REGULATIONS - 2015

DEPARTMENT OF
ELECTRONICS AND INSTRUMENTATION ENGINEERING

CURRICULUM AND SYLLABI OF
M.E. – CONTROL AND INSTRUMENTATION
## SEMESTER - I

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TOTAL CREDITS TO BE EARNED FOR THE AWARD OF THE DEGREE - 71
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15CI11C HIGHER ENGINEERING MATHEMATICS  
(Common to C&I and HVE)  
L T P C  
3 2 0 4  

COURSE OUTCOMES
Upon completion of this course, the students will be able to

CO 1 : learn the concepts of matrix theory. (K1)
CO 2 : understand simplex method, two phase method and graphical solution in linear programming. (K2)
CO 3 : learn moment generating functions and one dimensional random variables. (K1)
CO 4 : understand queueing models and computation methods in engineering. (K2)

UNIT I ADVANCED MATRIX THEORY  
15  

UNIT II LINEAR PROGRAMMING  
15  

UNIT III ONE DIMENSIONAL RANDOM VARIABLES  
15  
Random variables - Probability function – moments – moment generating functions and their properties – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions.

UNIT IV QUEUEING MODELS  
15  

UNIT V COMPUTATIONAL METHODS IN ENGINEERING  
15  

L: 45 T: 30 TOTAL: 75 PERIODS

REFERENCES
COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO 1 : explain the characteristics of various sensors. (K2)
CO 2 : describe the operation of various measuring instruments. (K2)
CO 3 : illustrate the working of various optical Microstructure sensors and Miniature Sensors. (K2)

UNIT I  RESISTIVE, INDUCTIVE AND CAPACITIVE ELEMENTS  
Potentiometric, strain-gage and electrode elements – Inductive and Capacitive elements: structures, equivalent circuits and characteristics, single, differential and angle displacement elements, displacement to phase converters, and proximity elements, magnetostrictive elements, temperature instabilities and features.

UNIT II  TRANSFORMER, ELECTRODYNAMIC, SERVO AND RESONANT ELEMENTS  
Transformer elements: Single core, differential, rotating coil and synchro transformers, weak-field sensors - Electrodynamc elements: Moving-coil, variable-reluctance- - Resonant elements: vibrating strings, vibrating beams, vibrating cylinders, piezoelectric resonators, acoustical resonators, microwave cavity resonators.

UNIT III  MECHANICAL, ACOUSTICAL AND FLOWMETERING ELEMENTS  
Stresses state of diaphragm, dynamic characteristics of diaphragm, temperature drifts, sensitivity drifts, sensitivity to acceleration – Inertial mass elements: sensing and transduction elements of flowmeters, electromagnetic flowmeters, nanoelectrode electromagnetic flowmeters -ultrasonic elements – Acoustical elements: acoustical filters.

UNIT IV  OPTICAL MICROSTRUCTURE SENSORS  
Photo detectors: Thermal detectors, pneumatic detectors, pyroelectric detectors, photoemissive devices, photo conductive detectors, photo diodes, avalanche photo diodes, schottky photo diodes, photo transistors – Fiber optic sensors: Fibers as light guides, reflection sensors, Intrinsic multimode sensor, temperature sensor, phase modulated sensor, fiber optic gyroscopes and other fiber sensors.

UNIT V  MISCELLANEOUS MINIATURE SENSORS  
Magnetic sensors: Hall Effect sensors, magnetoresistors and other sensors – Solid state chemical sensors: Silicon based sensors, metal oxide sensors, solid electrolyte sensors, membranes – Electromechanical micro sensors and basic factors of design.

L: 45 TOTAL: 45 PERIODS

TEXT BOOK


REFERENCES

15CI13C  SYSTEM THEORY  L T P C  3 0 0 3  
(Common to C&I and HVE)

COURSE OUTCOMES
Upon completion of this course, the students will be able to
- CO 1: explain the state space models for a linear system. (K2)
- CO 2: analyse the state space model with respect to observability and stabilizability. (K4)
- CO 3: apply state variable feedback to place system poles. (K3)
- CO 4: discuss state variable observers and controllers. (K2)
- CO 5: apply lyapunov stability methods to solve linear problems. (K3)

UNIT I  MODERN CONTROL THEORY
Limitations of conventional control theory - Concepts of State, State variables and State model – State model for linear time invariant systems: State space representation using physical-Phase and canonical variables.

UNIT II  SYSTEM RESPONSE
Transfer function from state model - Transfer matrix - Decomposition of transfer functions Direct, Cascade and Parallel decomposition techniques - Solution of state equation - State transition matrix computation.

UNIT III  SYSTEM MODELS
Characteristic equation - Eigen values and Eigen vectors - Invariance of Eigen values - Diagonalization - Jordan Canonical form - Concepts of Controllability and Observability - Kalman's and Gilbert's tests - Controllable and Observable phase variable forms - Effect of pole-zero cancellation on Controllability and Observability.

UNIT IV  MODEL CONTROL

UNIT V  LIAPUNOV STABILITY

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES
COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO 1: estimate discrete time models, which approximate continuous time dynamics. (K2)
CO 2: design a compensator for digital control system to achieve desired specification. (K3)
CO 3: analyse the state variable concepts in digital control system. (K4)

UNIT I SIGNAL PROCESSING IN DIGITAL CONTROL

 Advantage of Digital Control – Principles of Signal Conversion – Basic Discrete Time Signal –
Models – Sample and Hold System – Sampled Spectra and Aliasing – Reconstruction of Analog
Signals – Selection of Sampling Rate – Principles of Discretization

UNIT II MODELS OF DIGITAL CONTROL DEVICES AND SYSTEMS

Basic Digital Control Scheme – Z Domain Description of Sampled Continuous Time Plants – Z
Domain Description of Systems with Dead Time – Implementation of Digital Controller – Digital
Motors and their Control

UNIT III DESIGN OF DIGITAL CONTROLLER

Introduction - Z Plane Specifications of Control System Design – Digital Compensator Design
Synthesis – Stability on the Z Plane and Jury Stability Criterion

UNIT IV STATE VARIABLE ANALYSIS OF DIGITAL CONTROL SYSTEMS

State Descriptions of Digital Processors – State Description of Sampled Continuous Time Plants -
State Description of System with Dead Time – Solution of State Difference Equations –
Controllability and Observability

UNIT V DIGITAL CONTROL SYSTEMS WITH STATE FEEDBACK

State Regulator Design – State Observers – Separation Principle – State feedback with Integral
control – Dead beat control by state feedback and dead beat observers - Pole Placement Design
by State Feedback (Single Input) – Pole Placement Design by Output Feedback (Single Input)

L:45 T:30 Total : 75 PERIODS

TEXT BOOK

   2012.

REFERENCES

   (Pearson), 2002.
15CI15C  DIGITAL CONTROL AND INSTRUMENTATION LABORATORY – I  L T PC

0 0 4 2

COURSE OUTCOMES
Upon completion of this course, the students will be able to

CO 1 : analyse the closed loop response of various real time process. (K3, S3)
CO 2 : compute the controller parameter using simulation software. (K2, S3)
CO 3 : implement the various compensator. (K3, S3)
CO 4 : distinguish the characteristics of different transducer for a particular measurement. (K3, S3)

DETAILED SYLLABUS

1. Characteristics of Control Valve with and without Positioner
2. Operation of ON-OFF controlled Thermal Process
3. Closed loop response of Flow Control Loop
4. Closed loop response of Level Control Loop
5. Closed loop response of Pressure Control Loop
6. Closed loop response of Temperature Control Loop
7. Study of complex control system (Ratio / Cascade)
8. Experimental study of following using matlab
   a) Response of different order processes with and without Transportation Lag
   b) Cohen-coon method
   c) Z-N method
9. Characteristics of Resistive Potentiometer, Strain Gauge, Load Cell and LVDT
10. Characteristics of RTD, Thermocouple and Thermistor
11. Experimental determination of coefficient of discharge for Orifice, Pitot and Venturi tube
12. Design of lead, lag, Compensator and Implementation using ELVIS.

P: 60 TOTAL: 60 PERIODS
COURSE OUTCOMES
Upon completion of this course, the students will be able to

CO 1: describe the main functional units in a PC and the software used. (K2)
CO 2: explain the architecture of PC expansion bus and USB. (K2)
CO 3: differentiate PC expansion bus and USB. (K2)
CO 4: select a Virtual Instrument for a particular application. (K3)
CO 5: describe the functional units of a system for an application. (K2)

UNIT I   PC AND ITS PROGRAMMING
Microcomputer systems - Data representation - Bus expansion - Microprocessor operation - Data transfer and control - Parallel versus serial I/O. PC memory - Memory operation - Memory organization - Data integrity - Memory terminology - Memory size - Memory speed - CMOS memory - BIOS ROM - PC memory allocation - BIOS data area - Disk drives. Choice of language - Software development - Control structures - Loops - Error checking and input validation - Event-driven programs - Testing.

UNIT II  PC EXPANSION BUS SYSTEMS

UNIT III  THE UNIVERSAL SERIAL BUS

UNIT IV   VIRTUAL INSTRUMENTS
Selecting a virtual instrument - Instrument types - Instrument connection options - Digital storage oscilloscopes - Sampling rate and bandwidth - Resolution and accuracy - Low-cost DSO - High-speed DSO - High-resolution DSO - Choosing a computer-based DSO - Basic operation of a DSO - Waveform display - Parameter measurement - Spectrum analysis - Sound card oscilloscopes - Windows Oscilloscope - Software Oscilloscope - Waveform display - Parameter measurement - Spectrum analysis

UNIT V   APPLICATIONS
Expansion cards - Approaches - PC instruments - Industrial PC systems - Backplane bus-based systems - Networked/distributed PC systems - Specifying hardware and software - Hardware design - Software design. Applications - Monitoring oscillator stability - Testing crystal filters - A speech enunciator - Strain measurement and display - Backup battery load test - Load sequencer - Environmental monitoring - Icing flow tunnel.

L: 45 TOTAL: 45 PERIODS
TEXT BOOK

REFERENCES
3. MAPLE V programming guide.
4. MATLAB/SIMULINK user manual.
5. MATHCAD/VIS SIM user manual.
6. LABVIEW simulation user manual
COURSE OUTCOMES
Upon completion of this course, the students will be able to

CO 1 : analyze the dynamics of process operations mathematically. (K4)
CO 2 : analyze the characteristics of various controller. (K4)
CO 3 : develop the controller and to obtain the controller parameter. (K3)
CO 4 : describes control schemes and analysis its performance. (K2)

UNIT I PROCESS DYNAMICS  9
Introduction to process control - objective of modeling - models of industrial process hydraulic tanks - fluid flow systems - mixing process - chemical reactions - thermal systems heat exchangers and distillation column.

UNIT II CONTROL ACTIONS AND CONTROLLER TUNING  9
Basic control actions-on/off, P, P+I, P+I+D, floating control-pneumatic and electronic controllers- controller tuning-time response and frequency response methods- non-linear controllers.

UNIT III COMPLEX CONTROL TECHNIQUES  9
Feed forward – ratio – cascade - selective control system – split range – inferential - predictive-adaptive and multivariable control – implementation of complex control techniques in distillation column and heat exchanger.

UNIT IV PROGRAMMABLE LOGIC CONTROLLERS  9

UNIT V COMPUTER CONTROL OF PROCESS  9
PLC based control of processes – Computer control of liquid level system – heat exchanger – Smart sensors and Field bus.

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES
### COURSE OUTCOMES

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

- **CO 1**: outline the concepts of intelligent expert system. (K2)
- **CO 2**: explain the components of fuzzy logic system. (K5)
- **CO 3**: distinguish various structures of ANN. (K4)
- **CO 4**: describe the basic concepts of genetic algorithms. (K6)
- **CO 5**: apply ANN, FLC and GA to various electrical applications. (K3)

### UNIT I INTRODUCTION

Approaches to intelligent control - Architecture for intelligent control - Symbolic reasoning system-rule-based systems - AI approach - Knowledge representation - Expert systems.

### UNIT II ARTIFICIAL NEURAL NETWORKS

Concept of Artificial Neural Networks and its basic mathematical model, McCulloch-Pitts neuron model - simple perceptron - Adaline and Madaline - Feed-forward Multilayer Perceptron. Learning and Training the neural network - Data Processing: Scaling, Fourier transformation, principal-component analysis and wavelet transformations - Hopfield network, Self-organizing network and Recurrent network - Neural Network based controller.

### UNIT III FUZZY LOGIC SYSTEM

Introduction to crisp sets and fuzzy sets - basic fuzzy set operation and approximate reasoning - Introduction to fuzzy logic modeling and control - Fuzzification, inferencing and defuzzification - Fuzzy knowledge and rule bases. Fuzzy modeling and control schemes for nonlinear systems - Self-organizing fuzzy logic control - Fuzzy logic control for nonlinear time-delay system.

### UNIT IV GENETIC ALGORITHM

Basic concept of Genetic algorithm and detail algorithmic steps - adjustment of free parameters - Solution of typical control problems using genetic algorithm - Concept on some other search techniques like tabu search and ant-colony search techniques for solving optimization problems.

### UNIT V APPLICATIONS


**REFERENCES**

15CI24C  DIGITAL CONTROL AND INSTRUMENTATION LABORATORY – II  L T P C
0 0 4 2

COURSE OUTCOMES
Upon completion of this course, the students will be able to

CO 1: examine the system’s controllability and observability. (S3)
CO 2: develop system to acquire data from Real World into PC for analysis purpose using LabVIEW. (K3, S4)
CO 3: design linear and nonlinear controller. (S4)

DETAILED SYLLABUS
1. Developing voltmeter and signal generator using DAQ cards.
2. Simulating Reactor Control using Virtual Instrumentation
3. Real time Temperature Control using Virtual Instrumentation
4. Linear and Nonlinear PID controller using Virtual Instrumentation
5. Design of Instrumentation Amplifier and Implementation using ELVIS
6. Design of Low pass, High pass, Band pass filter for different order systems and implementation using ELVIS
7. Study of PLC and Programming
8. Develop and Implement a ladder diagram for Bottle Filling Plant and Mixing Process using PLC
9. Study of DCS – Process Field Control Station and Human Interface System
10. Develop a project using DCS for controlling Flow, Level, Pressure and Temperature processes
11. Develop a project using DCS for implementing logical sequence of a typical plant
12. Experimental study of following using Matlab
   a. Check the Controllability and Observability of Systems
   b. Design a Dead Beat Algorithm.

P: 60 TOTAL: 60 PERIODS
15CI25C  RESEARCH PAPER AND PATENT REVIEW – SEMINAR  L T P C  
0 0 4 2  

The student will make at least two technical presentations on recent research publication and patent related to their specialization. The presentation will be assessed by a committee constituted by the head of the department. The students also expected to submit a report at the end of the semester.

P: 60 TOTAL: 60 PERIODS
COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO 1: Describe common features and architecture of 8051 and PIC micro controller. (K2)

CO 2: Write programmes for serial communication, Timer and Interrupts blocks in micro controller. (K3)

CO 3: explain digital multi meter, frequency counter and DC motor control using PIC micro controller. (K3)

UNIT I  8051 ARCHITECTURE


UNIT II  8051 PROGRAMMING


UNIT III  PIC MICROCONTROLLER


UNIT IV  PIC MICROCONTROLLER PROGRAMMING

PIC programming in Assembly & C Languages –I/O port, Data Conversion, Timer programming - CCP modules -ADC, DAC and Sensor Interfacing –Flash and EEPROM memories.

UNIT V  SYSTEM DESIGN – CASE STUDY

Interfacing LCD Display – Keypad Interfacing - Generation of Gate signals for converters and Inverters - Motor Control – Controlling AC appliances – Measurement of frequency - Stand alone Data Acquisition System.

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS


REFERENCE

COURSE OUTCOMES
Upon completion of this course, the students will be able to
CO 1: identify the various data acquisition systems. (K2)
CO 2: explain the different peripheral interfaces and data transmission. (K2)
CO 3: select the appropriate instrumentation bus. (K3)
CO 4: differentiate the various parallel port busses. (K2)
CO 5: explain various PC based measurement. (K2)

UNIT I DATA ACQUISITION SYSTEMS
Overview of A/D converter, types and characteristics – Sampling Objective – Building blocks of Automation systems – Counters – Modes of operation: Frequency, Period, Time interval measurements, Prescaler, Heterodyne converter for frequency measurement. Single and Multi channel Data Acquisition systems.

UNIT II INTERFACING AND DATA TRANSMISSION

UNIT III INSTRUMENTATION BUS

UNIT IV PARALLEL PORT BUSES

UNIT V CASE STUDIES
PC based DAS, Data loggers, PC based industrial process measurements like flow, temperature, pressure and level development system, CRT interface and controller with monochrome and colour video display.

TEXT BOOKS

REFERENCES
COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO 1: recall the fundamental concepts of micro sensors and actuators. (K1)
CO 2: explain the various types of sensors used in industries. (K2)
CO 3: infer different sensor interfaces for different applications. (K3)

UNIT I  OVERVIEW OF SMART SENSOR SYSTEMS

UNIT II  SILICON SENSORS, OPTICAL SENSORS AND PHYSICAL CHEMOSENSORS
Physical Chemosensors: Introduction - Physical Chemosensing - Energy Domains - Examples and Applications.

UNIT III SMART TEMPERATURE SENSORS, CAPACITIVE SENSORS AND HALL MAGNETIC SENSORS

UNIT IV UNIVERSAL ASYNCHRONOUS SENSOR INTERFACES AND DAQ

UNIT V MICROCONTROLLERS AND DIGITAL SIGNAL PROCESSORS FOR SMART SENSOR SYSTEMS
Introduction - MCU and DSP Architectures, Organization, Structures, and Peripherals - Choosing a Low-Power MCU or DSP - Timer Modules - Analog Comparators, ADCs, and DACs as Modules of Microcontrollers - Embedded Networks and LCD Interfacing - Development Tools and Support.

