurements, PHI Publisher.
4. Car & Brown, Introduction to biomedical equipment technology, Pearson education.
5. Antenna theory & Practise by Rajeswari chatterjee.
6. Medical informatics by M.L.SAIKUMAR
7. Biomedical DSP by Wills J Tompkin, PHI

MEC 1055 APPLIED INDUSTRIAL INSTRUMENTATION

Department: Electronics and Communication Engineering

Programme: PG (ECE)

Pre-requisites: Fundamental knowledge on Measurements and Instrumentation, Microprocessor and Microcontroller

Course Objectives :

1	To explain the concept of industrial instrumentation and impart knowledge on industrial automation.
2	To develop an ability to measure and analyze thermal power station.
3	To develop an ability to evaluate the parameters in Petrochemical Plant.
4	To develop an ability to design energy conserved, intrinsically safe instrumentation.
5	To discuss special purpose instruments and control.

Course Outcomes

On the completion of this course, the students will able to:

CO1	Demonstrate on the understanding of various instrumentation processes.
CO2	Have an ability to identify and analyze various components of a processing plant.
CO3	Have an ability to evaluate the performance of a real time system.
CO4	Have an ability to evaluate a larger for industrial automation.
CO5	Update on the recent trends in automation technologies.

Module -1:

Measurement of Force, Torque, Velocity, Acceleration, Pressure, Temperature, Flow, Level, Viscosity, Humidity & Moisture (Qualitative Treatment Only).

Module -2:

Measurements in thermal power plant: Selection, Installation and maintenance of Instruments used for the measurement of fuel flow, Air flow, Drum level, Steam pressure, Steam temperature and other parameters in thermal power plant – Analyzers-Dissolved Oxygen Analyzers- Flue gas Oxygen Analyzers-pH measurement- Coal/Oil Analyzer – Pollution Controlling Instruments.

Module -3:

Measurement in Petrochemical Industry: Parameters to be measured in refinery and petrochemical industry-Temperature, Flow and Pressure measurements in Pyrolysis, catalytic cracking, reforming processes-Selection and maintenance of measuring instruments –
Intrinsic safety.

Module -4:

Instrumentation for energy conservation & management: Principle of energy audit, management & conservation and measurement techniques –Instrumentation for renewable energy systems – Energy management device (Peak load shedding)

Module -5:

Electrical and intrinsic safety - Explosion suppression and deluge systems – Flame arrestors, conservation vents and emergency vents – Flame, fire and smoke Detectors- Metal detectors.

Module -6:

Special Purpose Instrumentation: Toxic gas monitoring- Detection of Nuclear radiation – Water quality monitoring- Monitor measurement by neutron-Thermo-luminescent detectors – Measurement of length, mass, thickness, flow, level using nuclear radiation.

Module -7:

PLC based control of processes: Interfacings of Smart sensors and actuators on field bus, PLC based control of liquid level system and heat exchanger.

Text Books:

1. D.Patranabis, Principles of Industrial Instrumentation, Tata McGraw Hill Publishing Company Ltd., New Delhi, 1999.

Reference Books:

1. John G Webster, Measurement, Instrumentation and Sensors Handbook, CRC press a. IEEE press
2. Liptak B.G, Instrumentation Engineers Handbook (Measurement), Chilton Book Co., a. 1994.
3. Reay D.A, Industrial Energy Conservation, Pergamon Press,1977.
4. Hodge B.K, Analysis and Design of energy systems, Prentice Hall, (1988).
5. Liptak B.G, Instrument Engineers Handbook, Clinton Book Company, (1982)
6. Ness S.A. Air monitoring for Toxic explosions, Air integrated Approach, Von a. Nostrand (1991).
7. Ewing G., Analytical Instrumentation hand book, Dekker (1991).
8. Alans V., Water and Waste water examination manual, Lewis Chele

MEC 2001 ADVANCED DIGITAL SIGNAL PROCESSING

Department: Electronics and Communication Engineering

Programme: PG (ECE)

Pre-requisites: Fundamentals of transform methods, Signals and Systems, Random Signals, knowledge of Matlab, FIR and IIR filters, analog filters

Course Objectives:

