SAVITRIBAI PHULE PUNE UNIVERSITY

Syllabus

T. E. Instrumentation & Control

(2015 Course- Credit Base)

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Coordinator

(Board of Studies)

Instrumentation & Control Engineering

Savitribai Phule Pune Univeristy

Structure for T. E. Instrumentation and Control - 2015 course (Credit based)

SEMESTER- I

CODE	SUBJECT	TEACHING SCHEME		EXAMINATION SCHEME						Credits	
				Paper		PR	TW	Oral	Total	Theory	PR/OR/ TW
		TH	PR	In Semester Assessment	End semester Assessment						
306261	Embedded System Design	4	2	30	70	50	-	-	150	4	1
306262	Instrumental Methods for Chemical Analysis	4	2	30	70	-	-	50	150	4	1
306263	Control System Components	4	2	30	70	-	-	50	150	4	1
306264	Control System Design	4	2	30	70	50	-	-	150	4	1
306265	Industrial Organisation and Management	3	-	30	70	-	-	-	100	3	-
306266	Numerical Methods	-	2	-	-	-	25	-	25	-	1
306267	Seminar	-	1	-	-	-	25	-	25	-	1
	# Audit Course- 3	-	-	-	-	-	-	-	-	-	-
Total		19	11	150	350	100	50	100	750	25	

 # Students can opt for any other audit course from the list of Audit Course of any branch of engineering

Savitribai Phule Pune Univeristy

Structure for T. E. Instrumentation and Control - 2015 course (Credit based)

SEMESTER- II

CODE	SUBJECT	TEACHING SCHEME		EXAMINATION SCHEME						Credits	
				Paper						Theory	PR/OR /TW
		TH	PR	In Semester Assessment	End semester Assessment	PR	TW	Oral	Total		
306268	Digital Signal Processing	4	2	30	70	50	-	-	150	4	1
306269	Process Loop Components	4	2	30	70	50	-	-	150	4	1
306270	Unit Operations & Power Plant Instrumentation	4	-	30	70	-	-	-	100	4	-
306271	Instrument and System Design	4	2	30	70	-	-	50	150	4	1
306272	Bio- Medical Instrumentation	4	2	30	70	-	-	50	150	4	1
306273	Mini Project	-	2	-	-	-	50	-	50	-	1
	# Audit Course- 4	-	-	-	-	-	-	-	-	-	-
Total		20	10	150	350	100	50	100	750	25	

 # Students can opt for any other audit course from the list of Audit Course of any branch of engineering

SEMESTER- I

306261: Embedded System Design

Teaching Scheme:	Examination Scheme:	Credits:
Lectures: 4 Hrs/ Week	Paper: (30+70) 100 Marks	Theory: 4
Practical: 2 Hrs/ Week	In semester Assessment: 30 Marks	Practical: 1
	End Semester Assessment: 70 Marks.	
	Practical: 50 Marks	

Prerequisites: Students should be familiar with Digital Electronics, Digital Logic Design.

Course Objectives:

- To Understand the architectural detail of 8051 & AVR microcontroller
- To Develop ability to program the 8051 & AVR microcontroller
- To Develop ability of combining of software & Hardware of 8051 & AVR
- To develop ability to design and implement an application of embedded system

Course Outcome:

1. Students will be able to implement interfacing of devices with on chip peripherals of the microcontrollers
2. Students will be able to develop their own systems with necessary hardware and software.

Unit I:

Introduction to Microcontrollers & Embedded processors :

Architectural Overview & Features, The MCS-51 Microcontroller family, Block diagram of 8051, Pin Description, Connections of reset & oscillator pins, 8051 oscillator & clock , machine cycle, Memory Organization , