M.E. INDUSTRIAL AUTOMATION AND RADIO FREQUENCY ENGINEERING

Scheme of Instruction and Syllabus

Semester I

Subject Code	Name of the Subjects	No. of Hrs / Week				Scheme of Examination				
						Credits				
		L	T	P	Theory hours	Theory	IA	Practical	orals	Total
MEIARF1.1	Electromagnetic Field Theory	4	-	0	3	4	2	--	--	6
MEIARF1 .2	Control System Analysis and Design	4	-	0	3	4	2	--	--	6
MEIARF1.3	Industrial Drives And Control	4	-	0	3	4	2	--	--	6
MEIARF1.4	Radiating Systems	4	-	0	3	4	2	--	--	6
MEIARF1.5	Robotics And Automation	4	-	0	3	4	2	--	--	6
MEIARF1.6	Electromagnetic Field and Radiating Systems Lab	0	-	7	--	--	2	2	-	4
MEIARF1.7	Process Control And Instrumentation Lab	0	-	7	--	--	2	2	-	4
	Total	20	-	14	--	20	14	4		38

IA – Internal Assessment

Semester II

Subject Code	Name of the Subjects	No. of Hrs / Week				Scheme of Examination				
						Credits				
		L	T	P	Theory hours	Theory	IA	Practical	orals	Total
MEIARF 2.1	Embedded System & Parallel Processing	4	-	0	3	4	2	--	--	6
MEIARF 2.2	Industrial Data Networks	4	-	0	3	4	2	--	--	6
MEIARF 2.3	Microwave Engineering	4	-	0	3	4	2	--	--	6
MEIARF 2.4	Microwave Electronics and Semiconductor Devices	4	-	0	3	4	2	--	--	6
MEIARF 2.5	Industrial Management	4	-	0	3	4	2	--	--	6
MEIARF 2.6	Microwave Lab	0	-	7	--	--	2	2	--	4
MEIARF 2.7	Embedded System & Parallel ProcessingLab	0	-	7	--	--	2	2	--	4
	Total	20	-	14	--	20	14	4		38

Semester III

Subject Code	Name of the Subjects	No. of Hrs / Week				Scheme of Examination				
		L	T	P	Theory hours	Credits				
						Theory	IA	Practical	orals	Total
MEIARF 3.1	Elective – I	4	-	0	3	4	2	--	--	6
MEIARF 3.2	Elective – II	4	-	0	3	4	2	--	--	6
MEIARF 3.3	Project	-	-	20	-	-	4	--	8	12
	Total	8	-	20	--	8	8	-	8	24

List of Electives

Elective 1:

- **A) ADVANCED PROCESS CONTROL**
- **B) VIRTUAL INSTRUMENTATION**
- **C) RADAR SYSTEMS ENGINEERING**
- **D) MICROWAVE SOLID STATE DEVICES**
- **E) CHEMICAL PROCESS SYSTEMS**
- **F) BIOPROCESS INSTRUMENTATION & CONTROL**
- **G) LOGIC AND DISTRIBUTED CONTROL SYSTEMS**
- **H) INSTRUMENTATION SYSTEM DESIGN**
- **I) PHARMACEUTICAL BUSINESS MANAGEMENT**
- **J) RF MICROELECTRONIC CHIP DESIGN**
- **K) POWER ELECTRONICS**

Electives 2

- **L) INSTRUMENTATION**
- **M) SENSORS IN INSTRUMENTATION**
- **N) SIMULATION OF CIRCUITS AND DEVICES**
- **O) IMAGE PROCESSING**
- **P) ERROR CORRECTING CODES**
- **Q) ADVANCED ELECTRONIC SYSTEM DESIGN**
- **R) APPLIED INDUSTRIAL INSTRUMENTATION**
- **S) APPLIED BIOMEDICAL INSTRUMENTATION**
- **T) ELECTROMAGNETIC INTERFERENCE AND ELECTROMAGNETIC COMPATIBILITY**
- **U) TELEMETRY**
- **V) PROCESS MODELLING AND SIMULATION**
- **W) ADVANCED OPTICAL COMMUNICATION**

Semester IV

Subject Code	Name of the Subjects	No. of Hrs / Week				Scheme of Examination				
		L	T	P	Theory hours	Credits				
						Theory	IA	Practical	orals	Total
MEIARF 4.1	Dissertation	-	-	28	-	-	6	-	14	20
	Total	-	-	28	-	-	6	-	14	20

Semester I

MEIARF1.1: Electromagnetic Field Theory

Maxwell's equations: Differential and integral forms; continuity equation; constitutive relations; media classification; boundary conditions; Poynting theorem; time harmonic fields; complex Poynting vector, homogeneous wave equation and its solution
Plane waves: Polarization, attenuation, reflection, and refraction; Field representations and solutions in unbounded space:
Electromagnetic sources, solutions of 2D and 3D inhomogeneous wave equation, vector and scalar potentials, Hertz potentials, potentials for static fields, near zone and far zone representations. Waveguides and cavities: Parallel plate waveguide, grounded
dielectric slab, rectangular waveguide and cavity. Elements of Green's functions. Cylindrical waves and structures: Cylindrical wave functions, circular metallic guide, dielectric rod, cylindrical wave transformations, scattering by metallic cylinder. Spherical waves: Plane wave scattering by spheres, radar cross section. Electromagnetic theorems: Duality, uniqueness, image theory, equivalence principle, reciprocity and reaction theorem, conservation laws.
Sturm-Liouville problem and construction of one-dimensional Green's functions. Review of complex analysis. Construction of two- and three-dimensional Green's functions with examples and applications. Spectral representation of sources and Sommerfeld integrals. Fields in layered media. Dyadic Green's functions. Time-domain fields, retarded potentials, and transients. Periodic structures, Floquet modes, and band diagrams.

TEXT BOOK:

1. Advanced Engineering Electromagnetics by C. A. Balanis
2. Waves and Fields in Inhomoegeous Media by W. C. Chew
3. Field Theory of Guided Waves by R. E. Collin
4. Electromagnetic Wave Theory by J. A. Kong

MEIARF1.2: Control System Analysis and Design

Review of frequency and time response analysis and specifications of control systems, need for controllers, continues time compensations, continues time PI, PD, PID controllers, digital PID controllers.
Sampling, time and frequency domain description, aliasing, hold operation, mathematical model of sample and hold, zero and first order hold, factors limiting the choice of sampling rate, reconstruction.
Difference equation description, Z-transform method of description, pulse transfer function, time and frequency response of discrete time control systems, stability of digital control systems, Jury's stability test, state variable concepts, first companion, second companion, Jordan canonical models, discrete state variable models, elementary principles.
Review of principle of compensator design, Z-plane specifications, digital compensator design using frequency response plots, discrete integrator, discrete differentiator, development of digital PID controller, transfer function, design in the Z-plane.
Algorithm development of PID control algorithms, software implementation, implementation using microprocessors and microcontrollers, finite word length effects, choice of data acquisition systems, microcontroller based temperature control systems, microcontroller based motor speed control systems.

TEXT BOOK:

1. M.Gopal, "Digital Control and Static Variable Methods", Tata McGraw Hill, New Delhi, 1997.
2. John J. D'Azzo, "ConstantiveHoupios, Linear Control System Analysis and Design", McGraw Hill, 1995.
3. Kenneth J. Ayala, "The 8051 Microcontroller- Architecture, Programming and Applications", Penram International, 2nd Edition, 1996.

MEIARF1.3: Industrial Drives and Control

INTRODUCTION TO ELECTRIC DRIVES: Motor-Load system –Dynamics, load torque, steady state stability, speed control and multiqudrant operation –speed Torque characteristics of DC motor –breaking of series and separately excited dc motor, speed torque characteristics of induction motor MODELING OF AC AND DC MACHINES: Circuit model of Electric Machines-Transfer function models of series and separately excited DC motor-AC Machines –Dynamic modeling –linear transformations-equations in stator, rotor and synchronously rotating reference frames-flux linkage equations-Dynamic state space model-modeling of Synchronous motor

CONTROL OF DC DRIVES: Analysis of series and separately excited DC motor with single phase and Three phase converters operating in different modes and configurations- Analysis of series and separately excited DC motor fed from different choppers, effect of saturation in series motors-Closed loop control of dc drives-two quadrant and four quadrant operation

CONTROL OF AC DRIVES: Operation of induction motor with non-sinusoidal supply waveforms, Variable frequency operation of 3-phase inductions motors, constant flux operation, current fed operations, Dynamic and regenerative braking of CSI and VSI fed drives, Torque Equations, Constant torque operations, Static rotor resistance control and slip power recovery scheme –Combined stator voltage control and rotor resistance control-Synchronous motor control, control of stepped motors.