1	To help to understand the concept of different transforms and their uses in Industry
2	To impart knowledge on random signals by using parametric and non-parametric methods for power spectrum estimation
3	To impart knowledge on decimation , interpolation and filter structures
4	To help to understand the concept of adaptive filters such as LMS algorithm, RLS algorithm and their applications for adaptive noise cancellation, adaptive line enhancement and interference cancellation
5	To help to construct and recommend environment-friendly filters for real- time applications

Course Outcomes

On the completion of this course, the students will:

CO1	Demonstrate the understanding of different transforms and their uses in Industry
CO2	Have an ability to analyze random signals based on their time domain and frequency domain characteristics
CO3	Have an ability to analyze decimation , interpolation and filter structures
CO4	Be able to design adaptive filters for adaptive noise cancellation, adaptive line enhancement and interference cancellation
CO5	Be able to design and recommend environment-friendly filters for real- time applications

Module -1:

Introduction to Various Transforms & Algorithms:

Z-Transform, Discrete Fourier Transform, Inverse Discrete Fourier Transform, FFT Algorithms, DIT- FFT, DFT- FFT, Chirp Z Algorithm, Goertzel’s Algorithm, Discrete Cosine Transform

Module -2:

Wavelet Transform:

Introduction, Short Time Fourier Transform, Continuous Wavelet Transform, Discrete Wavelet Transform, Translation and Scaling, Orthogonality, Function Space, Finer Haar Scaling Functions, Nested Spaces, Haar Wavelet Function

Module -3:

Power Spectrum Estimation:

Estimation of Spectra from Finite Duration Observation of Signals, Computation of Energy Density Spectrum, Estimation of Auto Correlation & Power Spectrum of Random Signals, Non Parametric Methods for Power Spectrum Estimation

Module -4:

Parametric Methods for Power Spectrum Estimation:

Relationship between the auto correlation and the model parameters, The Yule – Walker method for the AR Model Parameters, The Burg Method for the AR Model parameters, unconstrained least-squares method for the AR Model parameters, sequential estimation methods for the AR Model parameters, selection of AR Model order

Module -5:

Multirate Signal Processing & Filter Structures:

Decimation by a factor D, Interpolation by a factor I, Filter Design and implementation for sampling rate conversion: Direct form FIR filter structures, Realization of IIR filter using Ladder & Lattice Structures

Module -6:

Adaptive Signal Processing:

Introduction to Adaptive systems and filters, linear filter structures, transversal filter, lattice predictor, approaches to the development of linear adaptive filters, stochastic gradient approach, least square estimation

Module -7:

Adaptive Filtering & Its Applications:

Introduction to Adaptive Filters, Stochastic Gradient Approach, Least Square Estimation, LMS Algorithm, RLS Algorithm, Wiener Filters, Adaptive Noise Canceller, Adaptive Line Enhancement, Interference Cancellation with an Adaptive Predictor

Text Books:

1. Digital Signal Processing 3/E by Proakis & Manolakis, PHI Edition.
2. Adaptive Filter Theory, Simon Haykin, Pearson Education.
3. K. P. Soman, K. I. Ramachandran, Insight Into Wavelets, From Theory to Practice, New Delhi, Prentice Hall of India, 2004.

Reference Books:

1. Digital Signal Processing 3/E by S.K.Mitra TMH Edition.
2. Discrete-Time Signal Processing 2/E by Oppenheim, Schafer & Buck, PHI Edition
3. Monson H. Hayes, Statistical Digital Signal Processing and Modelling, Wiley, 2002
4. Adaptive Signal Processing, Widrow and Stearns, Pearson Education.

MEC2161 PROCESS CONTROL INSTRUMENTATION

Department: Electronics and Communication Engineering

Programme: PG (ECE)

Pre-requisites: Fundamental knowledge on Control System and Instrumentation

Course Objectives:

1	To develop the mathematical model of the physical system
2	To differentiate between closed loop controller and open loop controller
3	To analyze the interdependency of multivariable controller.
4	To design a controller for practical systems under different condition
5	Explain the different processes involved in power generation

Course Outcomes:

On the completion of this course, the students will:

CO1	Analyze a physical system and develop the mathematical model of the physical system
CO2	Understand the concepts of closed loop and open loop system.
CO3	Design a controller for practical systems under different condition.
CO4	Understand the operation of different complex control schemes.
CO5	Understand the need of process control in different plants and industries

Module -1:

Introduction to process control, Examples of surge tank, shower, Use of instrumentation in Process control, Process model and dynamic behaviour.