L: 45 TOTAL: 45 PERIODS

REFERENCES

COURSE OUTCOMES
Upon completion of this course, the students will be able to
   CO 1 : recall the fundamental concepts of multisensor Data Fusion. (K1)
   CO 2 : describe the various types of Algorithm for Data fusion. (K2)
   CO 3 : summarize the advanced filtering techniques and estimation analysis. (K2)
   CO 4 : select the suitable algorithm for a specific application. (K3)

UNIT I   MULTISENSOR DATA FUSION INTRODUCTION                      9
Sensors and sensor data, Use of multiple sensors, Fusion applications. The inference hierarchy:
output data. Data fusion model. Architectural concepts and issues. Benefits of data fusion,
Mathematical tools used: Algorithms, co-ordinate transformations, rigid body motion. Dependability
and Markov chains, Meta – heuristics.

UNIT II ALGORITHMS FOR DATA FUSION                9
Taxonomy of algorithms for multisensor data fusion - Data association - Identity declaration.

UNIT III  ESTIMATION                   9
Kalman filtering, practical aspects of Kalman filtering, extended Kalman filters. Decision levels
identify fusion. Knowledge based approaches.

UNIT IV ADVANCED FILTERING                    9
Data information filter, extended information filter. Decentralized and scalable decentralized
estimation. Sensor fusion and approximate agreement. Optimal sensor fusion using range trees
recursively. Distributed dynamic sensor fusion.

UNIT V HIGH PERFORMANCE DATA STRUCTURES                   9
Tessellated, trees, graphs and function. Representing ranges and uncertainty in data structures.
Designing optimal sensor systems with in dependability bounds. Implementing data fusion system.

TEXT BOOK
   1. David L. Hall, “Mathematical techniques in Multisensor data fusion”, Artech House, Boston,
      2004.

REFERENCES
15CI05E MICRO ELECTRO MECHANICAL SYSTEMS

COURSE OUTCOMES
Upon completion of this course, the students will be able to

CO 1: describe various Microsystems and MEMS technologies and their applications. (K2)
CO 2: explain various semiconductor processes, micro fabrication, techniques and water – level packaging technologies. (K2)
CO 3: describe different sensing and actuating mechanisms in Microsystems. (K2)
CO 4: apply the MEMS techniques in developing the modern digital gadget models. (K3)

UNIT I OVERVIEW OF MEMS
History of MEMS, MEMS and Microsystems, Scaling laws in Miniaturization. Materials for MEMS and Microsystems.

UNIT II MICRO FABRICATIONS AND MICROMACHINING
Microsystem Design and Fabrication, Microsystem fabrication processes- Photolithography, Ion Implantation, Diffusion, Oxidation, Chemical and Physical Vapour deposition, Deposition by Epitaxy, Etching. Bulk Micro manufacturing, Surface micromachining, LIGA process.

UNIT III PHYSICAL MICROSENSORS
Design of Acoustic wave sensors, resonant sensor, Vibratory gyroscope, Capacitive and Piezo Resistive Pressure sensors- engineering mechanics behind these Microsensors.

UNIT IV MICROACTUATORS
Design of Actuators: Actuation using thermal forces, Actuation using shape memory Alloys, Actuation using piezoelectric crystals, Actuation using Electrostatic forces (Parallel plate, Torsion bar, Comb drive actuators), Micromechanical Motors and pumps.

UNIT V CASE STUDIES
Ink jet pointer heads, Micro mirror TV Projector, DNA chip, Micro arrays, and RF electronic devices.

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES
15CI06E MEDICAL IMAGING SYSTEMS L T P C 3 0 0 3

COURSE OUTCOMES
Upon completion of this course, the students will be able to
CO 1: explain the imaging modalities using the knowledge on human physiology. (K2)
CO 2: demonstrate the various imaging instruments. (K2)
CO 3: describe the principles of Ultrasound and Magnetic resonance Imaging. (K2)
CO 4: explain the fundamentals of Nuclear Medicine Imaging. (K2)

UNIT I HUMAN PHYSIOLOGY

UNIT II IMAGING PRINCIPLES AND RADIOGRAPHIC IMAGING

UNIT III PROJECTION RADIOGRAPHY AND COMPUTED TOMOGRAPHY
Projection Radiography – Instrumentation – X-Ray tubes, Filtration, grids, image intensifiers – Image formation – Basic Imaging equation, Geometric effects, Blurring effects, Film characteristics, SNR.

UNIT IV ULTRASOUND IMAGING AND MAGNETIC RESONANCE IMAGING

UNIT V NUCLEAR MEDICINE IMAGING

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS
REFERENCES
15CI07E  WIRELESS SENSOR NETWORKS  
(Common to CS and C&I)  
L T P C  
3 0 0 3

COURSE OUTCOMES
Upon completion of this course, the students will be able to

CO 1: Discuss the design issues in sensor networks. (K1-K2)
CO 2: Explain the different types of MAC protocols. (K1-K2)
CO 3: Discuss the different types of routing protocols. (K1-K2)
CO 4: Expose to the protocol stack issues in sensor networks. (K1-K3)
CO 5: Describe the architecture and protocols of wireless sensor networks. (K1-K2)

UNIT I  INTRODUCTION

UNIT II  ARCHITECTURES
Single node architecture – Hardware components – Energy consumption of sensor nodes – Network architecture – Sensor network scenarios – Design challenges in wireless sensor networks – Optimization goals and Figure of merit – Gateway concepts.

UNIT III  NETWORKING OF SENSORS
Physical layer and Transceiver design considerations – MAC protocols for wireless sensor networks – Low duty cycle protocols and wake up radio concepts – Schedule based protocols – Contention based protocols.

UNIT IV  INFRASTRUCTURE ESTABLISHMENT

UNIT V  SENSOR NETWORK PLATFORMS AND TOOLS
Operating systems for wireless sensor networks – Tiny OS – Programming challenges – Sensor node examples: EYES, Berkeley and Mica Motes – Case study: Forest fire detection, Habitat monitoring and Medical applications.

