BE SEM I

IC2014: Project Engineering and Management

Objectives: To impart and to train the perspective engineers who would like to join the EPC contracting or designing or project enterprises organizations in respect of instrumentation engineering.

Unit 1: Concept study and definition of Project Engineering & Management (7 Hrs)

Type of Standards and its studies as applicable to instrumentation and control engineering, Basics of Project Management, Degree of Automation, Organization Structure, Interdepartmental, Inter-organizational and Multi agency interaction involved in Project and their co ordination Project statement. Methods of tagging and nomenclature scheme based on ANSI / ISA std.(S-5.1)

Unit 2: Project engineering documents, drawing and Softwares: (8 Hrs)

Statement of Project (SOP), Process Flow Diagram, Material Balance Diagram, Pressure and Temperature Diagram, P & I diagram, Process Data sheet, Instrument Index, Specification sheet (S-20 Format) for Local & Primary Instruments, Transmitting & Secondary instruments and Final control devices for process and analytical parameters., Plant layouts and General arrangement drawing (Plans and Elevation), Isometric of instrument piping, Cable schedules Loop wiring diagrams, Field installation sketches, BOM and MBOM. Study of Project Engineering Software like INTools, MS-Project, Primawera.

Unit 3: Detailed Project engineering (7 Hrs)

Plant layouts and General arrangement drawing (Plans and Elevation), Isometric of instrument piping. Cable Engineering (Class of conductors, Types, Specification and Application), Selection of cables with respect to specific application, Cable identification schemes, Cable trays. Loop wiring diagrams, Installation sketches of field instrument,

Development of BOM and MBOM. Earthing and Grounding for General, Power and Signal.

Unit 4: Procurement activities: (9 Hrs)

Vendor registration, Tendering and bidding process, Bid evaluation, Pre-Qualification Evaluation of Vendor, Purchase orders, Kick-off meeting, Vendor documents, drawing and reports as necessary at above activities, Factory Acceptance Test (FAT) and/or Customer Acceptance Test (CAT).

Construction activities: Site conditions and planning, Front availability, Installation and commissioning activities and documents require at this stage, On site inspection and testing (SAT), Installation sketches, Contracting, Cold Commissioning and Hot commissioning, Performance trials, As-built Drawings & Documentations and final hand over.

Unit 5: Control Room (5 Hrs)

Control room layout and engineering. Control Centers, Panels and Desks: Types, Design, Inspection and Specification.Types of Operating Stations, Intelligent Operator Interface (IOI).

Networking: Hubs, Routers, LAN Cards and CAT Cable.

Unit 6: Project Management: (6 Hrs)

Project Management, Planning and Scheduling Life cycle phases, Statement of work (SOW), Project Specification, milestone scheduling, Work breakdown structure.

Cost and estimation: Types of estimates, pricing process, salary overheads, labor hours, materials and support costs. Program evaluation and review techniques (PERT) and Critical path method (CPM), S-curve concept and crash time concepts, software's used in project management; software features, classification, evaluation and implementation.

Outcomes:

- Information/Knowledge gained by the students towards the confidence of engineering of various aspects of projects during the course of their professional activities.

- After gaining sufficient experience, the students can indulge to create their own enterprises.

Text books:

1. Andrew & Williams, ”Applied instrumentation in process industries ,Gulf Publishing.
2. Project Management – A System Approach to Planning, Scheduling and Controlling by

Reference Books:

1. John Bacon ,”Management systems”, ISA
2. Liptak ,”Process control Instrument Engineers Hand book”,
3. Instrument Installation Project Management (ISA).

List of Home assignments

1) Study of standards and symbols (ANSI / ISA Std.)

2) Study of specification sheets.

3) Development of Process & Instrument diagram of typical process.

4) Development of Loop Wiring diagram.

5) Cable scheduling.

6) GA and mimic diagram of a control panel.

7) Development of Bar charts for certain project.

8) Preparation of Inquiry, Quotation, Comparative statement, Purchase orders, SAT, FAT and CAT, Inspection reports for control panel / transmitter/ control valve / recorder.

9) Hands on experience for Project Engineering & management software such as INTools, MS Project, Primavera.

IC2024: Process Control

Prerequisites: Basics of Control system and Process Loop Components.

Objectives: To study and implement advanced process control strategies like fuzzy logic, neural network, model based and model predictive control

Unit 1: Final Control Element Design and Engineering (6 Hrs)

Designing control valve for gas, vapor and liquid services: Valve sizing by ANSI/ISA 75.01 std Valve capacity testing by 75.02 Effect and remedies of cavitation and flashing. Control valve noise generation and remedies**.** High temperature and High-pressure service valves**.** Control valve selection . Design of Dampers. Sizing of Damper

Unit 2: Control strategies (7 Hrs)

Concept study of SISO and MIMO, Overview, theory and industrial applications of control strategies: Feedback, Feed-forward control, Cascade control, Ratio control, Selective control, Adaptive control, Split range control, IMC structure for feedback control

Unit 3: Modeling for control (8 Hrs)

Development of mathematical model: Necessity of modeling, fundamental laws for modeling of chemical processes (material balance and energy balance), examples: stirred tank heater, CSTR, modeling considerations for control purposes: input-output model, degrees of freedom, its relation with process controllers, linearization of nonlinear process model, empirical modeling

Unit 4: Analysis and properties of some common loops: (8 Hrs)

Flow, level, temperature, Pressure loops, nonlinear controllers: Nonlinear elements, Dual mode control, Nonlinear PID controllers, linearization, Development of Auto Tuning

Unit 5: Multivariable Systems (8 Hrs)

Multivariable transfer function matrix, Stability analysis: Open and closed loop characteristic equations, Neiderlinsky index, Resiliency, Interaction analysis: relative gain array, inverse Nyquist array, Design of Multiple single loop and multivariable controllers. Decoupling, feasibility of steady state decoupler design, steady state decoupling by singular value decomposition

Unit 6: Statistical Process Control (5 Hrs)

Introduction, Traditional Quality Control methods, serial correlation effects and standard process control, appropriate use of traditional statistical process control, stochastic process control, advanced multivariate techniques.

Outcomes: Students will learn process and their controlling techniques.

Text Books:

1. F.G.Shinskey, ”Process control Systems” ,TMH
2. Murrill, ”Fundamentals of Process Control”, ISA
3. Stephanopoulos George, “Chemical Process Control” PHI
4. Murrill, ”Applications concepts of Process control”, ISA

Reference Books:

1. Handbook of Control valves ,ISA
2. Considine, ”Hand book of Process Instrumentation”,
3. Hand book of Industrial Instrumentation–Considine & Ross, MH
4. Statistical Process Control ,ISA
5. Handbook of Instrumentation Andrews Vol-II
6. B Liptak, ”Optimization of unit operations”,

IC2034: Advance control strategies

Objectives: To study and implement advanced process control strategies like fuzzy logic, neural network, model based and model predictive control

Unit 1: Neural Networks (10 Hrs)

Preliminaries, fundamentals concepts and models of artificial neural system, neural network learning rules, Hebbian, Perceptron, delta Windrow-Hoff learning rules, different architectures of neural networks, single layer and multilayer perceptrons, back propagation algorithm, Generalized delta learning rule

Unit 2 : Neural network in process control systems (5 Hrs)

Neuro control approaches, training algorithms, evaluation of training algorithms, through simulation, self running neuro-control scheme, self tuning PID neuro controller, neuro control scheme for any one (Temperature/pressure/level/flow) system.

Unit 3 : Introduction to fuzzy logic (5 Hrs)

Introduction, concepts of fuzzy control from an industrial perspective, Fuzzy sets and crisp sets, fuzzy relation, fuzzy conditional statements, fuzzy rules, fuzzy learning algorithm.

Unit 4 : Fuzzy logic in process control systems (7 Hrs)

Structure of fuzzy logic based control systems, fuzzification and defuzzification module, Knowledge base, data base choice of membership function and scaling factors, fuzzy interface engine, fuzzy control scheme for any one (Temperature/pressure/level/flow) system.

Unit 5 : Model Predictive control (7 Hrs)

Motivation, General principles of model predictive control, optimization problem, dynamic matrix control, constraints and multivariable systems (Quadratic dynamic matrix

control), commercial predictive control schemes, design of model predictive control for any two input two output system.

Unit 6: Adaptive control (6 Hrs)

Introduction, Model reference adaptive control systems, The MIT rule, Model reference adaptive control systems using Lyapunov theory for first order and second order systems, Self tuning control.

Outcomes:

1. Understanding of fundamental concepts of Neural Network
2. Design a controller by using neural network for any process of interest.
3. Understanding of fundamental concepts of Fuzzy Logic
4. Design a controller by using fuzzy logic for any process of interest.
5. Design of model predictive control for any multivariable process
6. Design of adaptive controller for any process of interest.

Text Books

1. Kosko, B, “Neural Networks and Fuzzy Systems: A Dynamical Approach to Machine Intelligence”, Prentice Hall India, New Delhi, 1991.
2. B. Wayne Bequette, “Process Control : Modeling, Design, and Simulation”, Prentice Hall India, New Delhi, 2003.