Fundamental model:

Back ground, Reason of modelling, Lumped parameter system models, Balanced equation, Material balances, Form of dynamic model.

Module -2:

Introduction to feedback control:

Digital and Analog Controller (On –Off control, Proportional, Integral and Derivative control), Development of control system block diagram, Reason of set point changes.

PID controller tuning forms :

Ziglar-nichols open loop method., Cohen-Coon parameters.

Module -3:

Internal model control:

Introduction to model control, Static control law, Dynamic control law, Practical open loop controller design, Generation of open-loop controller design procedure, model uncertainty and disturbances.

Module -4:

Complex control schemes:

Background, Introduction to cascade control, cascade control analysis and design, feed forward control, feed forward control design, examples of feed forward control. Ratio control, selective and over ride control, split -range control, multivariable control.

Module -5:

Plant wide control and Model predictive control:

Steady state and dynamic effect of recycle, compressor control, Heat exchanger, the control and optimisation hierarchy. Optimisation problem, dynamics matrix control (DMC), multi variable system.

Module -6:

Process Control In Thermal Power plants:

Process of power generation in coal –fired and oil-fired thermal power plants, types of boilers, Combustion process, Super heater, Turbine, importance of Instrumentation in thermal power plant.

Module -7:

Process Control In Petrochemical Industries:

Introduction to Refinery and Petrochemical processes, Control of distillation column, Catalytic cracking unit, Catalytic reformer, Pyrolysis unit, Automatic Control of polyethylene production, Control of vinyl chloride and PVC production.

Text Books:

1. "Process control: Modelling Design and simulation" By B.Wayne Bequette,Wayne B Bequette
2. "Principle of Industrial Instrumentation" By D. Patranabis, TMH publications
3. "Principles of Process Control" By D. Patranabis, TMH publication 4. "Power plant performance " By A. B. Gill, Elsevier, India, New Delhi.
5. J.G. Balchan. and K.I. Mumme, 'Process Control Structures and Applications', Van Nostrand Reinhold Company, New York, 1988.

MEE 1105 OPTIMIZATION IN ENGINEERING DESIGN

Department: Electronics and Communication Engineering

Programme: PG (ECE)

Course Objectives: The objectives of this course are to give students:

1	Basic understanding of optimization problems, viz., their formulation, analytic and computational tools for their solutions, and applications in different areas.
2	An understanding of the various methods available towards problem optimization in one variable and multi-variable.

Course Outcomes

On the completion of this course, the students will have:

CO1	An ability to formulate finite-dimensional optimization problem.
CO2	Apply some sufficiency conditions to an optimization method to test whether a minimum or a maximum exists, and whether they are unique
CO3	An ability to use the first- and second-order conditions for unconstrained optima to calculate minima and maxima.
CO4	An ability to use various computational algorithms for unconstrained optimization, including steepest descent, Newton's method, conjugate-direction methods, and direct search methods.
CO5	An understanding to use both linear and nonlinear programming as effective tools to solve engineering design problems.

Module - 1

INTRODUCTION

Optimal problem formulation, Design variables constraints, Objective function, Variable bounds, Engineering optimization problems, Optimization algorithms.

Module - 2

ONE DIMENSIONAL SEARCH METHODS

Optimality Criteria, Bracketing methods: Exhaustive search methods, Region - Elimination methods; Interval halving method, Fibonacci search method, Golden section search method, Point-estimation method; Successive quadratic estimation method.

Module - 3

Gradient-based methods: Newton-Raphson method, Bisection method, Secant method, Cauchy’s (Steepest descent) method and Newton’s method.

Module - 4

LINEAR PROGRAMMING

Graphical method, Simplex Method, Revised simplex method, Duality in Linear Programming (LP), Sensitivity analysis, other algorithms for solving LP problems, Transformation, assignment and other applications.

Module - 5

MULTIVARIABLE OPTIMIZATION ALGORITHM

Optimality criteria, Unidirectional search, Direct search methods: Simplex search method, Hooke-Jeeves pattern search method.