L:45 TOTAL: 45 PERIODS

REFERENCES
COURSE OUTCOMES
Upon completion of this course, the students will be able to
CO 1: apply the describing function method to non-linear feedback systems. (K3)
CO 2: summarize phase plane analysis of linear and non-linear systems. (K2)
CO 3: discuss the non-linear problems using lyapenov methods and feedback linearization. (K2)

UNIT I  DESCRIBING FUNCTION

UNIT II  PHASE PLANE ANALYSIS
Concepts of phase plane analysis - Phase portraits - Singular points - Symmetry in Phase Plane Portraits - Constructing Phase Portraits - Phase plane Analysis of Linear and Nonlinear Systems.

UNIT III  LYAPUNOV THEORY

UNIT IV  FEEDBACK LINEARIZATION

UNIT V  SLIDING MODE CONTROL

L: 45 TOTAL : 45 PERIODS

TEXT BOOKS

REFERENCES
COURSE OUTCOMES
Upon completion of this course, the students will be able to

- CO 1: explain the classification of optimal control problem. (K2)
- CO 2: solve the optimal control problems. (K3)
- CO 3: explain the numerical techniques for optimal control. (K2)
- CO 4: analyse the kalman filter properties. (K3)

UNIT I   INTRODUCTION

UNIT II   LQ CONTROL PROBLEMS AND DYNAMIC PROGRAMMING

UNIT III   NUMERICAL TECHNIQUES FOR OPTIMAL CONTROL
Numerical solution of 2-point boundary value problem by steepest descent and Fletcher Powell method solution of Ricatti equation by negative exponential and interactive Methods.

UNIT IV   FILTERING AND ESTIMATION

UNIT V   KALMAN FILTER AND PROPERTIES

TEXT BOOKS

REFERENCES
COURSE OUTCOMES
Upon completion of this course, the students will be able to

- CO 1: explain the concepts of system modeling for various control system. (K2)
- CO 2: describe the various parametric system identification methods. (K2)
- CO 3: analyze various state estimation techniques. (K3)
- CO 4: apply the various adaptive control scheme for real time problems. (K3)

UNIT I MODELS FOR IDENTIFICATION

UNIT II NON-PARAMETRIC AND PARAMETRIC IDENTIFICATION

UNIT III NON-LINEAR IDENTIFICATION AND MODEL VALIDATION

UNIT IV ADAPTIVE CONTROL AND ADAPTATION TECHNIQUES

UNIT V CASE STUDIES
Inverted Pendulum, Aircraft Flight Control, process control application: heat exchanger, Distillation column, Wind mill application, Ship steering control.

L : 45 TOTAL : 45 PERIODS

TEXT BOOKS

REFERENCES
COURSE OUTCOMES
Upon completion of this course, the students will be able to
CO 1: explain the system concepts and different mathematical techniques applied in analyzing any given system. (K2)
CO 2: illustrate the techniques of plotting the responses in both domain analysis. (K2)
CO 3: apply frequency domain analysis to study biological systems. (K3)

UNIT I  CONTROL SYSTEM MODELLING

UNIT II  PHYSIOLOGICAL CONTROL SYSTEMS
Block diagram representation of the muscle stretch reflex – Difference between engineering and physiological control – generalized system properties – models with combination of system elements – introduction to simulation.

UNIT III  BIOLOGICAL CONTROL SYSTEMS

UNIT IV  PHYSIOLOGICAL SYSTEM MODELLING
Westheimer Saccadic Eye Movement Model - Respiration Models and Controls - Cardiovascular Control Systems - Sugar Level Control Mechanism - Endocrine Control System - Excretion Control.

UNIT V  TRANSFER FUNCTIONS
Human Operator Tracking Characteristics - Biological Receptors - Receptor Characteristics - Transfer Function Models of Receptors.

TEXT BOOKS

REFERENCES
COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO 1: describe the various linear model identification. (K2)
- CO 2: analyze the Internal Model Control. (K4)
- CO 3: express the elements of computer process control. (K2)
- CO 4: develop the advanced control schemes for real time processes. (K4)

UNIT I ADVANCED PROCESS MODELLING AND IDENTIFICATION


UNIT II INTERNAL MODEL CONTROL


UNIT III ELEMENTS OF COMPUTER PROCESS CONTROL


UNIT IV DESIGN OF ADVANCED CONTROL SCHEMES


UNIT V MULTIPLE LOOP CONTROL SCHEMES


TEXT BOOKS


REFERENCES

15CI13E  INDUSTRIAL AUTOMATION  L T P C
3 0 0 3

COURSE OUTCOMES
Upon completion of this course, the students will be able to

CO 1 : explain the various exploration techniques employed in petroleum. (K2)
CO 2 : discuss the different types of dryers, evaporators and heat exchangers used in chemical reactors. (K2)
CO 3 : summarize modern trends in iron making blast furnace. (K2)
CO 4 : explain about the working and construction of pumps. (K2)

UNIT I  PETROCHEMICAL INTRODUCTION  9
Petroleum Exploration, Production and Refining - Constituents of Crude Oil. P & I diagram of petroleum refinery – Atmospheric and Vacuum Distillation of Crude oil Thermal Conversion process – Control of Distillation Column – Temperature and Pressure Control – Feed control, Reflux Control, Reboiler Control.

UNIT II  CONTROLS OF CHEMICAL REACTORS  9

UNIT III  IRON AND STEEL  9
The need for iron and steel in the civilised world; history of steel making – Process description in diagrammatic and functional block details; raw materials reparation; operation of Blast Furnace (BF) and auxiliary units including stoves; Basic oxygen Furnace (BOF); Electric Furnace (EF); Open Hearth Furnace (OHF); relative merits of various steel making furnaces.

UNIT IV  QUALITY OF STEEL  9
Impurities present and allowed limits for usable steel; waste recycling casting of steel; primary and secondary rolling, cold rolling; steel finishing operations. Identification of various process parameters in the industry; weighing and proportioning; special gauges for measurement of thickness and shape.

UNIT V  SPECIAL APPLICATIONS FOR CONTROLS  9
Blast Furnace, Stove combustion control system; gas and water control system in Basic Oxygen Furnace; Mould Level control system in Sand Casting operations. Evolution of computer applications in the industry; Practices for model calculating and data logging; steel rolling mill control; annealing process control; utilities management with computer system.

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES
COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO 1: infer fundamental concepts of Solar Energy. (K2)
CO 2: interpret different design concepts of solar cells. (K2)
CO 3: outline different Power Electronic converters. (K2)
CO 4: summarize various PV system design. (K2)
CO 5: discuss applications on Solar Energy. (K2)

UNIT I  FUNDAMENTALS OF SOLAR ENERGY AND ELECTRONICS  9


UNIT II  DESIGN OF SOLAR CELLS  9


UNIT III  SOLAR POWER ELECTRONICS  9

DC to DC Converters Types: Buck, Boost, Buck-Boost - Charge Controllers - DC to AC Converters Types: Single phase, 3 phase, Inverter with PWM-MPPT design and Algorithm - Perturb & Observence, Hill Climbing.

UNIT IV  PV SYSTEM DESIGN  9

Introduction - Stand alone PV System Configuration, Types - Stand alone system with DC Load (Type A, Type B) - Stand alone system with Battery, DC Load - Stand alone system with AC/DC load with Battery - Design Methodology – Hybrid PV Systems - Grid Connected PV Systems.

UNIT V  APPLICATIONS  9


L : 45 TOTAL : 45 PERIODS

TEXT BOOKS


REFERENCE

COURSE OUTCOMES
Upon completion of this course, the students will be able to
   CO 1 : recall the fundamentals of automotive electronics. (K1)
   CO 2 : identify basic electric and electronic components. (K3)
   CO 3 : describe the principles of magnetism and magnetic fields. (K2)
   CO 4 : identify types of electrical test meters and equipment. (K3)

UNIT I   FUNDAMENTALS OF AUTOMOTIVE ELECTRONICS   9
Open loop and closed loop system components for electronic engine management, vehicle motion control, Current trends in modern Automobiles.

UNIT II  ELECTRONIC FUEL INJECTION AND IGNITION SYSTEMS  9
Introduction, Carburettor control system, throttle body ignition and multi port or point fuel injection, Advantages of electronic ignition system, Types of solid state ignition systems and their principle of operation, electronic spark timing control system.

UNIT III  ENGINE CONTROL SYSTEM     9
Engine cranking and warm up control, Acceleration enrichment –Deacceleration leaning and idle speed control, integrated engine control system, exhaust emission control system, Engine performance testing.

UNIT IV  AUTOMOBILE CHASSIS ELECTRONIC CONTROL SYSTEM      9
Principle of electronic braking, automatic transmission electronic control circuit, cruise control circuit, the electronic steering control theory, Antilock Braking System(ABS), Anti Slip Regulation(ASR), Electronic Stability Program(ESP) and other electronic control method.

UNIT V  AUTO BODY ELECTRONIC CONTROL TECHNOLOGY       9
Automotive central locking and anti-theft system control technology, electronically controlled windows and doors and airbag technology, principle of control circuit components and characteristics.

TEXTS BOOKS

REFERENCES
COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO 1: outline the measurement procedure of different industrial parameters. (K2)
CO 2: explain the measurement procedures of different parameters in thermal power plant. (K2)
CO 3: illustrate the measurement procedures for measurement of process parameters in Petrochemical Industry. (K2)
CO 4: describe the various types of pulp and paper properties and measurement techniques. (K2)
CO 5: explain the measurement principles for measuring the industrial parameters for different applications. (K2)

UNIT I REVIEW OF INDUSTRIAL INSTRUMENTATION 9

UNIT II MEASUREMENT IN THERMAL POWER PLANT 9
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.

UNIT III MEASUREMENT IN PETROCHEMICAL INDUSTRY 9
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.

UNIT IV INSTRUMENTATION FOR PULP AND PAPER INDUSTRIES 9
Definition of consistency — Techniques for head box consistency measurement -Functioning of Paper making machine — Quality parameters — moisture, basic weight, caliper, brightness, colour, ash content, strength, gloss and tensile strength - parameters monitoring Instrumentation.

UNIT V SPECIAL PURPOSE INSTRUMENTATION 9

L : 45 TOTAL : 45 PERIODS

TEXT BOOK

REFERENCES
15CI17E MODERN MEDICAL INSTRUMENTS L T P C

3 0 0 3

COURSE OUTCOMES
Upon completion of this course, the students will be able to
CO 1: explain the human physiology. (K2)
CO 2: model and experiment with the medical equipments. (K3)
CO 3: explain the procedure to test the safety of medical equipment. (K6)

UNIT I HUMAN PHYSIOLOGY AND SIGNALS

UNIT II DIAGNOSTIC AND IMAGING DEVICES

UNIT III THERAPEUTIC AND ASSISTIVE DEVICES

UNIT IV PATIENT MONITORING SYSTEM AND TELEMETRY

UNIT V MEDICAL INSTRUMENTS’ SAFETY AND CERTIFICATION

L : 45 TOTAL : 45 PERIODS

TEXT BOOKS

REFERENCES
COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO 1: design a small digital system to the specified functionality. (K3)
- CO 2: apply modern tools in combinational and sequential circuit design with VHDL. (K3)
- CO 3: explain new generation programmable logic devices. (K2)
- CO 4: apply testability algorithms in the design of digital circuits. (K3)

UNIT I  SEQUENTIAL CIRCUIT DESIGN  9


UNIT II  ASYNCHRONOUS SEQUENTIAL CIRCUIT DESIGN  9


UNIT III  FAULT DIAGNOSIS AND TESTABILITY ALGORITHMS  9


UNIT IV  SYSTEM DESIGN USING VHDL  9


UNIT V  NEW GENERATION PROGRAMMABLE LOGIC DEVICES  9


TEXT BOOKS

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO 1: discuss the essentials for the postgraduate level research in the area of statistical signal processing. (K1-K2)

CO 2: model random signals and determine its solution. (K1-K3)

CO 3: estimate the coefficient for perfect reproduction filter for both the stationary and non-stationary signals. (K1- K3)

CO 4: design FIR and IIR adaptive filters using adaptive algorithms. (K1- K4)

CO 5: estimate the power spectrum for discrete random signals using classical and non-classical methods. (K1- K3)

UNIT I DISCRETE RANDOM SIGNAL PROCESSING 9

UNIT II SIGNAL MODELING 9
Least Squares method, Pade approximations, Prony’s method – Pole zero modeling, All pole modeling, Linear prediction, Forward and Backward prediction, Finite data records, stochastic models, Solution of Prony’s normal equations – Levinson Durbin recursion.

UNIT III WIENER FILTERING 9

UNIT IV ADAPTIVE FILTERS 9

UNIT V SPECTRAL ESTIMATION 9
Nonparametric methods - Periodogram, Modified periodogram, Bartlett, Welch and Blackman-Tukey methods, Parametric methods - ARMA, AR and MA model based spectral estimation.

REFERENCES

15CI20E DIGITAL IMAGE PROCESSING TECHNIQUES

COURSE OUTCOMES
Upon completion of this course, the students will be able to
  CO 1: describe the image formation and the human visual system. (K2)
  CO 2: apply image processing techniques in both the spatial and frequency (Fourier) domains. (K3)
  CO 3: explain the techniques in image segmentation and feature extraction (K3)
  CO 4: describe the concepts of image registration and image fusion. (K2)

UNIT I FUNDAMENTALS OF DIGITAL IMAGE PROCESSING  9
Elements of visual perception, brightness, contrast, hue, saturation, mach band effect, 2D image transforms-DFT, DCT, KLT, and SVD. Image enhancement in spatial and frequency domain, Review of morphological image processing.

UNIT II SEGMENTATION  9
Edge detection, Thresholding, Region growing, Fuzzy clustering, Watershed algorithm, Active contour methods, Texture feature based segmentation, Model based segmentation, Atlas based segmentation, Wavelet based Segmentation methods

UNIT III FEATURE EXTRACTION  9
First and second order edge detection operators, Phase congruency, Localized feature extraction-detecting image curvature, shape features Hough transform, shape skeletonization, Boundary descriptors, Moments, Texture descriptors- Autocorrelation, Co-occurrence features, Runlength features, Fractal model based features, Gabor filter, wavelet features.

UNIT IV REGISTRATION AND IMAGE FUSION  9
Registration- Preprocessing, Feature selection-points, lines, regions and templates Feature correspondence - Point pattern matching, Line matching, region matching Template matching. Transformation functions-Similarity transformation and Affine Transformation. Resampling-Nearest Neighbour and Cubic Splines Image Fusion-Overview of image fusion, pixel fusion, Multi resolution based fusion discrete wavelet transform, Curvelet transform. Region based fusion.

UNIT V 3D IMAGE VISUALIZATION  9
Sources of 3D Data sets, Slicing the Data set, Arbitrary section planes, The use of color, Volumetric display, Stereo Viewing, Ray tracing, Reflection, Surfaces, Multiply connected surfaces, Image processing in 3D, Measurements on 3D images.

L : 45 TOTAL : 45 PERIODS

TEXT BOOKS

REFERENCES
15CI21E  DESIGN OF EMBEDDED SYSTEMS  
(Common to C&I and HVE)  

L T P C  
3 0 0 3  

COURSE OUTCOMES  
Upon completion of this course, the students will be able to  
- CO 1: explain the basic concepts and building blocks of embedded system. (K2)  
- CO 2: infer the fundamentals of Embedded processor Modeling. (K2)  
- CO 3: illustrate bus communication in processors and I/O interfacing. (K2)  
- CO 4: summarize processor scheduling algorithms and to explain the basics of RTOS. (K2)  
- CO 5: distinguish the different phases & modeling of embedded system with its applications on various fields. (K3)  

UNIT I  INTRODUCTION TO EMBEDDED SYSTEMS  
Introduction to Embedded Systems -The build process for embedded systems-Structural units in Embedded processor-Selection of processor & memory devices- DMA – Memory management methods-Timer and Counting devices, Watchdog Timer, Real Time Clock-Software Development tools-IDE, assembler, compiler, linker, simulator, debugger-In circuit emulator, Target Hardware Debugging, Boundary Scan.  

UNIT II  HARDWARE SOFTWARE PARTITIONING  

UNIT III  EMBEDDED NETWORKING AND INTERRUPTS SERVICE MECHANISM  

UNIT IV  RTOS BASED EMBEDDED SYSTEM DESIGN  
Introduction to basic concepts of RTOS-Need, Task, process & threads, interrupt routines in RTOS-Multiprocessing and Multitasking- Preemptive and non-preemptive scheduling-Task Communication - Shared memory - Message passing – Inter process Communication-Synchronization between processes-Semaphores-Mailbox-Pipes-Priority inversion-Priority inheritance-Comparison of Real time Operating systems: VxWorks, µC/OS-II, RT Linux  

UNIT V  EMBEDDED SYSTEM APPLICATION DEVELOPMENT WITH PROCESSOR  
Objective, Need, different Phases & Modelling of the EDLC-Choice of Target Architectures for Embedded Application Development for Control Dominated-Data Dominated Systems-Case studies on Digital Camera, Adaptive Cruise control in a Car, Mobile Phone software for key inputs.  

TEXT BOOKS  
REFERENCES
15CI22E  POWER PLANT INSTRUMENTATION  
L T P C  3 0 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO 1 : explain the operation of various conventional power plants and controllers in boilers. (K2)

CO 2 : describe the working of solar radiation measurements, Solar Photovoltaic systems and applications of solar energy. (K2)

CO 3 : describe the functioning of Wind Energy Conversion Systems and Biomass conversion technologies. (K2)

CO 4 : discuss the Geothermal resources, Ocean Energy and additional alternate energy resources. (K2)

UNIT I  OVERVIEW OF CONVENTIONAL POWER GENERATION AND CONTROL LOOPS IN BOILER


UNIT II  SOLAR ENERGY


UNIT III  WIND AND BIOMASS ENERGY


Biomass Energy – Biomass resources, Biomass conversion technologies, Biomass gasification, Constant pressure type and constant volume type biogas plants.