Reference Books

1. M. T. Hagan, H. B. Demuth and M. Beale, “Neural Network Design” Thomson Learning, Vikas Publishing House, New Delhi, 2002.
2. J. M. Zurada, “Introduction to Artificial Neural Systems”, Jaico Publication House 1997.
3. S. Haykin, “Neural Networks: A Comprehensive Foundation”, Pearson Education, New Delhi, 2002.
4. John Yen and Reza Langari, “Fuzzy Logic: Intelligence, Control and Information”, Pearson Education New Delhi, 2003.

5. S. Rajsekaran, G. A. Vijayalaxmi Pai, “Neural Networks, Fuzzy Logic, and Genetic Algorithms, Synthsis and Applications”, Prentice Hall of India, 2003.
6. I. J. Nagrath and M. Gopal, “Control Systems Engineering”, New Age International Publication, fourth Ed., 2005.
7. S. Omatu, M. Khalid and R Yusof, “Neuro Control and its Applications”, Springer – Verlag, London Limited 1996.
8. D. Driankov H. Hellendoorn and M. Reinfrank, “An Introduction to Fuzzy Control”, Narosa Publication House, Second Reprint, New Delhi, 1997.

IC2044: Process Modelling And Optimisation

Objectives: To learn the modeling of physical and chemical systems, concept of constrained and unconstrained optimization

Unit 1: Mathematical models of Chemical and Physical systems(6 Hrs)

Uses of mathematical models and principles of formulation, Fundamental laws: Continuity equations, Energy equation, Equations of motion, Chemical kinetics. Modeling of CSTR (isothermal, non-isothermal, constant holdup, variable holdup), Batch reactor, Ideal binary distillation column, Heat exchanger, Boiler, field controlled and armature controlled D. C. motors

Unit 2 : Computational methods for solving algebraic and differential equations and curve fitting: (6 Hrs)

Solution of algebraic equations: Interval halving method, Newton Raphson method

Solution of differential equations: Euler method, modified Euler method, Runge Kutta methods (2nd and 4th order), Adom Bashforth method.

Curve fitting: Lagrange interpolation method and least square method

Unit 3: Computer simulation of chemical and physical systems (6 Hrs)

Gravity flow tank, three isothermal CSTRs in series, non-isothermal CSTR, batch reactor, ideal binary distillation column, first and second order electrical systems, field controlled and armature controlled D. C. motors

Unit 4 : Basic concepts of optimization and unconstrained optimization

Continuity of functions, concave and convex functions, necessary **(8 Hrs)** and sufficiency condition for an extremum of an unconstrained function, calculation of extremum of an unconstrained function.

Unconstrained single variable optimization: Numerical methods for optimizing single variable function, scanning and bracketing procedures, unidirectional search: Newton, Quasi Newton and secant methods. Region elimination methods

Unconstrained multivariable optimization:

Direct methods: Conjugate search directions, Powell's method

Indirect methods: Gradient methods, Conjugate gradient method, Newton's method

Unit 5: Linear and nonlinear programming (8 Hrs)

Linear programming: Graphical solution, simplex method, Karmarkar algorithm

Nonlinear programming: Lagrange multiplier method, Quadratic programming, generalized reduced gradient method

Unit 6 : Applications of optimization to chemical and physical systems

Optimum shell and tube heat exchanger design, Optimization of heat exchanger**(8 Hrs)**

Networks, Optimization of evaporator design, Optimization of chemical reactor design and operation (Batch, semi batch and Continuous), Optimization of fluid flow systems

Outcomes: After completing this course student will be able to model and simulate of chemical and physical system. He / She will be able to apply the concepts of optimization in design of chemical and physical systems

IC2184: Bio Medical Instrumentation

Objective:- Students are able to understand Basic physiological system and related instruments.

Unit 1: Bio-potential Measurement (7 Hrs)

Electrode-Electrolyte interface, half-cell potential, Polarization- polarisable and non-polarizable electrodes, Ag/AgCl electrodes, Electrode circuit model; motion artifact.

Body Surface recording electrodes for ECG, EMG, and EEG. Internal Electrodes- needle and wire electrodes. Micro electrodes- metal microelectrodes, Electrical properties of microelectrodes. Electrodes for electric stimulation of tissue

Biotransducers:

Physiological parameters & suitable transducers for its measurements, operating principles & specifications for the transducers to measure parameters, Biosensors

Unit 2: Cardiovascular System: (4 Hrs)

Heart Structure, Cardiac Cycle, ECG Theory, ECG Electrodes, Electrocardiograph, Vectorcardiograph

Unit 3: Cardiovascular Measurements: (8 Hrs)

Heart Sounds, Phonocardiography, Blood Pressure Measurement (Invasive and Noninvasive), Blood Flow meters: Magnetic, Ultrasonic, Thermal Convection Methods, Cardiac Output Measurement (dye dilution method), Plethysmography

Unit 4: Central Nervous System : (8 Hrs)

Brain & its parts, different waves from different parts of the brain, brain stem, cranium nerves, structure of neuron, Neuro muscular transmission, Electroencephalography, Evoked Response, EEG amplifier, Biofeedback

Classification of muscles:

Muscle contraction mechanism, Myoelectric voltages, Electromyography (EMG)

Unit 5: Special Senses: (8 Hrs)

I. Ear: Mechanism of Hearing, Sound Conduction System, Basic Audiometer; Pure tone audiometer; Audiometer system Bekesy; Evoked response Audiometer system, Hearing Aids

II. Vision: Anatomy of Eye, Visual acuity, (Errors in Vision,) Slit Lamp, Tonometer, ophthalmoscope, Perimeter.

Unit 6: (7 Hrs)

Respiratory Instrumentation:

Natural Process of Breathing, O_2 and CO_2 Transport, Regulation of Breathing, Spirometers, airflow measurement, Oxygenators-Bubble Type, Membrane Type

Gas Analyzers:

Infrared gas analyzer, Oxygen analyzer, Nitrogen analyzer, and Ventilators

Electrical Safety:

Significance of Electrical Danger, Physiological Effect of Current, Ground Shock Hazards, Methods of Accident Prevention

Outcome : Upon completion of this course students are able to design a instrument and can do the maintenance of the biomedical equipment.

Text Books:

1. Carr & Brown,' Introduction To Biomedical Equipment Technology'
2. R. S. Khandpur,' Handbook of Biomedical Instrumentation', TMH

Reference books :-

1. Vander, Sherman,' Human Physiology- The Mechanism of Body Function', TMH Ed.1981
2. Cromwell,'Biomedical Instrumentation and Measurements',2nd edition, Pearson Education.
3. Tompkins,'Biomedical Digital Signal Processing', PHI
4. Arumugam,' Biomedical Instrumentation'
5. Ronald Pitts Crick, Pang Khaw,'Text book of clinical Ophthalmology' 2nd Edition, World Scientific publication. ISBN – 981-238-128-7

IC2064: Embedded Systems

Objective: To understand technologies and tools for embedded system.

Unit 1: Embedded systems (6 Hrs)

History, design challenges, optimizing design metrics, time to market, NRE and Unit cost design metrics, applications of embedded system and recent trends in Embedded systems

Processor and memory organization for embedded systems

Unit 2: Communication Protocols: (7 Hrs)

Wireless Communication Protocols like Bluetooth, GPRS, IrDa, IEEE 802.11, and 802.16

CAN, MODBUS, USB, SPI,

Unit 3: Introduction to ARM Architecture (7 Hrs)

Comparison between 8/16/32 bit microcontrollers,

Design Approaches (i) CISC (ii) RISC,

The ARM Design Philosophy, Embedded System Hardware, Embedded System Software

ARM Processor Fundamentals: Registers, Current Program Status Register, Pipeline Exceptions, Interrupts and the Vector table

Introduction to ARM 7/ ARM 9 and ARM extensions

Unit 4: Introduction to ARM Instruction Set: (7 Hrs)

Data processing instructions, branch instructions, load-store instructions, software interrupts instructions, program status register instructions, conditional execution.

Assembly language programming,

Introduction to Thumb Instruction Set:

Introduction to ARM Thumb, Thumb

Programmers model, ARM Thumb inter working

Unit 5: Exception and Interrupt Handling: (8 Hrs)

Exception types in ARM, exception handling,

External interrupt, software interrupts handling, abort handling

Memory management unit (MMU), Virtual memory, multitasking and the MMU, Page tables, Translation Look Aside Buffer, Fast Context Switch Extension

Unit 6: Case study of embedded systems: (7 Hrs)

Case study of embedded systems like digital camera, smart card, RFID, flight Simulation and car control

Outcomes: Student should able to develop embedded system that that make optimum use of available resources such as processor, memory, ports, devices and power.

Text Books:

1. Embedded Systems Architecture, Programming and Design, by, Rajkamal, Tata McGraw-Hill Publishing Company Limited
2. Embedded System Design: A Unified Hardware/Software Introduction, by Frank Vahid/ Tony Givargis, Wiley India Pvt.Ltd.
3. ARM System-on-Chip Architecture, 2nd edition, Published 2000, by Steve Furber. Adison- Wesley

Reference Books:

1. Embedded Real-Time Systems: Concepts, Design & Programming Black Book, By Dr.K. K. K.Prasad, Pub. Dreamtech Press.
2. ARM System Developers Guide Designing and Optimizing System Software, Published 2004, by Andrew N. SLOSS, Dominic SYMES, Chir WRIGHT. Elsevier Pub.