Module - 6

CONSTRAINED OPTIMIZATION ALGORITHM

Characteristics of a constrained problem. Direct methods: The complex method, Cutting plane method, Indirect method: Transformation Technique, Basic approach in the penalty function method, Interior penalty function method, convex method.

Module - 7

ADVANCED OPTIMIZATION TECHNIQUES

Genetic Algorithm, Working principles, GAs for constrained optimization, Other GA operators, Advanced GAs, Differences between GAs and traditional methods.

Simulated anneating method, working principles.

Particle swarm optimization method, working principles.

Books Recommended:

1. Optimization for Engineering Design - Kalyanmoy Deb.
2. Optimization Theory and Applications - S.S. Rao.
3. Analytical Decision Making in Engineering Design - Siddal.
4. Linear Programming – G. Hadley

MEC 2011 DIGITAL IMAGE PROCESSING TECHNIQUES

Department: Electronics and Communication Engineering

Programme: PG (ECE)

Pre-requisites: Knowledge of Digital Signal Processing, Human visual system, Matrix operations, Basic understanding on probability theory

Course Objectives

1	To gain understanding on digital image formation, characteristics and its processing steps.
2	To demonstrate the use of different spatial and frequency domain processing techniques to improve the image quality.
3	To apply various segmentation techniques of an image.
4	To introduce various image description and representation methods for computer vision applications.
5	To demonstrate various compression techniques and its applications.

Course Outcomes

On the completion of this course, the students will:

CO1	Develop an understanding on the image formation, pixel characteristics and processing step.
CO2	Have an ability to analyze the image quality using transformed and spatial domain filters.
CO3	Have an ability to segment and represent the image for computer vision tasks.
CO4	Have an ability to analyze the different image compression techniques and to evaluate its performance.
CO5	Develop an ability to create and apply the image processing techniques in various applications in many areas.

Module -1:

Digital Image Fundamentals:

Fundamental steps in Digital Image Processing, Components of an Image processing system, Digital Image Representation , Basic relationship between pixels, Color Modules, RGB and HSI color modules, Application of Fuzzy logic in Digital Image Processing.

Module -2:

Image Enhancement:

Image negatives , Histogram Equalization , Local Enhancement , Image Subtraction, Image Averaging , Smoothing Spatial Filters, Sharpening Spatial Filters, Combining Spatial Enhancement methods.

Module -3:

Image Transform:

Fourier Transform ,Discrete Fourier Transform, Fast Fourier Transform, Smoothing Frequency Domain filters, Sharpening Frequency Domain filters, Homomorphic filtering, Convolution and Correlation Theorems, Wavelet Transforms, The Fast Wavelet Transforms.

Module -4:

Image Restoration:

Noise Models, Restoration in the presence of Noise-Only Spatial filtering , Mean filters , Adaptive filters Periodic Noise Reduction by Frequency Domain filtering , Inverse Filtering , Minimum Mean Square Error (Wiener) Filtering, Geometric Mean Filter.

Module -5:

Image Segmentation:

Detection of Discontinuities, Point Detection, Line detection, Edge Detection, Thresholding , Optimal Global and Adaptive thresholding, Region-based Segmentation, Textural Images, Textural Feature extraction from Co-occurrence matrices .

Module -6:

Representation and Description:

Chain codes, Signatures, Boundary Segments, Skeletons, Boundary Descriptors, Regional Descriptors ,Use of the Principal Components for Description, Relational Descriptors.

Module -7:

Image Compression:

Fundamentals, Redundancy , Image Compression Models, Coding Theorems, Error-free Compression techniques like Variable- length Coding and Lossless Predictive Coding , Lossy Compression techniques like Lossy Predictive Coding and Wavelet Coding, Image Compression standards.

Text Books:

1. Digital Image Processing. 2/E by Rafael C. Gonzalez and Richard E. Woods. Pearson Education
2. Digital Image Processing and Analysis. by B. Chanda and D. Dutta Majumder PHI

MEC2113 REAL TIME EMBEDDED SYSTEM DESIGN

Department: Electronics and Communication Engineering

Programme: PG (ECE)

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

Course Objectives : This course enables the learner to:-

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: After completion of this course, learner will be able to:

CO1	Define the important components of embedded systems.
CO2	Apply the design strategy of embedded systems for creating applications.
CO3	Design semiconductor compact memories for embedded systems.
CO4	Illustrate the utility of interfacing circuits in embedded systems with example of digital camera.
CO5	Develop a system using embedded system peripherals and verify the system performance with real time data.

Module -1:

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 – 2:

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-3:

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 – 4:

Device and Interrupt service:

Bus models, time multiplexed bus, strobe and handshake protocols, strobe handshake compromise priority arbiter multilevel bus, and architecture.

Module -5:

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 – 6: 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 – 7:

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.

MEC 2019 MICRO-ELECTRO-MECHANICAL-SYSTEMS

Department: Electronics and Communication Engineering

Programme: PG (ECE)

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

Course Objectives

1	To develop an ability, enthusiasmcritical 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 acquirepractical knowledge of relevant technologies and multi disciplinary fields, including broad social, ethical and environmental issues, within which engineering is practiced.

Course Outcomes

On the completion of this course, the students will:

CO1	Demonstrate knowledge on fundamental principles and concepts of MEMS Technology
CO2	New applications and directions of modern engineering
CO3	Have an ability to analyze various techniques for building micro-devices in silicon, polymer, metal and other materials
CO4	Havean abilityto critically analyze micro-systems technology for technical feasibility as well as practicality using modern tools and relevant simulation software to perform design and analysis.
CO5	Have an ability to analyze physical, chemical, biological, and engineering principles involved in the design and operation of current and future micro-devices & ability to evaluate limitations and current challenges in micro-systems technology

Module -1:

Micro electromechanical systems:

Introduction, MEMS Overview, Microfabrication of MEMS: Surface Micromachining, Bulk Micromachining, LIGA, micromachining of polymeric MEMS devices

Module -2:

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 -3:

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 -4:

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 -5:

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 -6:

MEMS RF applications :

Mems based RF and Microwave circuits : RF Filters, Micromachined Phase shifters, and Micromachined antenna.

Module -7:

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(2^{nd} 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,” McGraw-Hill, 1st edition, ISBN: 0072393912.
2. Mems Mechanical Sensors Microelectromechanical system series Srephen Beeby/Artech House

MEC 2059 ARTIFICIAL INTELLIGENCE AND INTELLIGENT SYSTEMS

Department: Electronics and Communication Engineering

Programme: PG (ECE)

Course Objectives:

1	To explain the concept of Artificial intelligence, expert system and impart knowledge on the fundamental concept of Intelligent System.
2	To develop an ability to understand AI Programming language LISP and its comparison with others like PROLOG.
3	To develop an ability to evaluate the impact of Inconsistencies, Uncertainties, Probabilistic Reasoning and Structured Knowledge
4	To develop an ability to analyze the impact of Object-Oriented Representations, Knowledge Organization & Management and Expert Systems Architectures
5	To develop and ability to evaluate the performance of real time Intelligent system.

Course Outcomes:

On the completion of this course, the students will:

CO1	Demonstrate understanding on the Artificial Intelligence, expert system and impart knowledge on the intelligent system.
CO2	Have an ability to describe the concept of AI Programming language LISP and Prolog.
CO3	Demonstrate understanding on the impact of Inconsistencies, Uncertainties, Probabilistic Reasoning and Structured Knowledge
CO4	Have an ability to analyze the impact of Object-Oriented Representations, Knowledge Organization & Management and Expert Systems Architectures
CO5	Demonstrate insight to evaluate different emerging techniques to improve real time intelligent system

Module -1:

Overview of Artificial Intelligence, General Concept and Knowledge Representation:

Definition, Concept and Importance of Artificial Intelligence, Knowledge, Knowledge- Based Systems, Knowledge – Acquisition, Representation, Organization, and Manipulation, Syntax and Semantics, Inference Rules, The Resolution Principle, No deductive Inference Methods, Representations Using Rules.

Module -2:

Inconsistencies, Uncertainties, Probabilistic Reasoning and Structured Knowledge:

Truth Maintenance Systems, Default Reasoning and the Closed World Assumption, Predicate Completion and Circumscription, Modal and Temporal Logics. Reasoning with Uncertain Information, Bayesian Probabilistic Inference, Possible World Representations, Dumpster-Shafer Theory, Ad-Hoc Methods, Graphs, Frames and Related Structures, Associative Networks, Frame Structures, Conceptual Dependencies and Scripts.