UNIT IV  GEOTHERMAL AND OCEAN ENERGY


UNIT V  ADDITIONAL ALTERNATE ENERGY RESOURCES


Thermionic power generation – Principle, Thermionic generator and its performance analysis.

L: 45 TOTAL: 45 PERIODS
TEXT BOOKS


REFERENCES

COURSE OUTCOMES
Upon completion of this course, the students will be able to

CO 1: list the concepts of Visual Inspection & Liquid Penetrant Testing. (K2)
CO 2: differentiate the various types of Electromagnetic Testing. (K2)
CO 3: explain the concepts of Industrial Application using NDT. (K2)

UNIT I  NON-DESTRUCTIVE TESTING: AN INTRODUCTION, VISUAL INSPECTION & LIQUID PENETRANT TESTING  6
Introduction to various non-destructive methods, Comparison of Destructive and Non destructive Tests, Conditions for effective non-destructive testing - Visual Inspection, Optical aids used for visual inspection, Applications. Physical principles, procedure for penetrant testing, Penetrant testing materials, Penetrant testing methods-water washable, Post – Emulsification methods, Applications.

UNIT II  ELECTROMAGNETIC TESTING  10
Magnetic particle testing: Principle of MPT, procedure used for testing a component, Equipment used for MPT, Magnetizing techniques, Applications.

UNIT III  RADIOGRAPHY AND THERMOGRAPHY  10
Principle of Radiography, Radiographic imaging, Inspection Techniques – Single wall single image, Double wall Penetration, Multiwall Penetration technique- Applications and limitations of radiographic inspection- Real Time Radiography

UNIT IV  ULTRASONIC AND ACOUSTIC EMISSION TESTING  10
Principle, Ultrasonic transducers, Ultrasonic Flaw detection Equipment- Inspection Methods- Normal Incident Pulse- Echo Inspection, Normal Incident Through-transmission Testing, Angle Beam Pulse- Echo testing- Applications of Normal Beam Inspection in detecting fatigue cracks, Inclusions, Slag, Porosity and Intergranular cracks. Modes of display A- scan, B-Scan, C- Scan, Applications, - Principle of AET, Instrumentation, Applications - testing of metal pressure vessels, Fatigue crack detection in aerospace structures

UNIT V  INDUSTRIAL APPLICATIONS, COMPARISON AND SELECTION OF NDT METHODS  9
Applications of NDE in Nuclear, Aircraft, Automotive and petroleum Industries. A Comparison and selection of various NDT techniques. Codes, standards, specification and procedures.

L: 45 TOTAL: 45 PERIODS
TEXT BOOK

REFERENCES
15CI24E INSTRUMENTATION IN PULP AND PAPER INDUSTRIES L T P C
3 0 0 3

COURSE OUTCOMES
Upon completion of this course, the students will be able to
- CO 1: discuss the fundamental concepts of paper making process. (K2)
- CO 2: explain the various types of paper properties and measurement techniques. (K2)
- CO 3: describe the consistency measurement & control techniques. (K2)
- CO 4: discuss the working of paper making machine. (K2)

UNIT I AN OVERVIEW OF PAPER MAKING PROCESS
Paper making process - Raw materials - Pulp separation - screening - Bleaching - Cooking -
Chemical reaction - chippers - types of digesters - H factor and Kappa factors-Stock preparation -
Instrumentation needs - Energy conservation and paper quality control.

UNIT II PAPER PROPERTIES AND ITS MEASUREMENT
Physical, electrical, optical and chemical properties of paper - Basic weight, thickness, density,
Porosity, smoothness, softness, hardness and compressibility - stress-strain relationship-Tensile
strength, bursting strength, tearing resistance, folding endurance, stiffness and impact strength -
Dielectric constant, dielectric strength, dielectric loss and Properties of electrical insulating paper -
Brightness, color, gloss and capacity - Starch constant acidity and pH - Measurement techniques.

UNIT III CONSISTENCY MEASUREMENT
Definition of consistency - Techniques for head box consistency measurement - Stock consistency
measurement and control.

UNIT IV PAPER MAKING MACHINE
Functioning of Paper making machine - Quality parameters - moisture, basic weight, caliper,
brightness, colour, ash content, strength, gloss and tensile strength - parameters monitoring
Instrumentation.

UNIT V CONTROL ASPECTS
Machine and cross direction control technique — consistency, moisture and basic weight control
dryer control — computer based control systems - mill wide control.

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS
2. James P.Casey, “Pulp and Paper chemistry and chemical Technology”, John Wiley and
sons, 1981.

REFERENCES
15CI25E  ROBOTICS AND INDUSTRIAL AUTOMATION  

L T P C  3 0 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO 1: explain the individual components of Robotics. (K2)
- CO 2: summarize the kinematics transformation techniques used in Robotics. (K2)
- CO 3: explain about Jacobian matrix used for robotic differential motion and velocities. (K2)
- CO 4: describe the role of image processing and vision system for an automation of robot. (K2)

UNIT I  INTRODUCTION AND TERMINOLOGIES  9
Definition-Classification-History- Robots components - Degrees of freedom-Robot joints coordinates- Reference frames-workspace-Robot languages-actuators-sensors-Position, velocity and acceleration sensors-Torque sensors-tactile and touch sensors proximity and range sensors-social issues.

UNIT II  KINEMATICS  9
Mechanism-matrix representation-homogenous transformation-DH representation - Inverse kinematics-solution and programming-degeneracy and dexterity.

UNIT III  DIFFERENTIAL MOTION AND VELOCITIES  9

UNIT IV  ROBOT CONTROL SYSTEM  9
Sensor characteristics- Hydraulic, Pneumatic and Electric actuators-trajectory planning decentralised PID control- non-linear decoupling control.

UNIT V  IMAGE PROCESSING AND VISION SYSTEMS  9
Two and three dimensional images-spatial and frequency domain representation-noise and edges-convolution masks-Processing techniques-thresholding-noise reduction-edge detection-segmentation-Image analysis and object recognition.

L : 45 TOTAL : 45 PERIODS

TEXT BOOK

REFERENCES