IC2074: Power Plant Instrumentation

Objectives: As the power is the basic for all types of industrial and social usage. Instrumentation engineer ought to know the general information and Overview of all such power plants.

Unit 1 : Power Plant: (8 Hrs)

- Unit Overview, Types of Boilers, Turbine Generators Condensers, variable speed pumps and fans, material handling system.
- Comparison of Thermal Power plant, Hydro Electric Power Plant, Nuclear Power Plant, Solar Power Plant, Boiler Safety Standard, Boiler Inspection Procedures.

Unit 2: Boiler Instrumentation, Turbine Instrumentation, Allied System Instrumentation (8 Hrs)

- Supervision,operation,start-stop,emergency interlocks, logic operation
- Modeling of power plant operation for DCS, PLC, and SCADA.

Unit 3 : (6 Hrs)

Automation strategy of thermal power plant (PLC, DCS, SCADA) and open system application, block schematic, control equipment, boiler automation, diagnostic functions and protection, digital electro-hydraulic governer, Man-M/c Interface, software system, graphic display of automated power plant.

Application functions, variable pressure control

Unit 4 : (6 Hrs)

Hydroelectric power generation, Regulation and monitoring of voltage and frequency of output power, Pollution and effluent monitoring and control.

Unit 5: (6 Hrs)

Power generation using non-conventional energy (wind-power, solar power, sea tides), power plant safety and redundancies

Unit 6: (6 Hrs)

Nuclear power generation and control station.

Outcomes: After completion of studies, these instrumentation engineers who wants to take up the carrier in any power plant industries, the studies of students will give basic fundamental and awareness of subject matter.

Text Books:

1. D.M.Considine, ”Energy Technology Handbook”, MGN.
2. B.G.Liptak,”Process Control”,Chiton.
3. Dickinson and Cheremisinoff,”Solar Energy Techonology Vol. I & II, Dekker.
4. Krishna Kant,”Computer based Industrial Control” ,PHI
5. Popovic and Bhatkar, ”Distributed Computer Control for Industrial Automation”, Dekker.
6. Payne and Thompson, ”Efficient Boiler Operation Source Book”,
7. W.C.Tumer,”Energy management handbook.

Reference Books:

1. Handbook of GBEB, Vol-I,II,III.
2. Considine & Ross,”Handbook of Applied Instrumentation”,
3. Considine,” Handbook of Instrumentation”,

IC 2154: Industrial Automation

Objective:

Upon completion of this course, student should be able to:

Know the architecture and operation of Distributed Control Systems (DCS).

Design control strategy for process control system.

Apply control strategies for plant control.

Design and create a consistent and effective alarm philosophy.

Unit 1: Introduction to Basics of Industrial Automation (5 Hrs)

- Automation Basics, Fundamentals of Industrial Automation
- Need of Automation & Evolution of Automation
- Current Trends, Automation Strategy, Automation Tools

Unit 2: Introduction to DCS (8 Hrs)

DCS Introduction, Location of DCS in Plant, functions, advantages and limitations, DCS as an automation tool, Comparison of DCS with PLC. DCS components/ block diagram, Architecture of different makes, Functional requirements at each level, DCS specifications, Latest trends and developments, Performance Criteria for DCS.

Unit 3 - DCS Engineering (7Hrs)

Layout of DCS, Controller Details, Redundancy, I/O Card Details, Junction Box and Marshalling Cabinets, Operator Interface, Human Ergonomics, Workstation Layout, Types of Operating Station, Various Display Configurations.

Unit 4: DCS Programming (8Hrs)

Programming as per IEC 61131-3, Advantages, Overview of Programming Languages, Device Signal Tags, Configuration, and Programming for Live Process.

Unit 5: DCS Communication (8Hrs)

Communications (field/operator/long distance), OSI / ISO Model, Cables, Network topologies, Routers, switches, hubs.

Industrial Protocols: Foundation Fieldbus, HART, Profibus, Device net, Industrial Ethernet, AS-I. TCP/IP, Industrial Network security.

Database management, Historical Data use in logs, reports and trend displays.

Unit 6: Database & Alarm Management (6 Hrs)

Database management, Historical Data use in logs, reports and trend displays.

System Status Display, Process Reports, different types of logs and reports, Historical Data use in logs, reports and trend displays. Philosophies of Alarm Management, Alarm reporting, types of alarms generated and acceptance of alarms, Structure of good Alarm System, Safety Integrity Level (SIL) .

Text Books:

1. Poppovik Bhatkar,'Distributed Computer Control for Industrial Automation ', Dekkar Publication.
2. S.K.Singh,'Computer Aided Process Control', Prentice Hall of India.
3. Krishna Kant,'Computer Based Process Control', Prentice Hall of India
4. N.E. Battikha,'the Management of Control System: Justification and Technical Auditing', ISA.

Reference Books:

1. Bela G Liptak,'Instrument Engineer's Handbook – Process Software and Digital Network', 2005, CRC Press.

2. Thomos Fisher,'Batch Control Systems, Design, Application and Implementation', ISA.

3. John Park,' Practical Data Communication for Instrumentation and Control', Newnes Elsevier Publication.

Lab Courses

IC7014: Process Control

Objectives: To study and implement advanced process control strategies like fuzzy logic, neural network, model based and model predictive control

List of Practicals

1. Finding dynamic elements for any process (T_D, T_S)
2. Analysis of Pressure / Level loop (any one)
3. Analysis of Temperature loop.
4. Analysis of Flow loop.
5. Study of Feebback-Feedforward control
6. Study of Cascade control/Ratio control / Selective control (any one)
7. Study of Ratio control/ Selective control / Adaptive Control (any one)
8. Advance process controller study (ANN / Fuzzy / MPC)
9. Control valve design using any software package
10. Damper design for given process conditions.

Outcomes: To study and implement advanced process control strategies like fuzzy logic, neural network, model based and model predictive control

Text Books:.

1. Process control Systems-F.G.Shinskey, TMH
2. Fundamentals of Process Control - Murrill ISA
3. Chemical Process Control- Stephanopoulos George, PHI
4. Applications concepts of Process control- By Murrill ISA

Reference Books:

1. Handbook of Control valves –ISA
2. Hand book of Process Instrumentation–Considine
3. Hand book of Industrial Instrumentation–Considine & Ross, MH
4. Statistical Process Control ISA
5. Handbook of Instrumentation Andrews Vol II

IC7024: Advance control strategies

Objectives: To study and implement advanced process control strategies like fuzzy logic, neural network, model based and model predictive control

List of Practicals

Note: If students are performing experiment no. 1 to 4. They can complete any two experiments from the remaining to complete the laboratory course of this subject.

Or

Perform any 10 experiments to complete the lab course of this subject

1. Develop an experimental set-up of water bath and associated electronic circuitry to acquire the data from the process.
2. Develop power controlling circuitry to control the temperature of the process.
3. Develop an experimental set up to control the temperature of water bath using direct neural controller.
4. Develop an experimental set up to control the temperature of water bath using fuzzy PID controller.
5. Write a program to test the functioning of the artificial neuron with binary and continuous actuation function.
6. Write a generalized program to process the data by using the feed-forward neural network.
7. Write a program for the learning of the feed forward neural network-using delta learning neural network.
8. Write a program to study the effect of different network parameter on the performance of the neural networks.
9. Write a program to generate the different membership functions.
10. Write a program to implement Model predictive Control and test it on some application.
11. Design Model predictive control for binary distillation column
12. Design Model predictive control for Reactor
13. Write a program to implement adaptive control and test it in simulation for any multivariable process.
14. Study of MIT rule for any mechanical system
15. Design Model reference adaptive control systems using Lyapunov theory for any first order / second order systems
16. Study of any Multivariable system with reference to modeling, analysis and control

Outcomes:

1. Understanding of fundamental concepts of Neural Network
2. Design a controller by using neural network for any process of interest.
3. Understanding of fundamental concepts of Fuzzy Logic
4. Design a controller by using fuzzy logic for any process of interest.
5. Design of model predictive control for any multivariable process
6. Design of adaptive controller for any process of interest.

Text Books:

1. Kosko, B, "Neural Networks and Fuzzy Systems: A Dynamical Approach to Machine Intelligence", Prentice Hall India, New Delhi, 1991.