Module -3:

LISP and Other AI Programming Languages:

Introduction to LISP : Syntax and Numeric Function, Basic List Manipulation Functions in LISP, Functions, Predicates, Conditionals and Binding, Input, Output and Local Variables, Iteration and Recursion, Property Lists and Arrays, Miscellaneous Topics, PROLOG and Other AI Programming Languages.

Module -4:

Object-Oriented Representations, Search and Control Strategies, Matching Techniques

Overview of Objects, Classes, Messages and Methods, Simulation Example using an OOS Program, Preliminary Concepts, Examples of Search Problems, Uninformed or Blind Search, Informed Search, Searching And-Or Graphs, Structures Used in Matching, Measures for Matching, Matching Like Patterns, Partial Matching,.

Module -5:

Knowledge Organization & Management and Expert Systems Architectures:

Indexing and Retrieval Techniques, Integrating Knowledge in Memory, Memory Organization Systems, Rule Based System Architecture, Non-Production System Architecture, Dealing with uncertainty, Knowledge Acquisition and Validation, Knowledge System Building Tools.

Module -6:

Artificial Intelligent Systems:

Intelligent Agents, Communication among Agents, Search in State Spaces, Intelligent Systems based on Fuzzy Logic and Artificial Intelligence, Expert Systems & Artificial Intelligence, Machine Evolution and State Machines, Robot Vision.

Module -7:

Artificial Neural Networks:

Introduction and Benefits of Artificial Neural Networks (ANN), Elements and Architecture of ANN, Learning Process (Paradigms and Algorithms), Applications of ANN – Character Recognition, Control Applications, Data Compression, Self Organizing Semantic Maps.

Text Books:

1. Nilsson, Nils J. – Artificial Intelligence – A new Synthesis (Morgan Kaufmann Publishers)
2. Rich - Artificial Intelligence (Mc Graw Hill Education)
3. Charniak – Introduction to Artificial Intelligence (Pearson Education)
4. Patterson, Dan W. - Introduction to Artificial Intelligence and Expert Systems (Pearson Education)

Reference Books:

1. Winston, P.H. Winston - Artificial Intelligence (Addison Wesley, New Delhi)

2. Rolston, D.W. - Principles of AI & Expert System Development, (TMH, New Delhi)
3. Rusell – Artificial Intelligence: A modern Approach (Pearson Education)
4. Wise – Artificial Intelligence (Hands-on AI with Java: Smart Gaming, Robotics and More) ((Mc Graw Hill Education)
5. Schalkoff, Robert J. - Artificial Neural Net Works (Mc Graw Hill Education)
6. Giarratano, Joseph & Riley, Gary – Expert Systems: Principles and Programming (Thomson Brooks/Cole)
7. Jackson, Peter – Introduction to Expert Systems (Pearson Education)
8. Luger – Artificial Intelligence (Pearson Education)

MEC 2163 SPEECH PROCESSING AND RECOGNITION

Department: Electronics and Communication Engineering

Programme: PG (ECE)

Pre-requisites: Knowledge of probability theory, Signal & system, Understanding on signal processing techniques, Understanding of pattern recognition techniques, Knowledge of Matlab

Course Objectives:

1	To explain fundamentals of speech production, its perception and inherent features.
2	To develop an ability to analyze parameter estimation and feature representations of speech signals.
3	To develop an ability to evaluate the pattern comparison and design issues of speech recognition.
4	To develop the concept and utilization of statistical and pattern recognition models.
5	To develop the ability to apply the speech analysis and recognition methods for different real life applications.

Course Outcomes:

On the completion of this course, the students will:

CO1	Demonstrate the understanding on the speech production, its perception and features.
CO2	Have an ability to analyze various components of parameter estimation and feature representations of speech signals.
CO3	Have an ability to illustrate various models for speech synthesis and automatic recognition.
CO4	Have an ability to analyze the speech recognition and implementation issues.
CO5	Develop an ability to create and apply the speech recognition techniques in various applications in many areas.