ADVANCED CONTROL OF AC DRIVES: Principles of vector control –Direct and indirect vector control of induction motor –DTC- sensor less vector control-speed estimation methods-Applications of Fuzzy logic and Artificial Neural Network for the control of AC drives

TEXT BOOK:

1. Bimal K Bose Modern Power electronics and AC Drives,"Pearson education asia 2002.
2. Dubey, G.K "Power Semiconductor Controlled Drives," Prentice Hall International, New Jersey, 1989.
3. Krishnan. R, "Electrical Motor Drives- Modeling, Analysis and Control "Prentice Hall of India Pvt Ltd., 2nd Edition , 2003.
4. "Analysis of Electric Machinery and Drive Systems" Paul .C.Krause, Oleg wasyncznk, Scott.D.Sudhoff, 2nd edition , Wiley Interscience, John wiley& Sons, 2002.
5. Werner Leonard, Control of Electrical Drives' 3rd edition, Springer,2001.

MEIARF1.4: Radiating systems

Electromagnetic Waves : The Helmhotz Equation**,** Plane waves in Lossless medium**,** Plane waves in a lossy medium**,** Poynting Vector and Power Flow in Electromagnetic Fields**,** Polarisation of plane wave**,** Behaviour of Plane waves at the interface of two media

Concepts of Radiation: Basic Antenna Parameters**,** Radiated field of anHertzian dipole

Linear Wire Antennas: Half Wave Dipole Antenna**,** Quarter Wave Monopole Antenna**,** Ground plane effects, Loop Antennas

Antenna Arrays: Two element array, N element uniform linear array, planar array

Smart antennas: Antenna impedance - Self and mutual impedances, mutual coupling in arrays, Microstrip antennas, Frequency independent antennas, fundamental limits on, electrically small antennas

Aperture antennas, horn antennas, reflector antennas

Introduction to Numerical Techniques in Electromagnetics : Finite difference method**,** Basic Concepts of the Method of Moments**,** Method of Moments for Wire Antennas and Wire Scatterers

Texts/References

- M. N. O. Sadiku: Elements of Electromagnetics; Oxford University Press, 2000, 3/e.
- R. K. Shevgaonkar: Electromagnetic Waves; McGraw Hill, 2006, 1/e.
- C. A. Balanis: Antenna Theory: Analysis and Design, John Wiley, 2005, 3/e.

- W. Stutzman and G. Thiele: Antenna Theory and Design; John Wiley
- R.E. Collin: Antennas and Radio Wave Propagation; McGraw-Hill
- D. M. Sullivan: Electromagnetic Simulation using the FDTD Method, Wiley-IEEE, 2000, 1/e.
- A. Elsherbeni and V. Demir: The Finite-difference time-domain method for Electromagnetics with MATLAB Simulations; Scitech, 2009, 1/e.

MEIARF1.5: **Robotics and Automation**

Brief History automation-classification-specifications: Types of robots, Overview of robot subsystems, resolution, repeatability and accuracy, Degrees of freedom of robots, Robot configurations and concept of workspace, Mechanisms and transmission, End effectors and Different types of grippers, vacuum and other methods of gripping. Pneumatic, hydraulic and electrical actuators, applications of robots, specifications of different industrial robots.

Rotation matrices, Euler angle and RPY representation, Homogeneous transformation matrices, Denavit-Hartenberg notation, representation of absolute position and orientation in terms of joint parameters, direct kinematics.

Inverse Kinematics, inverse orientation, inverse locations, Singularities, Jacobian, Trajectory Planning: joint interpolation, task space interpolation, executing user specified tasks, sensor based motion planning: The Bug Algorithm, The Tangent Bug Algorithm, The Incremental Voronoi Graph.

Static force analysis of RP type and RR type planar robots, Dynamic analysis using Lagrangean and Newton-Euler formulations of RR and RP type planar robots, , Independent joint control, PD and PID feedback, actuator models, nonlinearity of manipulator models, force feedback, hybrid control.

Mobile robots and control issues: Industrial automation-General layout-general configuration of an automated flow line-conveyor systems and major elements.

Sensors and controllers: Internal and external sensors, position, velocity and acceleration sensors, proximity sensors, force sensors, laser range finder.

Robot vision: image processing fundamentals for robotic applications, image acquisition and preprocessing. Segmentation and region characterization object recognition by image matching and based on features

Refrences:

1. Nagrath and Mittal, “Robotics and Control”, Tata McGraw-Hill, 2003.
2. Spong and Vidhyasagar, “Robot Dynamics and Control”, John Wiley and sons, 2008.
3. Fu. K.S, Gonzalez, R.C., Lee, C.S.G, Robotics, control, sensing, Vision and Intelligence, McGraw Hill International, 1987
4. Steve LaValle, “Planning Algorithms”, Cambridge Univ. Press, New York, 2006.
5. Howie Choset, Kevin Lynch, Seth Hutchinson, George Kantor, Wolfram Burgard, Lydia Kavraki and Sebastian Thurn, “Principles of Robot Motion: Theory, Algorithms, and Implementations” , Prentice Hall of India, 2005.
6. Saeed B.Nniku, “Introduction to robotics- Analysis, Systems, Application” Prentice Hall of India Pvt. Ltd., 2003.

MEIARF1.6: Electromagnetic Fields and Radiating Systems Laboratory

Lab will be based on theory of Electromagnetic Field Theory and Radiating Systems and minimum of 08 experiments.

MEIARF1.7: Process Control And Instrumentation Laboratory

1. Study of Process Control Training plant
   Piping and Instrumentation diagram

2. Simulation of coupled parameter and Distributed parameter system.
3. Identification of linear dynamic model of a process using non parametric methods.
   (a) Design and implementation PID Control scheme on simulated process.
   (b) PID Implementation issues
4. Level and pressure control (with and without Interaction) in process control Test Rig.
   (a) Auto- Tuning of PID controller
5. (b) Design and implementation of gain scheduled Adaptive controller on the simulated model of variable area tank process.
6. Design and implementation of Feed forward and Cascade control schemes on the simulated model of CSIR process.
7. (a) Analysis of MIMO system.
   (b) Design and implementation of Multi-loop PID and Multivariable PID control schemes on the simulated model of two-tank systems.
8. Design and implementation of Robust PID control schemes on the simulated
9. model of variable area tank process.
10. Design and implementation of Self tuning and Model Reference Adaptive
11. Control schemes on the simulated model of variable area tank process.

Semester II

MEIARF2.1: Embedded System and Parallel Processing

Introduction: ARM embedded systems, RISC design philosophy, ARM processor fundamentals, Programmer's model, pipeline, ARM processor families.

ARM Instruction set:
Data processing instructions, Branch & load-store instructions, Software interrupt instructions, Program status register instructions, Manipulating bits & bit patterns, Arithmetic operations.

I/O related operations:
Input & output, Semi hosting, Serial IO, Input from switches & external events, Timing of IO actions, Programming.

ARM Hardware:
ARM hardware, ARM nodes, Exceptions & Exception Handlers, Program structures & testing.

Embedded ARM Applications:
VLSI Ruby II Advanced communication Processor.
VLSI ISDN subscriber processor.
Ericsson-Bluetooth baseband controller.
ARM 1176 – JZFS in Raspberry Pi.
ARM Cortex –A8 (armv7a) in Beagle Bone.

Introduction to CUDA: Data Parallelism CUDA Program Structure, A Matrix-Matrix Multiplication Example, Device Memories and Data Transfer, Kernel Functions and
Threading; Function declarations, Kernel launch, Predefined variables, Runtime API.CUDA Thread Organization, Using block Id x and thread Id x, Synchronization and Transparent Scalability, Thread Assignment, Thread Scheduling and Latency Tolerance

CUDA Memories: Importance of Memory Access Efficiency,

CUDA Device Memory Types, A Strategy for Reducing Global Memory Traffic Memory as a Limiting Factor to Parallelism, Global Memory Bandwidth, Dynamic Partitioning of SM Resources, Data Perfetching, Instruction Mix, Thread Granularity, Measured Performance

Introduction to OPENCL: Introduction to OPENCL Background, Data Parallelism Model, Device Architecture, Kernel Functions, Device Management and Kernel Launch, Electrostatic Potential Map in OpenCL.

Textbooks/ References:

1. Steve Furber "ARM System-on-Chip Architecture", Second Edition, Pearson Education, 2000.
2. J.R. Gibson "ARM Assembly Language – an Introduction" Dept. of Electrical Engineering and Electronics, The University of Liverpool, 2007.
3. Andrew N. Sloss, Dominic Symes, Chris Wright, " ARM System Developer's Guide" Elsevier, 2004.

MEIARF2.2: Industrial Data Networks

DATA NETWORK FUNDAMENTALS: EIA 232 interface standard – EIA 485 interface standard – EIA 422 interface standard – Serial interface converters - ISO/OSI Reference model – Data link control protocol – Media access protocol:-Command/response, Token passing and CSMA/CD - TCP/IP – Bridges – Routers – Gateways –Standard ETHERNET Configuration.

PLC, PLC PROGRAMMING &SCADA:Evolutions of PLCs – Programmable Controllers – Architecture – Comparative study of Industrial PLCs. –PLC Programming:- Ladder logic, Functional block programming, Sequential function chart, Instruction list and Structured text programming. SCADA:- Remote terminal units, Master station, Communication architectures and Open SCADA protocols.

DISTRIBUTED CONTROL SYSTEM & HART: Evolution - Different architectures - Local control 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. Introduction- Evolution of signal standard – HART communication protocol – Communication modes – HART Networks – HART commands – HART applications – MODBUS protocol structure – Function codes – Troubleshooting

PROFIBUS AND FF: Fieldbus:- Introduction, General Fieldbus architecture, Basic requirements of Fieldbus standard, Fieldbus topology, Interoperability and Interchangeability Profibus:- Introduction, Profibus protocol stack, Profibus communication model, Communication objects, System operation and Troubleshooting – Foundation fieldbus versus Profibus.

AS – INTERFACE (AS-i), DEVICENET AND INDUSTRIAL ETHERNET: AS interface:- Introduction, Physical layer, Data link layer and Operating characteristics. Devicenet:- Introduction, Physical layer, Data link layer and Application layer. Industrial Ethernet:- Introduction, 10Mbps Ethernet and 100Mbps Ethernet - Introduction to OLE for process control (OPC).

TEXT BOOK:

1. Hughes, T., "Programmable Logic Controllers", ISA Press, 2000.
2. Bowden, R., "HART Application Guide", HART Communication Foundation, 1999.
3. Mc-Millan, G.K., "Process/Industrial Instrument and Controls Handbook",McGraw-Hill, NewYork, 1999.
4. Berge, J., "Field Buses for Process Control: Engineering, Operation, and Maintenance", ISA Press, 2004.
5. Mackay, S., Wrijut, E., Reynders, D. and Park, J., "Practical Industrial Data Networks Design, Installation and Troubleshooting", Newnes Publication, Elsevier, 1st Edition, 2004.
6. Buchanan, W., "Computer Busses", CRC Press, 2000.
7. Petrezeulla, "Programmable Controllers", McGraw-Hill, 2004.
8. Lucas, M.P., "Distributed Control System", Van Nastrand Reinhold Company,New York, 1986.

9. Clarke, G., Reynders, D. and Wright, E., "Practical Modern SCADA Protocols: DNP3, 60870.5 and Related Systems", Newnes, 1st Edition, 2004.

MEIARF2.3: Microwave Engineering

Transmission lines (review) and multi-conductor lines. Waveguides. Broadband impedance matching. Scattering parameters. Passive devices components (tee, divider, couplers). Resonators and narrowband filters. Broadband and periodic filters. Circulators and isolators. Introduction to electromagnetic interference and compatibility (EMI/EMC). Design, simulation, fabrication and testing of a microwave circuit. computer-aided design; micro-strip realization and testing with a network analyzer.

TEXTBOOKS:

1. David Pozar Microwave Engineering, 4th ed., John Wiley
2. Collins. RE, Foundations for microwave engineering, John Wiley &Sons,inc 2nd edn,2009.
3. Ghosh.RN, Microwave circuit theory and analysis, McGrew hill.
4. Altmen JL., Microwave circuit, D van nostrand co.,inc.,1964.
5. Leo Young and H. Sobol, Ed. Advances in Microwaves, Vol.2, Academic Press Inc., 1974.
6. B.Bhatand S. Koul, Stripline-like transmission lines for MICs, John Wiley, 1989.
7. T.K. Ishii, Handbook of Microwave Technology, vol 1

MEIARF2.4: Microwave Electronics and Semiconductor Devices

Review of semiconductor fundamentals. Semi-classical theory of heterostructures. Quantum theory of heterostructures. Quantum heterostructure devices. Scattering processes in heterostructures. 3D scattering-assisted tunneling. High-frequency response of quantum devices. Charge control of the two-dimensional electron gas. Current voltage model of HEMTs. FET wave equation and small and large signal AC models of HEMTs. Noise modeling and measurement in HEMTs. Cyclo stationary effects. Measurement and characterization of parasitics. HEMT device optimization. Microscopic and compact modeling of HBTs and practical device optimization. Modeling and characterization of memory effects including traps and self-heating that impact the RF performance of RF devices.

Linear and nonlinear representations of active devices. Matching networks and signal flow graphs. Microwave transistor amplifier design theory. Noise, broadband, and high-power design methods. Microwave transistor oscillator design. Nonlinear RF measurement, modeling and circuit design. Linearization of amplifiers and modulators. Design, simulation, fabrication and testing a microwave electronic circuit

TEXTBOOKS:

1. High Speed Heterostructure Devices by Patrick Roblin
2. Microwave Transistor Amplifiers by Guillermo Gonzalez

MEIARF2.5: Industrial Management

Enterprise Management

Introduction to enterprise, business types, OEM, SSI vs LSI, Divisions and functions of an enterprise, Hierarchical structure and organization of group. Strategy Planning, Management techniques for developing strategy viz. Balanced Score Card, Opportunity Identification, Area vs. Product Matrix, Mind Mapping etc. Performance Management and analysis techniques viz. Ishikawa / Reverse Ishikawa diagrams, Critical Success Factors method, Business Process Re-engineering

Quality, Health, Safety and Environment Management and Enterprise Excellence

Quality Circles/ Forums, Quality Objectives, use of Statistical Process Control, Introduction to ISO 9000 and ISO 14000, Safety And Environmental norms.

Role of R & D, Innovation, Industry Institute Interaction, Long Term Economic Stability, Business expansion, diversion, Patent Management, Mergers and Takeovers, Global Market, Exports orientation, Effect of GAT/ WTO agreement

Production Planning, Inventory Control and Supply Chain Management

Manufacturing Excellence, Outsourcing, Production planning techniques, Purchase and Inventory Management, inventory control using Economic Order Quantity, Minimum Order Quantity, Ordering Level, store keeping, Finished goods, semi finished goods, raw material handling and storage, Value Addition, Supply Chain concepts and management for leveraging profit

Human Resources Management

Manpower planning, Human Resources: exploiting true potential, Staff training and development, Motivation, Selection and training of manpower, Appraisal and increments management, Leadership skills, Delegation and development for growth. Objectives and Job Descriptions/ Role Summary

Financial Management

Capital Structure, Fixed & Working Capital, Sources of finance, Net Present Value, Assets management, Non Productive Assets, Project Costing and Project Report preparation, Pay Back Period, Return on Investment, Earnings Per Share, Evaluating company performance using company reports, Credit Notes, Letter of Credit, Bills and Hundi, Challans and invoices, Balance Sheet, Profit and Loss Account

Statutory Requirements

Company Laws, Taxation and Liabilities, Labor laws, Factory Inspection, Value Added Tax, Excise and Service tax, Market Participant Identification Number, Permanent Account Number

E-Waste Management, RoHS Compliance

EMI- EMC Testing

Text books:

1. Management in Engineering- Gail Freeman- Bell and James Balkwill (PHI).
2. Modern Economic Theory- Dewett K. K.
3. Industrial organization and Engineering Economic- T. R. Bange and S. C. Sharma.
4. Engineering Economics- C. D. Stervens.
5. Elementary Economic Theory- Dr. R. D. Gupta.
6. Business organization and Management- M.C. Shukla.

MEIARF2.6: Microwave lab

- MIC component characterization, design simulation fabrication of MIC components.
- Measurement of wave length and Frequency, equivalent circuit of cavity wave meters.
- Typical wave meters, Resonant cavities.
- Methods of frequency measurements-Direct measurement – Interpolation method. Measurement of reflection coefficient Low, high, medium VSWR measurements. Standing wave pattern, Slotted line section and its limitation. Impedance measurement techniques. Nodal shift method. Tangent method. Reflectometer.
- Measurement of microwave power: Typical barrater elements, thermistor.
- Bolometer bridge circuits, extending range of bolometer devices, low and high power measurement techniques.
- Measurement of attenuation: insertion loss method. Substitution method.
- Measurement of S- parameters. Network Analyzer principle. Reflection and Transmission measurements using vector network Analyzer.
- Measurements on passive microwave components. Characteristics of directional coupler. Isolator, Circulator. Antenna Measurements.
- Measurements of radiation pattern, Antenna gain measurements. Far field and Near field techniques.

Text book:

1. Ginzton, EL,. Microwave Measurements, McGraw Hill-1957.
2. Sucher& Fox. Microwave Measurement. Vol.I, II, III.
3. Montgemery. Cc., Techniques of Microwave Measurements, Radiation Lab Series

MEIARF2.7: EmbeddedSystems & Parallel Processing Laboratory

Lab will be based on theory of Embedded System & Parallel Processing and minimum of 08 experiments having ARM Processors, CUDA and OPENCL Concepts.

Semester III

Elective I

A) Advanced Process Control

Review of systems: Review of first and higher order systems, closed and open loop response. Response to step, impulse and sinusoidal disturbances. Control valve typeslinear, equal percentage and quick opening valve. Design of valves. Transient response.
Block diagrams. Stability Analysis: Frequency response, design of control system, controller tuning and process identification. Zigler-Nichols and Cohen-Coon tuning methods, Bode-Nyquist Plots - Process modelling.
Special Control Techniques: Advanced control techniques, cascade, ratio, feed forward, adaptive control, selective controls, computing relays, simple alarms, Smith predictor, internal model control, theoretical analysis of complex processes.
Multivariable Control Analysis of multivariable systems, Interaction, examples of storage tanks. Review of matrix algebra, Bristol arrays, Niederlinski index - Tuning of multivariable controllers.
Sample Data Controllers: Basic review of Z transforms, Response of discrete systems to various inputs. Open and closed loop response to step, impulse and sinusoidal inputs, closed loop response of discrete systems. Design of digital controllers.

Text book:

1. *'Process Systems analysis and Control', D.R. Coughanour, Mc.Graw Hill, II Edition, 1991.*
2. *'Process Dynamics and Control', D.E.Seborg, T.F.Edger, and D.A.Millichamp, John Wiley and Sons, II Edition, 2004.*
3. 'Principle and Practice of Automatic Process Control', C.A.Smith and A.B.Corripio, John Wiley and Sons, 1985.
4 . *'Process Modelling Simulation and Control for Chemical Engineers', W.L.Luyben, McGraw Hill, II Edition, 1990.*
5.'Chemical Process Control – Theory and Practice', Stephanopoulous, Prentice Hall ofIndia Ltd.,.1984.

B) Virtual Instrumentation

Virtual Instrumentation: Historical perspective, advantages, block diagram and architecture of a virtual instrument, data-flow techniques, graphical programming in data flow, comparison with conventional programming. Development of Virtual Instrument using GUI, Real-time systems, Embedded Controller, OPC, HMI / SCADA software, Active X programming. VI programming techniques: VIS and sub-VIS, loops and

charts, arrays, clusters and graphs, case and sequence structures, formula nodes, local and global variables, string
and file I/O, Instrument Drivers, Publishing measurement data in the web. Data acquisition basics: Introduction to data acquisition on PC, Sampling fundamentals, Input/Output techniques and buses. ADC, DAC, Digital I/O, counters and timers, DMA, Software and hardware installation, Calibration, Resolution, Data acquisition interface requirements. VI Chassis requirements. Common Instrument Interfaces: Current loop, RS 232C/ RS485, GPIB. Bus Interfaces: USB, PCMCIA, VXI, SCSI, PCI, PXI, Firewire. PXI system controllers, Ethernet control of PXI. Networking basics for office & Industrial applications, VISA and IVI.VI toolsets, Distributed I/O modules. Application of Virtual Instrumentation: Instrument Control, Development of process database management system, Simulation of systems using VI, Development of Control system, Industrial Communication, Image acquisition and processing, Motion control.

TEXTBOOKS:

1. Gary Johnson, LabVIEW Graphical Programming, Second edition, McGraw Hill, Newyork, 1997.
2. Lisa K. wells & Jeffrey Travis, LabVIEW for everyone, Prentice Hall, New Jersey, 1997.
3. Kevin James, PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control, Newnes, 2000.

C) Radar Systems Engineering

The radar range equation: Radar fundamentals. derivation of range equation, the search radar equation, jamming and radar range with jamming, radar clutter and radar range with clutter. radar range with combined interferences sources. The theory of target detection: Noise and false alarms. Detection of one sample of signal with noise, integration of pulse trains, detection of fluctuating targets, CFAR, Optimum and matched filter Theory. loss factors in detection. Targets and interference: Definition of radar cross section . Radar cross section of simple and complex objects, Spatial distribution of cross section. Bistatic cross
section. CW and FM Radar: Doppler Effect. CW and FMCW Radar, Airborne Doppler Navigation, Multi frequency CW Radar.
MTI Radar: Delay lines and line cancellors, subclutterVisibility.MTI using range gates and filters, pulse Doppler radar. Non-coherent MTI radar. Application of Digital signal processing to radar system. Tracking Radar: Different types of tracking techniques. Tracking in range. Tracking in Doppler. Search Acquisition radar. Comparision of Trackers. Introduction to pulse compression Radar: Height finding radars. Air traffic control. Radars and data handling . Atmospheric effects of radar. Electromagnetic compatibility aspects. Airborne Radars, synthetic Aperture Radar. Secondary surveillance Radars.

TEXTBOOKS:

1. David barton .k, Modern radar system analysis, Artech house, 1988.
2. Fred nathanson e, Radar design principles signal processing and the environment, McGraw Hill.1969.
3. Cook CE. Bernfield. M, Radar signals. Academic press, 1967.
4. Skolnik, Introduction to radar systems ,Mcgraw hill, 2nd Edition 2003.

D) **Microwave Solid State Devices**

Varactor diode: Equivalent circuit, static and dynamic figures of merit Manley Rowe power relation. Parametric amplifiers. Up converter, Degeneration amplifiers, Varactor multipliers. Charge storage capacitance. Tunnel diode: equivalent circuit. Tunnel diode stability, Tunnel diode amplifiers. Gunn devices: Volt amp. Characteristics, Small signal, Nonlinear, large signal
theory, Modes of operation of Gunn diode, Gunn amplifiers-Gunn oscillators, Avalanche transit time MW diodes. Small signal theory, Large signal operation, Noise. PIN diodes: Description, the I-layer. Equivalent circuit behavior under reverse bias
and forward bias. Diode impedance. Materials. Applications. Schottky Barrier Diode: Physics of Schottky barriers. Design of and performance of Schottky barrier diode applications. IMPATT & TRAPATT diodes: Principles and applications as amplifiers and oscillators. Microwave Transistor: Wafer design. Equivalent circuit. Design compromises. Package design.

TEXTBOOKS:

1. Watson, “Microwave Semiconductor Devices and their applications”, McGraw Hill, 1969.
2. Sze. S.M, and Kwok K. Ng,“Physics of Semiconductor Devices”, John Weiley-3rd edition 2007.
3. Shurmer,H.V, “Microwave Semiconductors”, Wien Oldenbourg,1971.Stephen Maas, George vendelin

E) Chemical Process Systems

Typical products and their and uses, Systematic analysis of chemical processes. Flow sheets and symbols for various operations. Variation in process conditions, raw materials and fuels – effect on end products and economy.

Overall Balances, Component balances in engineering equipment, combustion reactions, Stoichiometric balances in manufacturing processes. Forms of energy, Total balance, Heat balance, Heat effects and combustion reactions,

Energy balances in manufacturing processes, optimum utilization of energy, Heat transfer operations in chemical reactors. Equipments- Fundamental concepts in heat exchangers, Evaporators and distillation column, Design and classification of heat exchangers,

Evaporators and distillation column. Fundamental principles and classification of heat exchangers, Evaporators, Distillation

columns and equipment for Agitation and mixing of fluids dimensional analysis to estimate power consumption for agitation.

Energy Conservation in process systems and industries, Optimization principles and pinch analysis to calculate energy consumption.

TEXT BOOK:

1. W.L. McCabe, J.C. Smith and P. Harriott, “Unit Operations of Chemical Engineering”, sixth Edition, McGraw Hill, 2001.
2. Walter L.Badger and Julivst. Banchero “Introduction to Chemical Engineering”, Tata McGraw Hill publishing company, 1997
3. L.B. Anderson and L.A. Wenzel, “Introduction to Chemical Engineering”, McGraw
4. P.Harriot, “Process Control”, McGraw Hill, 1984.
5. D.A. Reay, “Industrial Energy Conservation”, McGraw-Hill, New York, 1979.

F) Bioprocess Instrumentation & Control

Physical and chemical sensors; Biosensors; On-line sensors for cell properties; off-line Analytical methods. Agitation and capacity coefficient in fermenters; Control of pH, dissolved oxygen, dissolved carbon dioxide, temperature of fermenters; Rheological measurement and control application of microcomputers in the study of microbial process. Elements of Digital computers; Computer Interfaces and peripheral devices; Fermentation software systems Data smoothing and interpolation; State and parameter estimation; Direct regulatory control; cascade control of metabolism. Programmed batch bio-reaction; Design and operation strategies for batch plants; Continuous process control.

TEXT BOOKS:

1. *Bailey J.E. and Ollis,D.F. “ Biochemical Engineering Fundamentals” 2nd Edition, (1986), McGraw Hill Book CO.,Singapore.*
2. *T.K.Ghose (Ed.) “Process Computations in Biotechnology” (1994), Tata McGraw Hill Publ.Co.,N.Delhi.*
3. A.Fischer (Ed.), “Advances in Biochemical Engineering,” Vol. 13, 1973, Springer Verlag, Germany
4. *Aiba, Humphry and Millis, “ Bio Chemical Engineering ”, 2nd Ed., (1973), Academic press*
5. *McNeil and Harvey, “Fermentation - A Practical Approach” (1990). IRL Press, U.K.*
6. *Scragg, “Bioreactors in Biotechnology - A Practical Approach” (1991), Ellis Horwood Ltd., U.K.*

G) Logic and Distributed Control Systems

Review of computers in process control: Data loggers, Data Acquisition Systems (DAS), Direct Digital Control (DDC). Supervisory Control and Data Acquisition Systems (SCADA), sampling considerations. Functional block diagram of computer control
systems. alarms, interrupts. Characteristics of digital data, controller software, linearization. Digital controller modes: Error, proportional, derivative and composite controller modes. Programmable logic controller (PLC) basics: Definition, overview of PLC systems,
input/output modules, power supplies, isolators. General PLC programming procedures, programming on-off inputs/ outputs. Auxiliary commands and functions: PLC Basic Functions: Register basics, timer functions, counter functions. PLC intermediate functions: Arithmetic functions, number comparison functions, Skip and MCR functions, data move systems. PLC Advanced intermediate functions: Utilizing digital bits, sequencer functions, matrix functions. PLC Advanced functions: Alternate programming languages, analog PLC operation, networking of PLC, PLC-PID functions, PLC installation, troubleshooting and maintenance, design of interlocks and alarms using PLC. Creating ladder diagrams from process control descriptions. Interface and backplane bus standards for instrumentation systems. Field bus: Introduction, concept. HART protocol: Method of operation, structure, operating conditions and applications. Smart transmitters, examples, smart valves and smart actuators. Distributed control systems (DCS): Definition, Local Control (LCU) architecture, LCU languages, LCU - Process interfacing issues, communication facilities, configuration of
DCS, displays, redundancy concept - case studies in DCS.

TEXT BOOKS:

1. John. W.Webb Ronald A Reis , Programmable Logic Controllers – Principles and Applications, Third edition, Prentice Hall Inc., New Jersey, 1995.
2. Lukcas M.P Distributed Control Systems, Van Nostrand Reinhold Co., New York, 1986.
3. Deshpande P.B and Ash R.H, Elements of Process Control Applications, ISA Press, New York, 1995.
4. Curtis D. Johnson, Process Control Instrumentation Technology, Fourth edition, Prentice Hall of India, New Delhi, 1999.

H) Instrumentation System Design

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 DESIGN OF TRANSMITTERSRTD based Temperature Transmitter – Thermocouple based Temperature Transmitter- Design of Capacitance based Level Transmitter – Air-purge Level Measurement – Design of Smart Flow Transmitters. DESIGN OF DATA LOGGER AND PID CONTROLLER Design of ON / OFF Controller using Linear Integrated Circuits- Electronic PID Controller – Microcontroller Based Digital PID Controller - Micro - controller based Data Logger – Design of PC based Data Acquisition Cards ORIFICE AND CONTROL VALVE SIZING
Orifice Sizing: - Liquid, Gas and steam services - Control Valves – Valve body:-Commercial valve bodies – Control valve sizing – Liquid, Gas and steam Services – Cavitation and flashing –Selection criteria – RotameterDesign.DESIGN OF ALARM AND ANNUNCIATION CIRCUIT
Alarm and Annunciation circuits using Analog and Digital Circuits – Thyristor Power Controller – Design of Programmable Logic Controller

TEXT BOOKS

1. C. D. Johnson, “Process Control Instrumentation Technology”, 8th Edition, Prentice Hall, 2006.
2. Control Valve Handbook, 4th Edition, Emerson Process Management, Fisher Controls International, 2005.
3. R.W. Miller, “Flow Measurement Engineering Handbook”, Mc-Graw Hill, New York1996.

I) Pharmaceutical Business Management

Fundamentals of management Management basic Concepts:Definition, Need for management, Function of management, Management thoughts, Contribution of Taylor, Fayol, Peter Drucker in modern management. Functions and responsibilities of a manager.
Planning: Nature and purpose of planning, important steps in planning, types of planning, planning process, advantages and limitations. Sales forecasting methods, analysis, advantages and limitations.
Objectives: Types of objectives, Importance of objective, Management by objectives, Advantages and Limitations
Organizing: Organizational structure, basic principals of organization, Departmentalization, Delegation, Decentralization, Staffing, Line & Staff organization. Decision making: Types of strategies, Policies, Definition and Importance of decision making, Decision making process Controlling: Concepts and purpose of control techniques, Budgetary and non budgetary control, Management audit, Manage--ment information system, Break even analysis, Network techniques (PERT & CPM), Profit and loss account, Balance sheets
Pharmaceutical industry and operation management Historical perspective of pharmaceutical industry in India, Current status and growth scenario. Operation management in Pharmaceutical Industry: Controlling of manufacturing operation, Importance and function of Q.C and Q.A. R&D in Pharma industry, Drug discovery process, Drug development process, Clinical research organization. Material management: Classification of materials, objectives and principals of purchasing, inventory control.
Industrial relations. Meaning, Scope, Causes of disputes, Tribunals, Strikes, Lock outs. Labor law. Trade unions, Job satisfaction, Personal counseling. Introduction to Factories Act,1948, Trade unions Act 1926 and Industrial Disputes Act 1947.
Pharmaceutical Marketing Difference between marketing and selling, Channels of distribution, Wholesale, Retail, Departmental. Sales promotions, Objective, Principles & Techniques. Ethics of sales, Advertising-Needs & Methods, Merchandising, Detailing Medical representative: Role & Qualities. Marketing research: Nature & Importance Product management: Product life cycle, Launching a new product, Branding, Packaging Price: Definition, Factors affecting , procedure for determination of price,types of price
Human Resource and Development Motivation: definition, concept, Theory' s- Maslow' s Theory, Hertzberg' s theory, Vroom' s theory, Expectancy theory, Reinforcement theory, Equity or social comparison theory X & Y. Leadership: definition, importance, qualities of leadership, leadership styles, trait theory, managerial grid Communication: importance, functions, communication process, forms of communication, types of communication Interview techniques: - presentation skills, group discussion Performance appraisal: need and techniques, recruitment and training International market. Pharmaceutical export, procedure, documentation. Export, registration authorities, regulatory agencies

TEXT BOOKS

1) Peter Drucker; The Practice of management, Harper and Row, New York, 1954.
2) Harold Koontz, Cyril O'Donnel& Heinz Weihrich; Management, 7th edition,1980.
3) P.C. Tripathi& P.N. Reddy; Principals of Management, Tata McGraw Hill publishing Co/ Ltd, 2nd edition, New Delhi.
4) Koontz H. &Weihrich H.; Essentials of Management, Tata McGraw Hill publishing Co/ Ltd, 5th edition, New Delhi, 1998.
5) Satya Saran Chatterjee; An Introduction to Management, The world Press Pvt. Ltd, 12th Edition, Calcutta, 1998.
6) G. Vidyasagar; Pharmaceutical Industrial Management, Pharma book Syndicate, Hyderabad, 2005.
7) Philip Kotler & Gary Armstrong; Principles of Marketing, Pearson Education Pvt. Ltd., 10th Edition, Singapore, 2005.
8) Mickey Smith; Principles of Pharmaceutical Marketing, CBS Publisher & Distributors, 3rd Edition, New Delhi, 2001.
9) J.C. Gandhi; Marketing A Managerial Intoduction, Tata McGraw Hill publishing Co/ Ltd, 8th Edition New Delhi, 1995.
10) Mickey Smith; Pharmaceutical Marketing in the 21th Century, Viva Books Pvt. Ltd., New Delhi, 2001.

11) Horngren, Sundem& Stratton; Introduction to Management Accounting, Prentice Hall of India Pvt. Ltd., 11th Edition, New Delhi, 2000.
12) Cost Accounting & Management Accounting: Everest Publication, New Delhi.
13) Principles and Methods of Pharmacy Management by Harry Smith.
14) Marketing Management by Philip Kotlar.

J) RF Microelectronic Chip Design:

Introduction to RF and Wireless Technology: Complexity, design and applications. Choice of Technology. Basic concepts in RF Design: Nonlinearly and Time Variance, intersymbol Interference, random processes and Noise. Definitions of sensitivity and dynamic range, conversion Gains and Distortion. Analog and Digital Modulation for RF circuits: Comparison of various techniques for power efficiency. Coherent and Non coherent defection. Mobile RF Communication systems and basics of Multiple Access techniques. Receiver and Transmitter Architectures and Testing heterodyne, Homodyne, Image-reject, Direct-IF and sub-sampled receivers. Direct Conversion and two steps transmitters. BJT and MOSFET behavior at RF frequencies Modeling of the transistors and SPICE models. Noise performance and limitation of devices. Integrated Parasitic elements at high frequencies and their monolithic implementation. Basic blocks in RF systems and their VLSI implementation : Low Noise Amplifiers design in various technologies, Design of Mixers at GHz frequency range. Various Mixers, their working and implementations, Oscillators: Basic topologies VCO and definition of phase noise. Noise-Power trade-off. Resonatorless VCO design. Quadrature and single-sideband generators, Radio Frequency Synthesizes: PLLS, Various RF synthesizer architectures and frequency dividers, Power Amplifiers design. Linearisation techniques, Design issues in integrated RF filters. CAD tools for RF VLSI designs.

TEXT BOOKS

1. B.Razavi, RF Microelectronics, Prentice-Hall PTR,1998
2. T.H.Lee, The Design of CMOS Radio-Frequency Integrated Circuits", Cambridge University Press, 1998.
3. R.JacobBaker,H.W.Li, and D.E. Boyce, CMOS Circuit Design ,Layout and Simulation, Prentice-Hall of India,1998.
4. Y.P. Tsividis Mixed Analog and Digital VLSI Devices and Technology, McGraw Hill,1996

K) PowerElectronics

Principles of Steady State Converter Analysis – Boost and Buck Converter Examples
Steady-State Equivalent Circuit Modeling, Losses, and Efficiency – Equivalent circuit model – complete circuit model - - Switch Realization- Switching loss - Converter Circuits – Circuit manipulation – Transformer isolation – Converter evaluation and design
The Basic AC Modeling Approach - Averaging the Inductor and capacitor Waveforms - A NonidealFlyback Converter - State-Space Averaging - Circuit Averaging and Averaged Switch Modeling - The Canonical Circuit Model - Converter Transfer Functions - Analysis of Converter Transfer Functions - Graphical Construction of Impedances and Transfer Functions - Controller Design - Input Filter Design- Current Programmed Control
Basic Magnetics Theory - Transformer Modeling - Loss Mechanisms in Magnetic Devices - Eddy Currents in Winding Conductors - Inductor Design - Filter Inductor Design Constraints - A Step-by-Step Procedure - Transformer Design - A Step-by-Step Transformer Design Procedure
Power Phasors in Sinusoidal Systems - Harmonic Currents in Three-Phase Systems - AC Line Current Harmonic Standards - **Line-Commutated Rectifiers -** The Single-Phase Full-Wave Rectifier - The Three-Phase Bridge Rectifier - Phase Control - **Pulse-Width Modulated Rectifiers -** Realization of a Near-Ideal Rectifier - Control of the Current Waveform - Ideal Three-Phase Rectifiers

Resonant Conversion - Sinusoidal Analysis of Resonant Converters – Examples - Soft Switching - Soft-Switching Mechanisms of Semiconductor Devices - The Zero-Current-Switching Quasi-Resonant Switch Cell - Resonant Switch Topologies - Soft Switching in PWM Converters

TEXT BOOKS

1. Robert W. Erickson, DraganMaksimovic," Fundamentals of Power Electronics", Kluwer Academic Publishers, Second Edition, New York, Boston, Dordrecht, London, Moscow.
2. Muhammad H Rashid, " Power Electronics – Circuits, Devices and Applications", Third Edition, Prentice Hall of India, 2004.
3. M.D. Singh, K.B.Khanchandani, " Power Electronics", Tata McGraw Hill, 1998.
4. Ned Mohan, Tore M Undeland, William P. Robbins, Power Electronics, Converters, Applications and Design", John Wiley & Sons, 1994.

Elective II

L) Instrumentation

1. Scope of instrumentation in food processing & agro sector. Requirement and performance criteria of sensor, biosensors, remote sensing. Standards and norms of food and agro industries. 2. (a) Soil science and Testing: PH, conductivity, resistivity, temperature, soil moisture and salinity, ion concentration, measurements, methods of soil analysis.(b) Instrumentation for environmental conditioning of seed germination and growth.
3. Food process industry and Instrumentation:(a). Process Flow of sugar plant, sensors and instrumentation set-up for it.
(b) Process Flow of fermenter and control (Batch process)(b) Oil extraction plant and instrumentation set-up (c) Pesticides manufacturing process and control4. (a) Process Flow diagram of Diary and confectionary industry and instrumentation set-up.
(b) Juice extraction control set-up5. Water Management and Instrumentation:(a) Application of SCADA for DAM parameters and control
(b) Water distribution and management control, Auto-Drip irrigation systems(c) Irrigation Canal management, upstream and downstream flow control concepts, supervisory control.6. Green houses and Instrumentation; ventilation, cooling and heating wind speed, temperature and humidity, rain gauge, carbon dioxide enrichment measurement and control. 7. Farm Equipments and Modernisation :(a) Automation in Earth Moving Equipment and farm implements, pneumatic, hydraulic and electronic control circuits in harvesters, cotton pickers, tractors etc.
(b) Automation in packaging industry. 8. (a) Leaf area, length, evapotranspiration, temperature, wetness and respiration measurement and data logging. Electromagnetic, radiation, photosynthesis, infrared and CV, bio sensor methods in agriculture. (b) Agro meteorological instrumentation weather stations.

TEXT BOOKS

1. Considine D. M., "Process Instrumentation, and Control Handbook" McGraw Hill International
2. Liptak B. G., "Instrument Engineers Handbook, Process Measurement Volume I and Process Control Volume II" Chilton Book Company, 2001
3. Johnson C. D., "Process Control Instrumentation Technology" 7th Edition, Pearson Education, New Delhi, 2003.
4. D. Patranabis, "Industrial Instrumentation" Tata McGraw Hill publications, New Delhi.

M) Sensors in Instrumentation:

Sensor characteristics; R, L and C sensors: Hall effect sensors; Piezoelectric sensors; Micro-sensors. Sensors for displacement, pressure, temperature, flow etc. Optical sensors; chemical and bio-sensors. Sensor applications in non-destructive testing. Interfacing sensors with microprocessors and micro controllers.

TEXT BOOKS

1) D. V.S.Murthy,Transducers in instrumentation,Prentice Hall, 1995.
2) J. P.Bentley, Principles of measurement systems, Wiley,1989
3) J. W.Gardner, Microsensors, principles and applications, Wiley,1996.
4) S.M.Sze, Semiconductor Sensors, Wiley,1994

N) Simulation of Circuits and Devices

Formulation of network equations: Nodal, mesh, modified nodal and hybrid analysis equations.
Sparse matrix techniques; Solution of nonlinear networks through Newton-Raphson technique.
Multistep methods: convergence and stability; Special classes of multistep methods: Adams-bashforth, Adams-Moulton and Gear's methods; Solution of stiff systems of equations; Adaptation of multistep methods to the solution of electrical networks; General purpose circuit simulators.
Review of semiconductor equations (Poisson, continuity, drift-diffusion, trap rate). Finite difference formulation of these equations in 1D and 2D. Grid generation.
Physical/empirical models of semiconductor parameters (mobility, lifetime, band gap, etc.).
Computation of characteristics of simple devices (p-n junction, MOS capacitor, MOSFET, etc.); Small-signal analysis.