2. B. Wayne Bequette, "Process Control Modeling, Design, and Simulation", Prentice Hall India, New Delhi, 2003.

Reference Books:

1. M. T. Hagan, H. B. Demuth and M. Beale, "Neural Network Design" Thomson Learning, Vikas Publishing House, New Delhi, 2002.
2. J. M. Zurada, Introduction to Artificial Neural Systems", Jaico Publication House 1997.
3. S. Haykin, "Neural Networks: A Comprehensive Foundation", Pearson Education, New Delhi, 2002.
4. John Yen and Reza Langari, "Fuzzy Logic: Intelligence, Control and Information", Pearson Education New Delhi, 2003.
5. S. Rajsekaran, G. A. Vijayalaxmi Pai, "Neural Networks, Fuzzy Logic, and Genetic Algorithms, Synthsis and Applications", Prentice Hall of India, 2003.
6. I. J. Nagrath and M. Gopal, "Control Systems Engineering", New Age International Publication, fourth Ed., 2005.
7. S. Omatu, M. Khalid and R Yusof, "Neuro Control and its Applications", Springer – Verlag, London Limited 1996.
8. D. Driankov H. Hellendoorn and M. Reinfrank, "An Introduction to Fuzzy Control", Narosa Publication House, Second Reprint, New Delhi, 1

IC7034: Process Modelling and Optimization

Objectives: To learn the modeling of physical and chemical systems, concept of constrained and unconstrained optimization

List of Practical's

1. Modeling and simulation of Gravity flow tank

2. Modeling and simulation of Non-isothermal CSTR.

3. Modeling and simulation of three isothermal CSTRs in series.

4. Modeling and simulation of ideal binary distillation column.

5. Modeling and simulation of armature controlled D. C. Shunt motor.

6. Curve fitting using least square method.

7. Optimization of single variable function using Newton's method.

8. Optimization of multivariable function using Newton's method.

9. Optimization of shell and tube heat exchanger.

10. Optimization of Multistage evaporator.

11. Optimization of pipe diameter for an incompressible fluid.

12. Optimization of Reactor design.

Outcomes: After completing this course student will be able to model and simulate of chemical and physical system. He / She will be able to apply the concepts of optimization in design of chemical and physical systems

Text Books:

1. W. L. Luyben, "Process, Modeling, Simulation and Control for Chemical Engineers", McGraw Hill, 1973

2. Thomas Edgar, David Himmelblau, “Optimization of Chemical Processes”, Second edition, McGraw Hill, 2001.

Reference Books:

1. W. F. Stoecker,“ Design of Thermal Systems”,International Education, McGraw hill 1989.

2. J. Malley, “Practical Process Instrumentation and Control”, McGraw Hill.

3. Deo Narsingh, “System Simulation with digital Computer” Prentice Hall India, New Delhi.

4. B. S. Grewal, “Higher Engineering Mathematics”, Khanna Publications, New Delhi, 1986

IC7184: Bio Medical Instrumentation

Objective :- Students are able to understand Basic physiological system and related instruments.

List of Practical:

1. To Study and Check Specifications of an ECG Recorder.
2. To Design and Implement basic ECG Calibrator.
3. To Measure Blood Pressure Using Sphygmomanometer, Calibration of BP apparatus
4. Study of Audiometer
5. To Design a Clinical Thermometer
6. To record/monitor heart sounds using Electronic Stethoscope
7. To Develop a Photoplethysmography Sensor for Pulse Rate Measurement
8. To Develop a Flow Type Sensor Using Thermistor for Expiratory Volume Measurement
9. To Design and Implement an ECG Simulator
10. To Design a Notch Filter for Power Line Frequency
11. To Design and Implement an ECG Amplifier
12. To Implement a Heart Rate Meter
13. To Study EEG/EMG
14. To Study Ophthalmic instruments

Outcome: - Upon completion of this course students are able to design a instrument and can do the maintenance of the biomedical equipment.

Text Books:

Carr & Brown,' Introduction to Biomedical Equipment Technology'

R. S. Khandpur,' Handbook of Biomedical Instrumentation', TMH

Reference books:-

1. Vander, Sherman,' Human Physiology- The Mechanism of Body Function', TMH Ed.1981

2. Cromwell,'Biomedical Instrumentation and Measurements',2nd edition, Pearson Education.
3. Tompkins,'Biomedical Digital Signal Processing', PHI
4. Arumugam,' Biomedical Instrumentation'
5. Ronald Pitts Crick, Pang Khaw,'Text book of clinical Ophthalmology' 2nd Edition, World Scientific publication. ISBN – 981-238-128-7

IC7054: Embedded Systems

Objectives: To understand technologies and tools for embedded system.

List of Practicals

1. Simulation software of ARM processor
2. Simulation software of ARM processor
3. Simulation software of ARM processor
4. Study of Timers of ARM
5. Interfacing of LEDs to ARM board
6. Interfacing of LCD to ARM board
7. Interfacing of keyboard and LCD to ARM board
8. Analog to Digital Converter with ARM
9. Digital to analog Converter / PWM with ARM
10. Implementation of I2C protocol
11. Implementation of USB protocol

Outcomes: Student should able to develop embedded system that that make optimum use of available resources such as processor, memory, ports, devices and power

Text Books:

1. Embedded Systems Architecture, Programming and Design, by, Rajkamal, Tata McGraw-Hill Publishing Company Limited
2. Embedded System Design: A Unified Hardware/Software Introduction, by Frank Vahid/ Tony Givargis, Wiley India Pvt.Ltd.
3. ARM System-on-Chip Architecture, 2nd edition, Published 2000, by Steve Furber. Adison- Wesley

Reference Books:

1. Embedded Real-Time Systems: Concepts, Design & Programming Black Book, By Dr.K.K.K.Prasad, Pub. Dreamtech Press.

2. ARM System Developers Guide Designing and Optimizing System Software, Published 2004, by Andrew N. SLOSS, Dominic SYMES, Chir WRIGHT. Elsevier Pub.

IC7064: Power Plant Instrumentation

Objectives: As the power is the basic for all types of industrial and social usage. Instrumentation engineer ought to know the general information and overview of all such power plants.

LIST OF PRACTICALS

1. Visit to Power Plant. Its study and report writing.
2. Study of power plant simulation technique.
3. Sequential start-up and shut-down of auxiliaries and related process drawings.

Outcomes: After completion of studies, these instrumentation engineers who want to take up the career in any power plant industries, the studies of students will give basic fundamental and awareness of subject matter.

Text Books:

1. D.M.Considine,"Energy Technology Handbook",MGN.
2. B.G.Liptak,"Process Control",Chiton.
3. Dickinson and Cheremisinoff,"Solar Energy Techonology Vol. I & II,Dekker.
4. Krishna kant,"Computer based Industrial Control",PHI
5. Popovic and Bhatkar,"Distributed Computer Control for Industrial Atomation", Dekker.
6. Payne and Thompson,"Efficient Boiler Operation Source Book",
7. W.C.Tumer,"Energy management handbook.

Reference Books:

1. Handbook of GBEB,Volume-I, II & III.
2. Considine & Ross,"Handbook of Applied Instrumentation",
3. Considine," Handbook of Instrumentation",

IC7174: Latex

Objective: Students will learn technical document writing language.

List of Practical

1. **Producing Simple Documents using LATEX:**

Latex Commands, Special Characters, Quotation Marks, Accents, Sizes, Hyphenation, Justification & Breaking, Lines, Paragraphs & Pages , Spaces, Boxes, Fonts &Layouts etc.

2. **Producing Simple Documents using LATEX**

3**. Basic Latex Document Structures:**

Document Class Declarations, Titling, Abstracts & Summaries,

Sections, Ordinary Paragraphs

4. **Other Doc structures:**

Lists, Tables, Figures , Images Verbatim text.,& Tabbing

5. **Mathematical Typesetting With LATEX:**

Math Environment, The Equation , Basic Constructs(Arithmetic, Superscripts & Upper scripts, Roots, Binomial Coeff., Ellipse),Text in Maths, Delimiters, Operators, Math alphabets& Symbols etc.

6. **Mathematical Typesetting With LATEX:**

7. Textual Tools:

Abstract, Table of Contents, Bibliography, Indexes, Glossaries, Cross referencing, Footnotes & End Notes

8. **Textual Tools:**

Outcome: Students can write project and seminar report in the Latex.

Text Books:

1. George Gratzer,' First Steps in Latex', [1999]

2. F. Mittelbach and M Goossens with Braams, Carlisle, and Rowley [2004],'The Latex Companion', second edition

Reference Books:

1. Peter Flynn,' Formatting Information: A beginner's introduction to typesetting with Latex (formerly "Beginner's Latex") '
2. Michael Doob,' Gentle Introduction to TeX '.

INTER DEPARTMENTAL SUBJECTS

IC2084: Pattern Recognition and Analysis

Objectives: This class provides an introduction to classical pattern recognition. Pattern recognition is the assignment of a physical object or event to one of several prescribed categories.

Unit 1: (7 Hrs)

Intro to pattern recognition, feature detection, classification, Review of probability theory, conditional probability and Bayes rule, Random vectors, expectation, correlation, covariance, Review of linear algebra, linear transformations, Decision theory, ROC curves, Likelihood ratio test.

Unit 2: (7 Hrs)

Linear and quadratic discriminant, Fisher discriminant, Sufficient statistics, coping with missing or noisy features, Template-based recognition, eigenvector analysis, feature extraction, Training methods, Maximum likelihood and Bayesian parameter estimation

Unit 3: (7 Hrs)

Linear discriminant/Perceptron learning, optimization by gradient descent, SVM k-nearest-neighbor classification

Unit 4: (7 Hrs)

Non-parametric classification, density estimation, Parzen estimation, unsupervised learning, clustering, vector quantization, K-means, Mixture modeling, optimization by Expectation-Maximization

Unit5: (7 Hrs)

Feature extraction for representation and classification.

Unit 6: (7 Hrs)

Neural networks for pattern recognition, Back propagation algorithm, Capacity of multilayer, feed forward architectures.

Reference Books:

1. Richard Duda and Peter Hart, ‘Pattern Classification and Scene Analysis’ John Wiley & Sons 1973.
2. Keinosuke Fukunaga, ‘Introduction to Statistical Pattern Recognition’ Academic Press 1990.
3. Christopher M. Bishop, ‘Neural Networks for Pattern Recognition’ Oxford University Press, 1995.
4. Sergios Theodoridis and Konstantinos Koutroumbas, ‘Pattern Recognition’ Academic Press, 1998.

IC2094: Biomedical Imaging Processing

Objective: To introduce principles and survey technology and applications in the field of biomedical imaging.

Unit-1 Introduction to fundamentals of image processing-I (7 Hrs)

Review of 1D Linear system theory, 2D superposition and space-invariance, Sampling theory, 2D Fourier Theory and Theorems, Hankel Transforms

Unit-2 X-ray Imaging (7 Hrs)

Historic Overview, Physics, Structure of Matter, Electromagnetic Radiation, X-ray interaction with matter (Photoelectric absorption, Compton scattering, Pair production)

X-ray generation: X-ray tube, Bremsstrahlung, X-ray tube spectrum, Characteristic radiation, Realization of X-Ray tube, Spot size/Heel effect

X-ray detection: Filters, Intensifying screens, Image intensifier, Photographic film, Film characteristics curve, Film resolution, Fluorescent screens, Fluoroscopy, Detector performance, Gas ionization chambers, Scintillation detectors, Photomultiplier tube, photodiode, Spiral CT. Biological effects of X-ray, Units, Determinants of Biological Effects, Radiation Dose for various X-ray procedures.

Unit-3 Computer Tomography (7 Hrs)

CT images, Principles, Evolution of data acquisition systems.

Mathematics of Image Reconstruction: Back-projection, Correction for back-projection, Central section theorem and Fourier domain approach, Filtered back-projection, Convolution back-projection.

CT scanner Performance: Spatial Resolution, System transfer function, Modulation Transfer Function, Line Spread Function, Point Spread Function, Contrast resolution.

Unit-4 Ultrasound Imaging (7 Hrs)

Ultrasound echo equation, Geometric extension of transducer, Impulse response, Diffraction (Fresnel and Fraunhofer regions), Lateral and depth resolution, Phased array systems.

Unit-5 Magnetic Resonance Imaging (MRI) (7 Hrs)

Spin physics, Bloch equation, Signal equation, K-space trajectories, Projection reconstruction, 2D Fourier transform trajectory, Image contrast, MRI SNR, Excitation K-space.

Unit-6 Case Studies (7 Hrs)

Textbook:

1. Introduction to Biomedical Imaging, by Andrew Webb, IEEE Press, 2003.

(Classroom lectures will emphasize the main points in the material and allow for discussion. I expect you to read the assigned chapters, but focus on the concepts presented in lecture. Homework and exams will be structured with the assumption that you have read all of the assigned text and handout material.)

Recommended Textbooks for background knowledge in human physiology and cell biology:

1. Vander, Sherman, Luciano, Human Physiology: The Mechanisms of Body Function, McGraw Hill, 2004.
2. Alberts, et al., Molecular Biology of the Cell, Garland Science, 4th edition, 2002

References Books:

1. Cho, Jones, and Singh, Foundations of Medical Imaging
2. Robb, Biomedical Imaging, Visualization, and Analysis
3. Mudry, Biomedical Imaging (Principles and Applications in Engineering)
4. Shung, Principles of Medical Imaging
5. Webb, the Physics of Medical Imaging

IC2104: Industrial Automation

Theory: 3 Hr/Week

Objectives: Upon completion of this course, student should be able to:

- Know fundamentals of Automation
- Develop and Implement Logic for PLC & DCS

Unit-1: Introduction to Control System Components (10Hrs)

- Elements of process control loop
- Transmitters
- Converters
- Controllers
- Control Valves

Unit-2: Introduction to Basics of Industrial Automation (4 Hrs)

- Automation Basics, Fundamentals of Industrial Automation
- Need of Automation & Evolution of Automation
- Current Trends, Automation Strategy, Automation Tools

Unit-3: Programmable Logic Controller – (8 Hrs)

Hardware

- Types of Processes, Comparison.
  Evolution of PLC, Definition, Functions, Advantages.
- Architecture, DI-DO-AI-AO examples and ratings, I/O module,
- Working of PLC, Scan time, Types & Specifications.

Unit-4: Programmable Logic Controller – (10 Hrs)

Software

- Development of Relay Logic Ladder Diagram
- Introduction to PLC Programming
  Programming devices, languages and Instructions
- PLC Timers and Counters: Types and examples.

Unit-5: Introduction to Distributed Control System (5 Hrs)

Hardware

- DCS Introduction, functions, advantages and limitations,
- Comparison of DCS with PLC.
- DCS Architecture, Functional requirements, DCS specifications.

Unit-6: Introduction to Distributed Control System (5 Hrs)

Software

- Configuration and Programming
- Various Display Configurations.
- DCS workstations

Text/Reference Books:

- Programmable Logic Controllers – John Webb
- Introduction to Programmable Logic Controllers – Gary Dunning
- Programmable Controllers – Richard Cox
- Distributed Control System- Popovic & Bhatkar.

BE SEM II

IC2114: Process Instrumentation

Objectives: To make student aware the various techniques used and applied to various process plants stated down, towards the instrumentation and control aspects. This will include the various instrumental approaches towards supervisory, controls, interlock sequencing pre-requisites for the various process plants.

Unit 1: Heat Transfer Equipments (7Hrs)

Heat Exchangers, Chillers & Dryer:

Supervisory, Modulating/Regulatory, Safety and Protection instrumentation schemes for Heat Exchangers, Chillers and Dryers.

Applicable codes and Standards for above equipments.

Unit 2: Mass Transfer Equipments (7 Hrs)

Pumps and Compressors:

Supervisory, Modulating/Regulatory, Safety and Protection instrumentation schemes for Pumps and Compressors.

Applicable Codes and Standards for above equipments.

Unit 3: Heat & Mass Transfer Equipments (7 Hrs)

Boiler:

Supervisory, Modulating/Regulatory, Safety and Protection instrumentation schemes for Boiler. Applicable Codes and Standards for above equipments.

Unit 4: Heat & Mass Transfer Equipments (7 Hrs)

Chemical Reactors:

Supervisory, Modulating/Regulatory, Safety and Protection instrumentation schemes for Batch Reactors and CSTRs. Applicable Codes and Standards for above equipments.

Unit 5: Heat & Mass Transfer Equipments (8 Hrs)

Distillation Column:

Supervisory, Modulating/Regulatory, Safety and Protection instrumentation schemes for Distillation Column.

Applicable Codes and Standards for above equipments.

Unit 6: Heat & Mass Transfer Equipments (6 Hrs)

A) Crystallizers, Evaporators:

Supervisory, Modulating/Regulatory, Safety and Protection instrumentation schemes for Crystallizers, Evaporators.

Applicable Codes and Standards for above equipments.

B) Case study for Process Plant Operation (Field and Control Room end)

1. Power Plants
2. Petrochemical Refineries

Outcomes: The thorough studies of above unit operations will enable the students to get the feel of, how the approach should be made while designing engineering and application oriented aspects in actual professional environments

Text Book:

1. Krishna Kant,'Computer Based Industrial Control', PHI.
2. Stephonopolous ,'Chemical Process Control', PHI.
3. Lindsley .D,'Boiler Control System', TMH.

Reference Books:

1. F.G. Shinskey,' Process controls Systems', TMH.
2. T.G. Fisher,' Batch Control System', ISA.
3. F. G. Shinskey,' Distillation Column Control', TMH.
4. B.G. Liptak, Chilton, 'Handbook of Instrumentation-Process control'.

IC2124: Industrial Electronics

Objectives: Upon completion of this course, the students will get knowledge of:

- Power devices characteristics, specifications and selection
- Power electronics circuits working and analysis.
- Industrial applications of power electronics.

Unit: 1 (8 Hrs)

Power electronic devices:

Power electronic devices: Characteristics, specification and datasheet Interpretation of SCR, TRIAC, DIAC, Power MOSFET, IGBT etc. static and dynamic losses. Turn on and turn off requirement for power devices .Cooling requirement. Thermal modeling,

Heat sink calculations and mounting technique.

Unit: 2 (8 Hrs)

Thyristor applications: triggering and commutation methods. Opto power devices interfacing. Protection circuits for power devices. Crow bar circuit, Single phase controlled rectifiers,

Static switches. A C Power control methods using thyristors.Light dimmer circuit. Heater power control circuits.

Unit: 3 (6 Hrs)

Inverters and converters: Inverter techniques, topologies, device selection and efficiency considerations, dc to dc converters techniques, design consideration and applications. Step up and step down choppers principles and applications, Three phase rectifiers. Switching mode power supplies, principle, schematic and applications.

Unit: 4 (6 Hrs)

Industrial applications:

DC motor control: Various schemes for control of shunt, series and permanent Magnet DC motors.

AC motor control methods: Control of single phase and three phase induction motors. Control of DC and AC servo motors.

Uninterruptible power supplies schematic, configuration and selection criteria.

Induction and dielectric heating principles, schematic and applications.

Outcomes: Knowledge of power electronic devices and power electronic circuits. Power conversion and control techniques, general and industrial applications.

Text Books:

1. Ramamoorthy .M,'Introduction to Thyristors & Their Applications', Affili East West Press New Delhi, 1994.
2. Berde M S,'Thyristor Engineering', Khanna Publisher, pune, 1986.
3. Sen .P .C,'Power Elecronics', Tata McGraw Hill Pub. Co., 1990.
4. Rashid Muhammad .H,'Power Electronics', Singapore, Pearson Education, 2004.

Reference books:

Valentine R: Motor Control Electronics Handbook. New York. McGraw Hill Inc, 1998.

IC2134: Digital Control

Objectives: Digital Control is the final classroom subject in our undergraduate Instrumentation and control curriculum. It is designed to teach Final year students the fundamentals of control theory based on digital implementation.

Unit 1: Review of Discrete Time Systems (6 Hrs)

Modeling of Discrete time Control system, Sampling theorem, Z transform, Inverse Z transform, Properties, Concept of Pulse transfer function. Concept of Stability in Discrete Control systems: Jury Stability Test, bilinear transformation, Effect of Sampling on stability.

Unit 2 : State Space Analysis of Digital Systems (6 Hrs)

State Descriptions of Digital Control System, Systems with dead time, Solution of sate equation, Pulse transfer Function Realization, discrete state transition matrix, similarity transformation**.** Lyapunov Stability analysis, Multivariable Systems.

Unit 3: Digital Controller (6 Hrs)

Approximation of Digital Controller from Continuous system, Design consideration of digital controllers. Synthesis formula of Controller design. Dead beat Response and ringing of poles**,** Dahlin's algorithm, Smith Predictor algorithm, Introduction to recursive deadbeat controller design

Unit 4 : Digital Controller Design (10 Hrs)

Design by Root Locus

Digital PID controller design, Phase-Lag and Phase-Lead Controllers

Design By Bode Plot

Introduction, Design of a Proportional Controller, Phase-Lead Compensation, Phase-Lag Compensation

Unit 5: Pole Placement and Observer Design (8 Hrs)

Concept of Controllability, Observability. Stability improvement by state feedback, Useful Transformation in state space analysis and design. Design via Pole placement. State observer**.** State feedback with Integral control.

Unit 6 : Optimal control (8 Hrs)

Quadratic performance index, State Regulator design through the lyapunov equation, Optimal State Regulator through the matrix riccati equation.

Outcomes:

1. Knowledge of basic concepts of digital control systems.

2. Basic skills in design of digital PID, lead, lag, lead-lag compensation, pole placement and observer design and optimal control.

Text Books :

1. Gopal. M., "Digital control Engineering ", Wiley Eastern Ltd., 1989.
2. K. Ogata, "Discrete Time Control systems", Prentice Hall, Second Edition, 2003

Reference Books :

1. G. F. Franklin, J. David Powell, Michael Workman, "Digital control of Dynamic Systems", 3rd Edition, Addison Wesley, 2000.
2. Forsytheand W. and Goodall R.N., "Digital Control", McMillan, 1991.
3. M. Gopal “Digital Control and State Variable Method” Tata McGraw Hill, Delhi, 1997.
4. Contantine .H and Gary. B. Lamont “Digital Control Systems”, Second Edition, McGraw Hill International, 2002.

IC2144: System Identification

Objectives: System identification is the final classroom subject in our undergraduate Instrumentation and control curriculum. It is designed to teach Final year students the fundamentals of system identification and its use for analysis and design of digital controllers.

Unit1: Introduction to system identification (7Hrs)

Definition, introducing example of a resistance, use of a target function, stochastic behaviour of estimate properties of location and dispersion

Bias-free and consistent estimate, efficiency, Cramer-Rao lower bound, optimal design of experiments, persistent excitation.

Basic steps in the identification process, information and data collection, system representations and model structures, model validation

Unit2 : Methods and properties of least square estimation (7Hrs)

- Quantifying stochastic errors, covariance matrix of estimated parameters and model characteristics, insecurity on the residue
- Avoiding over modeling, influence of the increasing number of parameters on insecurity, balancing model complexity and model variability. Akaike information criterion, detection of undermodelling and model errors

Unit 3 : Model selection and validation (8 Hrs)

Quantifying stochastic errors, covariance matrix of estimated parameters and model characteristics, insecurity on the residue, avoiding over modeling, influence of the increasing number of parameters on insecurity, balancing model complexity and model variability. Akaike information criterion, detection of undermodelling and model errors

Unit 4 : System Representation (6 Hrs)

State space models, difference equation, simple/multivariable input/output Time invariant/time variant, causal/anti-causal/acausal, deterministic/stochastic models

Linear models: AR, ARX, ARMA, ARMAX, output error models, Box-Jenkins models, behaviour models

Unit 5 : Prediction error methods (8 Hrs)

Target function, maximum likelihood estimators, ARMA (X), Box-Jenkins, interpretation in the frequency domain, real system within/without the model class, calculation-technical aspects. Validation and model selection (choices by the user), simulation/prediction, whiteness of the residue. Pretreatment: trend-correction, eliminating zeniths, estimating time delays, filtering

Unit 6: System identification applications (8 Hrs)

Glass oven process, chemical reactor, Distillation column, traffic modeling, Quadruple tank process, biomedical application. White box versus black box models, grey box models, regular versus partial differential equations.

Outcomes:

- Skill up the knowledge of mathematical need in process industries
- Basic Knowledge of system identification using different techniques.

Text Books :

1.Lennart Ljung, “System Identification- Theory for Users”, Prentice Hall, 1999.

Reference Books :

1. T. Söderström and P. Stoica,’Instrumental Variable Methods in System Identification’, Springer-Verlag, Berlin, 1983.
2. Söderström and P. Stoica, ‘System identification’, Prentice Hall, New Jersey (1989).

3. G. E. Box, G. M. Jenkins and G. C. Rainsel, ”Time series analysis”, Third edition,Oearson education, New Delhi, 2004.

IC2194: Advanced Biomedical Instrumentation

Objective: - To Learn the basic Bio imaging techniques and related instruments.

Unit 1 Life Saving Devices: (8 Hrs)

Pacemaker, Types of pacemakers: External & Internal, Defibrillators: AC & DC Defibrillator, Heart Lung Machine,

Elements of Intensive Care Monitoring:

Bedside Monitors, Drug Delivery System, ICU layout

Operating Room Instrumentation:

Electro surgical Unit, Anesthesia Machine

Unit 2: (5 Hrs)

Clinical Lab Instrumentation: Blood and its composition and function, Electron Microscope Blood Cell Counters, Electrophoresis, Pulse Oximetry, Conventional and Automated, Hb and Glucose Measurement, Introduction to telemetry & Telemedicine

Unit 3: Imaging Systems: (8 Hrs)

X Ray properties, Generation of X-rays, block diagram of X- Ray machine, image intensifier, Drawback of x-ray imaging, CT Scanning, basic CT scanning system, Types of gantries, gray scale [Hounsfield No.], image reconstruction techniques in tomography, image artifacts

Unit 4: Advanced Imaging Systems: (8 Hrs)

Radionuclide Imaging: Rectilinear Scanner, Scintillation Camera, Positron Emission Tomography, Single Photon Emission Computed Tomography , Ultrasound Imaging: Fundamentals of Acoustic propagation, Ultrasonic transducers and frequencies, A, B, M Scan and Echocardiography, Introduction to MRI & Thermography.

Unit 5: Laser applications in Medicine: (7 Hrs)

Types of Lasers, Properties of Laser, Interaction of Lasers with Tissues -Thermal and Non thermal, Basic Endoscopes system & its characteristics, Laser Applications in

ophthalmology- Diabetic Retinopathy , Glaucoma and Retinal hole and detachment treatment , Dermatology- Tattoo, port wine treatment

Pain relief Instrumentation:

Diathermy: short wave, Microwave, Ultrasound diathermy

Unit 6: (7 Hrs)

Concept of Rehabilitation Engineering:

Orthrotics & Prosthetic devices, overview of various orthrotics & prosthetic devices along with its materials. Wheelchair –Types, Materials used in wheelchair, Joysticks used in wheelchair

Kidney Instrumentation:

Kidney Structure, Regulation of Water and Electrolyte Balance, Artificial Kidney-types (coil type, parallel plate Type), Dialysis System, Lithotripsy

Outcome:- After completing this course student will be able to design hardware and software related to various biomedical instruments.

Text Books:

1. Carr & Brown,' Introduction To Biomedical Equipment Technology'
2. R. S. Khandpur,' Handbook of Biomedical Instrumentation', TMH

Reference Books:

1. Jacobsons & Webster,'Medicine and Clinical Engineering', PHI
2. Cromwell,' Biomedical Instrumentation and Measurements', PHI
3. Bronzino,' The Biomedical Engineering Handbook', IEEE Press
4. Feenberg,'Applied Chemical Engineering'
5. K. Kirk Shung, Michael B. Smith, Benjamin Tsui 'Principles of Medical Imaging',-Pub: Academic Press.
6. Carruth,' Medical Laser Applications'
7. Sliney & Trokal,'Medical Lasers & their safe Use'

IC2164: Embedded Operating Systems

Objective: After the completion of the course, students will be able to build operating system for embedded System

Unit 1: Overview and Process Management (6Hrs)

Introduction to operating systems, Computer System Structures, Operating System structures.

Process: concept, scheduling, operations on Process, Inter process communication,

Threads: Overview, multithreading models, threading issues,

CPU scheduling

Unit 2: Memory Management (9 Hrs)

Memory management: Swapping, contiguous memory allocation, paging, segmentation, segmentation with paging.

Virtual memory: Demand paging, page replacement, allocation of frames, thrashing.

Unit 3: Storage Management (3 Hrs)

File System Interface: File concept, access methods, directory structure, and file system mounting and sharing

File System Implementation: file system structure, implementation, directory implementation, allocation methods, free space management, recovery, NFS

Mass Storage structure: disk structure, disk scheduling, disk management, swap space management

Unit 4: Embedded Operating Systems Concepts (5 Hrs)

Embedded Operating Systems Concepts: Architecture of Kernel, Tasks and Task Scheduler, Interrupt Service Routines, Semaphores, Mutex, Mailboxes, Message Queues, Event Registers, Pipes, Signals, Timers, Memory Management, Priority Inversion Problem

Unit 5: Embedded Linux (7Hrs)

Embedded Linux: Introduction, Kernel Consideration, Root file systems and root file systems setup, Storage device Manipulation, Setting up Bootloader

Unit 6: RTOS (5 Hrs)

RTOS: concepts, types, scheduling algorithms, case study: MicroC/OSII.

Outcome: After the completion of the course, students will be able to build operating system for embedded System

Text Books:

1. Operating system concepts, Silerschatz, Galvin, Gagne, sixth edition, publication-John Wiley & Sons, INC
2. Dr. K. V. K. K. Prasad,'Embedded / Real Time Systems: Concepts, Design & Programming'.
3. Karim Yaghmour,' Building embedded LINUX Systems'.
4. Craig Hollabaugh ,'Embedded Linux – Hardware, Software and Interfacing'.
5. Jean J. Labrosse ,'MicroC/OS – II The Real-Time Kernel', Second Edition, CMP Books, San Francisco, CA.

Reference books:

1. Christopher Hallinan,'Embedded Linux Primer: A Practical, Real-World ,Approach' Prentice Hall

John Lombardo,' **Embedded Linux**

IC2174: Building Automation and Security System

Objectives: Upon completion of this course, student should be able to:

- Familiar with elements of Building Automation for homes, hotels, Restaurants and industry.
- Know about HVAC system, security, access, Alarm management and Energy management Systems.

Unit –1: Introduction to Building Automation (9 Hrs)

Concept and application of Building Automation and Management System; Design issues related to building automation and its effect on functional efficiency; Components of building automation system: HVAC, electrical, lighting, security, fire-fighting, communication etc.; Integrated approach in design, maintenance and management system; Current trend and innovations in building automation systems; Impact of Information Technology in building automation and management system; Concept of artificial intelligence; Knowledge base and decision support systems and building automation and management systems; expert system: application of expert system in building automation; Stages in development of expert system, expert system applications in architecture; Computerizing building maintenance information Introduction, Location, Integration of all systems of a building such as HVAC, security, fire, or lighting systems & Alarm management. Benefits of Building Automation System, Intelligent detection, Sensors used.

Unit –2: HVAC (8 Hrs)

Principles of HVAC system design and analysis; component and system selection criteria including room air distribution, fans and air circulation, humidifying and dehumidifying processes, piping and ducting design. Air quality standards. Control systems and techniques; operational economics.

Unit –3: Fire and Security System (6 Hrs)

Fire alarm systems, smoke alarm systems, smoke detectors, heat detectors and LPG leak detectors sound an alarm to alert the security staff in the building and auto dial, Video Door Phone ,Digital Door Lock .Topics treated include fire and smoke control; failure mechanisms of building enclosure illustrated by case studies; code requirements for enclosure systems; systems approach for fire safety.

Unit –4: Access Control System (6Hrs)

Biometric Intrusion Alarm system, Radio Frequency Identification (RFID)

Unit –5: CCTV & DVM (6 Hrs)

CCTV.IP cameras, broadband/LAN network Digital Video Recorder

Unit –6 : Energy Management System (9 Hrs)

Standards of energy efficiency in buildings. Trends in energy consumption, Energy audit: evaluation of energy performance of existing buildings, weather normalization methods, measurements, desegregation of total energy

Consumption, use of computer models, impact of people behavior. Energy efficiency measures in buildings: approaches, materials and equipments, operating strategies, evaluation methods of energy savings. Renewable energy sources: passive or active solar systems, geothermal systems, free-cooling. Optimum selection of energy sources. Air-to-air energy recovery.

Outcomes: Awareness in professional and modern development in industrial and building automation.

Text Books:

1. Jim Sinopoli,'Smart Buildings',fairmont Press (March 8, 2007).
2. Barney Capehart,'Web Based Enterprise Energy and Building Automation Systems',C.E.M, Editor.
3. Anto Budiardjo,'Building Automation Beyond the Simple Web Server',Clasma Events, Inc.
4. Paul Ehrlich,'What is an Intelligent Building?',Building Intelligence Group.

Lab Courses

IC7104: Process Instrumentation

Objectives: To make student aware the various techniques used and applied to various process plants stated down, towards the instrumentation and control aspects. This will include the various instrumental approaches towards supervisory, controls, interlock sequencing pre-requisites for the various process plants.

List of Practicals

Study of various process plants with respect to Applicable Instrumentation & Control Schematics for Supervisory, Modulating, Safety & sequencing operations.

1. Boiler Equipments
2. Heat Exchangers
3. Compressors
4. Pumps
5. Evaporator
6. Crystallizer
7. Dryers
8. Development of P & Id for complete Batch process reactors as per Sequence of operations described in assignment sheet.
9. Study of Process Plant in association with DCS - SCADA applications. Instrumentations & Control Schematics for, Supervisory, Modulating, Safety & sequencing operations.
10. Study of Manufacturing Plant in association with PLC – SCADA, Applications. Instrumentations & Control Schematics for, Supervisory, Modulating, Safety & sequencing operations.

11. Students shall prepare technical descriptive part of each items, Respective description supported with the concerned engineering drawing/sketch, SAMA diagrams SFC flow chart.

Outcomes: The thorough studies of above unit operations will enable the students to get the feel of, how the approach should be made while designing engineering and application oriented aspects in actual professional environments

Text Book:

1. Computer Based Industrial Control –Krishna Kant ,PHI
2. Chemical Process Control- Stephonopolous, PHI.
3. Boiler Control System – Lindsley D, TMH.

Reference Books:

1. Process control Systems-F.G. Shinskey, TMH
2. Batch Control System-T.G. Fisher, ISA
3. Distillation Column Control – F. G. Shinskey, TMH
4. Handbook of Instrumentation -Process control –B.G. Liptak, Chilton

IC7114: Industrial Electronics

Objectives: Upon completion of this course, the students will get knowledge of:

- Power devices characteristics, specifications and selection .
- Power electronics circuits working and analysis.
- Industrial applications of power electronics.

List of Practicals

17. Study of a light dimmer circuit
18. Study of a crow bar circuit
19. Study of an smps
20. Study of a dc motor control circuit
21. Study of an inverter circuit
22. Study of step up chopper
23. Optocouplers - power devices interfacing
24. Study of driver ICs
25. Study of power ICs.
26. Study of a dc to dc converter.

Outcomes: Knowledge of power electronic devices and power electronic circuits. Power conversion and control techniques, general and industrial applications.

Text Books:

1. Ramamoorthy M: Intro to Thyristors & Their Applications. Affili East West Press New Delhi, 1994.
2. Berde M S: Thyristor Engineering. Khanna Publisher, pune, 1986.

3. Sen P C: Power Electronics. Tata McGraw Hill Pub. Co., 1990.
4. Rashid Muhammad H: Power Electronics. Singapore. Pearson Education, 2004.

Reference books

Valentine R: Motor Control Electronics Handbook. New York. McGraw Hill Inc, 1998.

IC7124: Digital Control

Objectives: Digital Control is the final classroom subject in our undergraduate Instrumentation and control curriculum. It is designed to teach Final year students the fundamentals of control theory based on digital implementation.

List of Practicals

1. Investigate stability of discrete system using Jury Test
2. Determine the Range of sampling period for stability of the system.
3. Effect of Dead time on system performance
4. Investigate stability of given system by Lyapunov theorem
5. Design of discrete controller-by-controller synthesis formula.
6. Design of deadbeat controller.
7. Design of discrete controller-by Root Locus
8. Design of discrete controller-by Bode plot
9. Determine the controllability and Observability of a system.
10. Design of control system using pole placement technique.
11. State Regulator design

Outcomes:

1. Knowledge of basic concepts of digital control systems.

2. Basic skills in design of digital PID, lead, lag, lead-lag compensation, pole placement and observer design and optimal control.

Text Books :

1. Gopal. M., "Digital control Engineering ", Wiley Eastern Ltd., 1989.
2. K. Ogata, "Discrete Time Control systems", Prentice Hall, Second Edition, 2003

Reference Books :

1. G.F.Franklin, J.David Powell, Michael Workman, "Digital control of Dynamic Systems", 3rd Edition, Addison Wesley, 2000.
2. Forsytheand W. and Goodall R.N., "Digital Control", McMillan, 1991.
3. M.Gopal “Digital Control and State Variable Method”Tata McGraw Hill, Delhi, 1997.
4. Contantine H. and Gary B. Lamont “Digital Control Systems”, Second Edition, McGraw-hill International, 2002.

IC7134: System Identification

Objectives: System identification is the final classroom subject in our undergraduate Instrumentation and control curriculum. It is designed to teach Final year students the fundamentals of system identification and its use for analysis and design of digital controllers.

List of Practicals

1. Collection and plot the data of level control system
2. Design of PRBS signal to excite the
3. Obtain the model from given data
4. Estimate the parameters of the system using least square method
5. Obtain the covarance matrix using given data
6. Determine undermodeling and model errors for given data
7. Fit the given data and represent the model in AR/ARX/ARMA
8. Simulate the Multivariable system and collect the data. Obtain the model using collected data by means of PEM technique
9. Obtain the model of any one system (take any one system from unit VI) using PEM and design a controller for it

Outcomes:

1. Skill up the knowledge of mathematical need in process industries
2. Basic Knowledge of system identification using different techniques.

Text Books :

Lennart Ljung, “System Identification- Theory for Users”, Prentice Hall, 1999.

Reference Books :

1. T. Söderström and P. Stoica: Instrumental Variable Methods in System Identification. Springer-Verlag, Berlin, 1983.

2. Söderström and P. Stoica, System identification, Prentice Hall, New Jersey (1989).
3. G. E. Box, G. M. Jenkins and G. C. Rainsel, ”Time series analysis”, Third ed. Oearson education, New Delhi, 2004.

IC7154: Embedded Operating System

List of Practicals

1. An experiment on accessing serial port of PC
2. An experiment on scheduling algorithms
3. An experiment on Embedded Linux
4. An experiment on embedded linux / uCOS.
5. An experiment on MicroC/OSII

Atleast four experiment of above must be completed in the lab work.

Text Books:

6. Operating system concepts, Silerschatz, Galvin, Gagne, sixth edition, publication- John Wiley & Sons, INC
7. Dr. K. V. K. K. Prasad,’Embedded / Real Time Systems: Concepts, Design & Programming’.
8. Karim Yaghmour,’ Building embedded LINUX Systems’.
9. Craig Hollabaugh ,’Embedded Linux – Hardware, Software and Interfacing’.
10. Jean J. Labrosse ,’MicroC/OS – II The Real-Time Kernel’, Second Edition, CMP Books, San Francisco, CA.

Reference books:

2. Christopher Hallinan,‘Embedded Linux Primer: A Practical, Real-World ,Approach’ Prentice Hall

John Lombardo,’ **Embedded Linux**

IC 2204: Industrial Automation

Objective:

Upon completion of this course, student should be able to:

Know the architecture and operation of Distributed Control Systems (DCS).

Design control strategy for process control system.

Apply control strategies for plant control.

Design and create a consistent and effective alarm philosophy.

Unit 1: Introduction to Basics of Industrial Automation (5 Hrs)

- Automation Basics, Fundamentals of Industrial Automation
- Need of Automation & Evolution of Automation
- Current Trends, Automation Strategy, Automation Tools

Unit 2: Introduction to DCS (8 Hrs)

DCS Introduction, Location of DCS in Plant, functions, advantages and limitations, DCS as an automation tool, Comparison of DCS with PLC. DCS components/ block diagram, Architecture of different makes, Functional requirements at each level, DCS specifications, Latest trends and developments, Performance Criteria for DCS.

Unit 3 - DCS Engineering (7Hrs)

Layout of DCS, Controller Details, Redundancy, I/O Card Details, Junction Box and Marshalling Cabinets, Operator Interface, Human Ergonomics, Workstation Layout, Types of Operating Station, Various Display Configurations.

Unit 4: DCS Programming (8Hrs)

Programming as per IEC 61131-3, Advantages, Overview of Programming Languages, Device Signal Tags, Configuration, and Programming for Live Process.

Unit 5: DCS Communication (8Hrs)

Communications (field/operator/long distance), OSI / ISO Model, Cables, Network topologies, Routers, switches, hubs.

Industrial Protocols: Foundation Fieldbus, HART, Profibus, Device net, Industrial Ethernet, AS-I. TCP/IP.

Unit 6: Database & Alarm Management (6 Hrs)

Database management, Historical Data use in logs, reports and trend displays.

System Status Display, Process Reports, different types of logs and reports, Historical Data use in logs, reports and trend displays.

Philosophies of Alarm Management, Alarm reporting, types of alarms generated and acceptance of alarms, Safety Integrity Level (SIL).

Text Books:

1. Poppovik Bhatkar,'Distributed Computer Control for Industrial Automation ', Dekkar Publication.
2. S.K.Singh,'Computer Aided Process Control', Prentice Hall of India.
3. Krishna Kant,'Computer Based Process Control', Prentice Hall of India
4. N.E. Battikha,'the Management of Control System: Justification and Technical Auditing', ISA.

Reference Books:

1. Bela G Liptak,'Instrument Engineer's Handbook – Process Software and Digital Network', 2005, CRC Press.

2. Thomos Fisher,'Batch Control Systems, Design, Application and Implementation', ISA.

3. John Park,' Practical Data Communication for Instrumentation and Control', Newnes Elsevier Publication.

Image Processing and Pattern Recognition (BE)

Theory – 3 hrs per week

Objective: To learn the fundamentals of image processing tools with applied to pattern recognition applications.

Unit I Visual preliminaries and image transformation (6)

Introduction, brightness adaptation and contrast, activity and contour, texture and pattern discrimination.
Geometric model of an image, basic transformations, perspective projection, photometric model: intensity, transformation of energy, noise process.

Unit II Image Enhancement (8)

Contrast intensification: linear stretching, non-linear stretching, histogram specification, low contrast stretching.
Smoothing: Image averaging, mean filter, order statistics filter, edge preserving smoothing. Sharpening: High pass filtering, homomorphic filtering.

Unit III Image Analysis: Segmentation (8)
Region extraction, pixel based approach: feature thresholding, optimum threshold, threshold selection methods, multilevel thresholding, and region based approach

Unit IV Image Analysis: Edge detection (6)
Edge detection, derivative operators: Sobel, Prewittt, Canny, second order derivative, line detection: overview of earlier work.

Unit V (7)

Linear and quadratic discriminant, Fisher discriminant, Sufficient statistics, coping with missing or noisy features, Template-based recognition, eigenvector analysis, feature extraction, Training methods, Maximum likelihood and Bayesian parameter estimation

Unit VI (5)

Non-parametric classification, density estimation, Parzen estimation, unsupervised learning, clustering, vector quantization, K-means, Mixture modeling, optimization by Expectation-Maximization.

Text/Reference Books

1. *Computer and Robot Vision*, R.M. Haralick and L.G. Shapiro, Addison-Wesley, 1992

2. *Machine Vision*, Jain, Kasturi, Schnuck, McGraw-Hill, 1995

3. *Robot Vision*, B. K. P. Horn, MIT Press, 1986

4. *Computer Vision*, D. H. Ballard & C. M. Brown, Prentice Hall, 1982

5. *Object Recognition by Computer*, W.E.L. Grimson, MIT Press, 1990

6. *Syntactic Pattern Recognition: An Introduction*, R. C. Gonzalez and M. G. Thomason

7. *Pattern Classification and Scene Analysis*, R.O. Duda and P.E. Hart, Wiley 1973

8. *Pattern Recognition Statistical, Structural and Neural Approaches*, R.J Schalkoff, Wiley, 1992

9. *Artificial Intelligence: An Engineering Approach*, R.J. Schalkoff, McGraw-Hill, 1990

10. *Pattern Recognition Engineering*, M. Nadler and E.P. Smith, Wiley, 1993

11. *Digital Image Processing and Computer Vision*, R.J. Schalkoff, Wiley, 1989

12. *The Image Processing Handbook*, J.C. Russ, CRC Press, 1992

13. *Digital Image Processing*, K.R. Castleman, Prentice Hall, 1996

14. *Digital Image Processing*, R. C. Gonzalez & R. Woods, Addison-Wesley, 1992

15. *Digital Image Processing*, W.K. Pratt, Wiley 1991

16. *Fundamentals of Digital Image Processing*, A.K. Jain, Prentice Hall, 1989

17. *Digital Picture Processing*, A. Rosenfeld and A.C. Kak, Academic Press 1982

18. *Digital Pictures*, A.N. Netravali and B.G. Haskell, Plenum Press 1988

19. *Vision in Man and Machine*, M.D. Levine, McGraw Hill 1985

20. *Computer Imaging: Digital Image Analysis and Processing*, Scott E Umbaugh, the CRC Press, Boca Raton, FL, January 2005

21. *Digital Image Processing*, R. C. Gonzalez & R. Woods, Addison-Wesley, 2002

22. *Computer Vision and Image Processing*, S. E Umbaugh, Prentice Hall, 1998