Module -1:

Speech production:

Introduction, Speech Production Process, Representing Speech in Time and Frequency domains, Speech Sounds and Features, Approaches to Automatic Speech Recognition by Machine

Module -2:

Signal Processing and Analysis Method for Speech Recognition:

Introduction, The Bank of filters front end processor, Linear predictive coding model for Speech Recognition, Vector quantization

Module -3:

Pattern comparison techniques:

Introduction, Speech Detection, Distortion Measures, Spectral-Distortion Measures, Incorporation of Spectral Dynamics Features into the Distortion Measures, Time Alignment and Normalization

Module -4:

Speech Recognition System Design and Implementation Issues:

Introduction, Application of Source-Coding Techniques to Recognition, Template Training Methods, Performance Analysis and Recognition Enhancements, Template Adaptation to New Talkers, Discriminative Methods in Speech Recognition, Speech Recognition in Adverse Environments

Module -5:

Hidden Markov Models:

Introduction, Discrete-Time Markov Process, Extensions to HMM, Basic Problems for HMM, Types of HMMs, Continuous Observation Densities in HMM, Auto Regressive HMMs, Variants on HMM structures, Inclusion of Explicit State Duration Density in HMMs, Optimization Criterion, Comparisons of HMMs

Module -6:

Statistical Models for Speech Recognition:

Implementation Issues for HMMs, Improving the Effectiveness of Model Estimates, Model Clustering and Splitting, HMM System for Isolated Word Recognition, Gaussian Mixture Models and Speaker Recognition using GMM

Module -7:

Applications of Automatic Speech Recognition:

Introduction, Speech-Recognizer Performance Scores, Characteristic of Speech- Recognition Applications, Broad classes of Speech-Recognition Applications, Command and Control Applications, Projections for Speech Recognition, Applications of Speech Recognition in Mobile Phones

Text Book:

1. Fundamentals of Speech Recognition by Lawrence Rabiner, Biing –Hwang Juang Pearson Ed

MEC 2067 VHDL & VERILOG

Department: Electronics and Communication Engineering

Programme: PG (ECE)

Pre-requisites: Knowledge of logic circuits, design and modeling tools (Xilinx's, active HDL, modelsim, C, C+, C++ etc).

Course Objectives : This course enables the learner to:-

1	Demonstrate the important components of VHDL
2	Explain the sequential processing of logic circuits
3	Explain the data types, subprograms, packages and VHDL synthesis
4	Show the important terms of Verilog@HDL
5	Demonstrate the synthesis, modeling, model optimization and verification of Verilog@HDL

Course Outcomes: After completion of this course, learner will be able to:

CO1	Define the important components of VHDL
CO2	Analyze the sequential processing of logic circuits
CO3	Define data types, subprograms, packages and VHDL synthesis of logic circuits.
CO4	Use the important components of Verilog@HDL for the design and analysis of logic circuits
CO5	Develop a system using Verilog@HDL synthesis, modeling, model optimization and verification techniques for industry use

Module -1:

Introduction to VHDL:

System design with uses, History of VHDL, Simulation fundamentals, Modelling hardware, and Language basics, Building blocks in VHDL, Design units and library.

Module -2:

Sequential Processing:

Process statement, Signal vs variable assignment, Sequential statements, For loop, While loop, Condition statements, Examples of half adder and full adder, Test bench.

Module -3:

Data Types and Subprograms:

Data types, Scalar, Composite, Access type, File type; Arrays; Objects, Signal variables, Constants and files, Association lists, Interface lists, Structural description, Examples. Subprogram, Functions, Conversion function, Resolution functions, Procedures.

Module -4:

Packages and VHDL Synthesis:

Packages, Package declaration, deferred constants, Subprogram declaration. Simple gate - concurrent assignment, IF control flow statement, Case control flow statement, Simple sequential statements, Asynchronous reset, Asynchronous preset and clear, Complex sequential statements.

Module -5:

Introduction to Verilog:

Synthesis and Synthesis in a design process, logic value system, Bit-widths, value holder and hardware modelling, Continuos assignment statement, Procedural assignment statement, Logical operator, arithmetic operator, relational operators, shift operators, vector operations, bit-selects, if statement, case statement, more on inferring latches, loop statement, Latch with preset and clear, modelling flip-flops, functions, tasks, gate level modelling.