TEXT BOOKS

1) L.O.Chua and P.M.Lin, Computer aided analysis and electronic circuits, Prentice Hall, 1975.
2) S. Selberherr, Analysis and Simulation of Semiconductor Devices, Springer-Verlag, 1984.
3) N.J. McCalla, Fundamentals of Computer Aided Circuit Simulation, Kluwer Academic Publishers, 1988.

O) Image Processing:

Image representation - Gray scale and colour Images, image sampling and quantization.
Two dimensional orthogonal transforms - DFT, FFT, WHT, Haar transform, KLT, DCT.
Image enhancement - filters in spatial and frequency domains, histogram-based processing, homomorphic filtering. Edge detection - non parametric and model based approaches, LOG filters, localisation problem.
Image Restoration - PSF, circulant and block - circulant matrices, deconvolution, restoration using inverse filtering, Wiener filtering and maximum entropy-based methods.
Mathematical morphology - binary morphology, dilation, erosion, opening and closing, duality relations, gray scale morphology, applications such as hit-and-miss transform, thinning and shape decomposition.
Computer tomography - parallel beam projection, Radon transform, and its inverse, Back-projection operator, Fourier-slice theorem, CBP and FBP methods, ART, Fan beam projection.
Image communication - JPEG, MPEGs and H.26x standards, packet video, error concealment.
Image texture analysis - co-occurence matrix, measures of textures, statistical models for textures.
Misc. topics such as - Hough Transform, boundary detection, chain coding, and segmentation, thresholding methods.

TEXT BOOKS

1) A. K. Jain, Fundamentals of digital image processing, Prentice Hall of India, 1989.
2) R.M. Haralick, and L.G. Shapiro, Computer and Robot Vision, Vol-1, Addison Wesley, Reading, MA, 1992.
3) R. Jain, R. Kasturi and B.G. Schunck, Machine Vision, McGraw-Hill International Edition, 1995.
4) W. K. Pratt, Digital image processing, Prentice Hall, 1989.
5) A. Rosenfold and A. C. Kak, Digital image processing, Vols. 1 and 2, Prentice Hall, 1986.
6) H. C. Andrew and B. R. Hunt, Digital image restoration, Prentice Hall, 1977

P) Error Correcting Codes

Linear block codes : Systematic linear codes and optimum decoding for the binary symmetric channel; Generator and Parity Check matrices, Syndrome decoding on symmetric channels; Hamming codes; Weight enumerators and the MacWilliams identities; Perfect codes.

Introduction to finite fields and finite rings; factorization of (X^n-1) over a finite field; Cyclic Codes.

BCH codes; Idempotents and Mattson-Solomon polynomials; Reed-Solomon codes, Justeen codes, MDS codes, Alterant, Goppa and generalized BCH codes; Spectral properties of cyclic codes.

Decoding of BCH codes: Berlekamp's decoding algorithm, Massey's minimum shift register synthesis technique and its relation to Berlekamp's algorithm. A fast Berlekamp - Massey algorithm.

Convolution codes; Wozencraft'ssequential decoding algorithm, Fann's algorithm and other sequential decoding algorithms; Viterbi decoding algorithm.

TEXT BOOKS

1) F.J. MacWilliams and N.J.A. Slone, The theory of error correcting codes, North Holland, 1977.
2) R.E. Balahut, Theory and practice of error control codes, Addison Wesley, 1983.

Q) **Advanced Electronic System Design**

RF behaviour of passive components, Chip components and circuit board considerations, Review of transmission lines, Impedance and admittance transformation, Parallel and series connection of networks, ABCD and scattering parameters, Analysis of amplifier using scattering parameter. RF filter – Basic resonator and filter configurations – Butterworth and Chebyshev filters. Implementation of microstrip filter design. Band pass filter and cascading of band pass filter elements.

Impedance matching using discrete components. Microstrip line matching networks. Amplifier classes of operation and biasing networks – Amplifier power gain, Unilateral design(S12 =0) – Simple input and output matching networks – Bilateral design - Stability circle and conditional stability, Simultaneous conjugate matching for unconditionally stable transistors. Broadband amplifiers, High power amplifiers and multistage amplifiers.

DC power supply design using transistors and SCRs, Design of crowbar and foldback protection circuits, Switched mode power supplies, Forward, flyback, buck and boost converters, Design of transformers and control circuits for SMPS.

Amplification of Low level signals, Grounding, Shielding and Guarding techniques, Dual slope, quad slope and high speed A/D converters, Microprocessors Compatible A/D converters, Multiplying A/D converters and Logarithmic A/D converters, Sample and Hold, Design of two and four wire transmitters.

Introduction to technology of printed circuit boards (PCB), General lay out and rules and parameters, PCB design rules for Digital, High Frequency, Analog, Power Electronics and Microwave circuits, Computer Aided design of PCBs.

TEXT BOOKS

1. Reinhold Luduig and PavelBretchko, RF Circuit Design – Theory and Applications, Pearson Education, 2000.
2. Sydney Soclof, “Applications of Analog Integrated Circuits”, Prentice Hall of India, 1990.
3. Walter C.Bosshart, “Printed circuit Boards – Design and Technology”, TATA McGraw-Hill, 1983.
4. Keith H.Billings, “Handbook of Switched Mode Supplies” McGraw-Hill Publishing Co., 1989.
5. Michael Jaacob, “Applications and Design with Analog Integrated Circuits” Prentice Hall of India, 1991.
6. OtmarKigenstein, “Switched Mode Power supplies in Practice”, John Wiley and Sons, 1989.
7. Muhammad H.Rashid, Power Electronics – Circuits, Devices and Applications, Prentice Hall of India, 2004.

R) Applied Industrial Instrumentation

Review of Industrial Instrumentation Measurement of Force, Torque, Velocity, Acceleration, Pressure, Temperature, Flow, Level, Viscosity, Humidity & Moisture (Qualitative Treatment Only). measurement 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 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. Instrumentation for energy conservation & management and safety Principle of energy audit, management & conservation and measurement techniques –Instrumentation for renewable energy systems – Energy management device (Peak load shedding) - Electrical and intrinsic safety - Explosion suppression and deluge systems – Flame arrestors, conservation vents and emergency vents – Flame, fire and smoke Detectors- Metal detectors. 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.

TEXT BOOKS

1. D.Patranabis, Principles of Industrial Instrumentation, Tata McGraw Hill Publishing Company Ltd., New Delhi, 1999.
2. John G Webster, Measurement, Instrumentation and Sensors Handbook, CRC press IEEE press
3. Liptak B.G, Instrumentation Engineers Handbook (Measurement), Chilton Book Co., 1994.
4. Reay D.A, Industrial Energy Conservation, Pergamon Press,1977.
5. Hodge B.K, Analysis and Design of energy systems, Prentice Hall, (1988).
6. Liptak B.G, Instrument Engineers Handbook, Clinton Book Company, (1982)
7. Ness S.A. Air monitoring for Toxic explosions, Air integrated Approach, Von Nostrand (1991).
8. Ewing G., Analytical Instrumentation hand book, Dekker (1991).

S) Applied Biomedical Instrumentation

INTRODUCTION TO BIOMEDICAL MEASUREMENTS
Physiological systems and measurable variables- Nature and complexities of biomedical measurements- Medical equipment standards- organization, classification and regulation- Biocompatibility - Human and Equipment safety – Physiological effects of electricity, Micro and macro shocks, thermal effects.
ADVANCES IN MODELING AND SIMULATIONS IN BIOMEDICAL INSTRUMENTATIONModeling and simulation in Biomedical instrumentation – Difference in modeling engineering systems and physiological systems – Model based analysis of Action Potentials - cardiac output – respiratory mechanism - Blood glucose regulation and neuromuscular function. BIOMEDICAL SIGNALS AND THEIR ACQUISITIONSTypes and Classification of biological signals – Signal transactions – Noise and artifacts and their management - Biopotential electrodes- types and characteristics - Origin, recording schemes and analysis of biomedical signals with typical examples of Electrocardiography(ECG), Electroencephalograhy(EEG), and Electromyography (EMG)– Processing and transformation of signals-applications of wavelet transforms in signal compression and denoising.
INSTRUMENTATION FOR DIAGNOSIS AND MONITORING Advanced medical imaging techniques and modalities -Instrumentation and applications in monitoring and diagnosis- Computed tomography, Magnetic Resonance Imaging and ultrasound- Algorithms and applications of artificial intelligence in medical image analysis and diagnosis-Telemedicine and its applications in telemonitoring.BIOMEDICAL IMPLANTS AND MICROSYSTEMS Implantable medical devices: artificial valves, vascular grafts and artificial joints- cochlear implants - cardiac pacemakers – Microfabriation technologies for biomedical Microsystems- microsensors for clinical applications – biomedical microfluid systems

TEXTBOOKS

1. John G.Webster (editor), Bioinstrumentation, John Wiley & Sons, 2004.
2. Shayne Cox Gad, Safety Evaluation of Medical Devices, Marcel Deckle Inc, 2002.
3. Michael C. K. Khoo, Physiological Control Systems- Analysis Simulation and Estimation, 2001.
4. John G.Webster (editor), Medical Instrumentation Application and design, John Wiley & Sons, 2005.
5. Cromwell l., Biomedical Instrumentation and Measurements, Prentice Hall of India, 1995.
6. RangarajM.Rangayan, Biomedical signal analysis, John Wiley & Sons (ASIA) Pvt. Ltd.,
7. Kayvannajarian and Robert splinter, Biomedical Signal and Image Processing, CRC Press, 2005.
8. John M.Semmlow, Biosignal and Bio medical Image processing, CRC Press, 2004.
9. Joseph J. Carr and John M Brown, Introduction to Biomedical Equipment Technology, Pearson Education, 2004
10. Strong P, Biophysical measurements, Tektronix Inc 1997.

T) Electromagnetic Interference and Electromagnetic Compatibility

INTRODUCTION Sources of EMI, Conducted and radiated interference- Characteristics - Designing for electromagnetic compatibility (EMC)- EMC regulation- typical noise path- use of network theory- methods of eliminating interferences.

METHOD OF HARDENING Cabling –capacitive coupling- inductive coupling- shielding to prevent magnetic radiation- shield transfer impedance, Grounding – safety grounds – signal grounds- single point and multipoint ground systems- hybrid grounds- functional ground layout –grounding of cable shields- ground loops-guard shields. balancing, filtering and shielding Power supply decoupling- decoupling filters-amplifier filtering – high frequency filtering- shielding – near and far fields- shielding effectiveness- absorption and reflection loss, Shielding with magnetic material- conductive gaskets, windows and coatings- grounding of shields.

Digital circuit noise and layout Frequency versus time domain- analog versus digital circuits- digital logic noise- internal noise sources- digital circuit ground noise –power distribution-noise voltage objectives-measuring noise voltages-unused inputs-logic families.

Electrostatic discharge,STANDARDS AND LABORATORY TECHNIQUES

Static Generation- human body model- static discharges-ED protection in equipment design- ESD versus EMC, Industrial and Government standards – FCC requirements – CISPR recommendations-Laboratory techniques-Measurement methods for field strength-EMI

TEXTBOOKS

1. Bernhard Keiser, “Principles of Electro-magnetic Compatibility”, Artech House, Inc. (685 canton street, Norwood, MA 020062 USA) 1987.
2. Bridges, J.E Milleta J. and Ricketts.L.W., “EMP Radiation and Protective techniques”, John Wiley and sons, USA 1976.
3. IEEE National Symposium on “Electromagnetic Compatibility”, IEEE, 445, hoes Lane, Piscataiway, NJ 08855.
4. Robertson RF microwave handbook; rohde and Schwarz – Microwave handbook
5. Henry W.Ott, “ Noise reduction techniques in electronic systems”, John Wiley & Sons, 1989

U) Telemetry

CLASSIFICATION OF TELEMETRY SYSTEMS

Voltage, current, position, frequency, pulse, land – line and radio telemetry. telemetry system overview, Bio-telemetry; radio telemetry services single and multi-channel telemetry circuits.

LAND – LINE TELEMETRY

Voltage telemetering system current telemetering system motion balance current telemetering system force balancing current telemetering system position telemetering system using bridge configuration position telemetering system using synchors.

AMPLITUDE MODULATION AND DEMODULATION OF A CARRIER WAVE
Expression for an AM – wave frequency spectrum of an AM – wave bandwidth AM – detector illustration of AM for a measuring system full – wave phase sensitive demodulator block diagram of a carrier amplifier system.
FREQUENCY MODULATION AND DEMODULATION OF A CARRIER WAVE
Expression for an FM – wave frequency spectrum of an FM – wave bandwidth diode FM modulator reactance modulator phase shift discriminator ratio detector.
AMPLITUDE MODULATION AND DEMODULATION CIRCUITS FOR MESURENT SYSTEMS:
Basic configuration for a modular electronical chopper semiconductor modulator balanced modulator basic configuration of a demodulator chopper demodulator semiconductor demodulators balanced demodulator.
MULTIPLEXING IN TELEMETRY SYSTEMS: Block diagram of a multiplexer and its mechanical switch equivalent block diagram of a demultiplexer and its mechanical switch equivalent frequency division multiplexing time division multiplexing sample –and – hold circuit an outline of pulse modulation techniques used in telemetry.
RADIO TELEMETRY SYSTEMS: Analog TDM system FM – FM telemetry system standard
telemetry channel frequencies for FDM block diagrams of PAM, PCM and FDM telemetry systems.
TRANSMISSION CHANNEL: Wire line channels, radio channels, micro – wave channels, power line carrier channels and fiber optic transmission.

TEXT BOOKS:

1) Introduction to Telemetry by Alan Andrews, Foulsham – Sams technical books, Published by W – Foulsham& Co
2) Ltd., England.
3) Understanding telemetry circuits, by John D. Lenk, Foulsham – Sams technical books, Published by W. Foulsham
4) Electrical and electronic measurements and instrumentation, by A.K. Sawhney, DhanpatRai& Sons.

V) Process Modelling And Simulation

Introduction to modelling, a systematic approach to model building, classification of models. Conservation principles, thermodynamic principles of process systems. Development of steady state and dynamic lumped and distributed parameter models
based on first principles. Analysis of ill-conditioned systems. Development of grey box models. Empirical model building. Statistical model calibration and validation. Population balance models. Examples. Solution strategies for lumped parameter models. Stiff differential equations. Solution methods for initial value and boundary value problems. Euler's method. R-K method,
shooting method, finite difference methods. Solving the problems using *MATLAB/SCILAB.*
Solution strategies for distributed parameter models. Solving parabolic, elliptic and hyperbolic partial differential equations. Finite element and finite volume methods.

TEXT BOOKS:

1. K. M. Hangos and I. T. Cameron, "Process Modelling and Model Analysis", Academic Press, 2001.
2. W.L. Luyben, "Process Modelling, Simulation and Control for Chemical Engineers", 2nd Edn., McGraw Hill Book Co., New York, 1990.
3. W. F. Ramirez, "Computational Methods for Process Simulation", Butterworths,1995.
4. Mark E. Davis, "Numerical Methods and Modelling for Chemical Engineers", John Wiley & Sons, 1984.
5. Singiresu S. Rao, "Applied Numerical Methods for Engineers and Scientists" Prentice Hall, Upper Saddle River, NJ, 2001

W) Advanced Optical Communication

Generations of Optical Fiber Links. Description of a 8 Mbps Optical fiber communication link: System Architecture, System Technology, Hardware Architecture, Specifications, Types of LASERS used. Description of a 2.5 Gbps Optical fiber communication link: Optical Transport Network Concept, Optical Cross-connect
Optical Networks: Optical Wavelength Division Multiplexing, Commercial WDM systems, Intelligent Optical internetworking, Architecture, Tunable transmitters and receivers, Optical Amplifier, Wavelength multiplexer/demultiplexer, Wavelength Routers, Wavelength Converters , Applications: Asynchronous Transmitter Mode (ATM) and Synchronous Optical Network(SONET).
Photonic Packet Switching: Synchronization of Networks, Unslotted Networks, Optical Buffering.
Wireless Optical Communication Systems: Wireless optical intensity channels, Introduction to optical intensity signalling, MIMO optical channels.

TEXT BOOKS:

1. Govind P. Agarwal: Fiber Optic Communication Systems, 2nd Edition (John Wiley)
2. CasimerDeCusatis: Fiber Optic Data Communication: Technological trends and advances (Academic Press)
3. AjoyGhatak and K. Thyagarajan: Optical Electronics: (Cambridge University Press)
4. Steve Hranilovic : Wireless Optical Communication Systems: Springer
5. Gerd Keiser: Optical fiber communication, McGraw Hill
6. Das : Optical Signal Processing, Springer – Verlag 1990
7. John Senior: Optical Fiber Communications, 2nd Edition Prentice Hall International

SEMESTER 4

Thesis work

Thesis work will start from the 3rd semester and will continue in the 4th semester.