Module -6:

Modelling:

Modelling of combinational, sequential logic and memory, Writing a Boolean expression, modelling a FSM and universal shift register, Modelling of a counter and ALU, modelling of parameterized adder, comparator and parity generator, Modelling of a decoder, multiplexer, and three state gate, factorial, UART, Blackjack model.

Module -7:

Model Optimizations and Verification

Resource allocation, common sub-expressions, moving code, common factoring, commutativity and associativity, flip-flop and latch optimizations, design size. A test bench, delays in assignment statements, unconnected ports, missing latches, More on delays, event list, synthesis directives, blocking and non-blocking assignments.

Text Books:

1. “VHDL” by Douglas Perry, TMH, 1999.

Reference Books:

1. VERILOG HDL SYNTHESIS, by J. Bhasker, BS Publication 2004.
2. Fundamental of Digital Logic with VERILOG DESIGN, by Stephen Brown I Zvonko Vranesic, The McGraw-Hill Companies.
3. VERILOG HDL, A Guide to Digital Design and Synthesis, by Prabhu Goel,

MEC 2075 INSTRUMENTATION SYSTEM DESIGN

Department: Electronics and Communication Engineering

Programme: PG (ECE)

Pre-requisites: Fundamental knowledge on Measurements and Instrumentation, Microprocessor and Microcontroller

Course Objectives :

1	To explain the concept of industrial instrumentation and impart knowledge on industrial automation.
2	To develop an ability to measure and analyze thermal power station.
3	To develop an ability to evaluate the parameters in Petrochemical Plant.
4	To develop an ability to design energy conserved, intrinsically safe instrumentation.
5	To discuss special purpose instruments and control.

Course Outcomes:

On the completion of this course, the students will able to:

CO1	Demonstrate on the understanding of various instrumentation processes.
CO2	Have an ability to identify and analyze various components of a processing plant.
CO3	Have an ability to evaluate the performance of a real time system.
CO4	Have an ability to evaluate a larger for industrial automation.
CO5	Update on the recent trends in automation technologies.

Module -1:

DESIGN OF SIGNAL CONDITIONING CIRCUITS:

Design of V/I Converter and I/V Converter- Analog and Digital Filter design – Signal conditioning circuit for pH measurement –Compensation circuit - Signal conditioning circuit for Temperature measurement - Cold Junction Compensation – software and Hardware approaches -Thermocouple Linearization – Software and Hardware approaches

Module -2:

DESIGN OF TRANSMITTERS:

RTD based Temperature Transmitter – Thermocouple based Temperature Transmitter- Design of Capacitance based Level Transmitter – Air-purge Level Measurement – Design of Smart Flow Transmitters.

Module -3:

DESIGN OF DATA LOGGER AND PID CONTROLLER:

Design of ON / OFF Controller using Linear Integrated Circuits, Electronic PID Controller, Microcontroller Based Digital PID Controller, Microcontroller based Data Logger design, Design of PC based Data Acquisition Cards

Module -4:

DESIGN OF ALARM AND ANNUNCIATION CIRCUIT:

Alarm and Annunciation circuits using Analog and Digital Circuits, Thyristor Power Controller.

Module -5:

PROGRAMMABLE LOGIC CONTROLLERS:

Evolution of PLC, Sequential and Programmable controllers Architecture, Relay based logic controller, I/O modules-Digital and Analog.

Module -6:

PROGRAMMING OF PLC:

Addressing modes of PLC, Languages used in PLC Programming, Instructions used in Ladder programming, Programming examples of different processes.

Module -7:

Communication topolgies used in PLC, Configuring of PLC, Documentation and selection of PLC.

Text Books:

1. Lucas M.P, "Distributed Control System", Van Nostrand Reinhold Co. NY 1986
2. Pertrezeulla, "Programmable Controllers", McGraw-Hill, 1989
3. Chidambarm. M, " Computer control of processes", Narosa Publications, 2002.
4. C. D. Johnson, "Process Control Instrumentation Technology", 8^{th} Edition, Prentice Hall, 2006.
5. Chidambarm. M, " Computer control of processes", Narosa Publications, 2002.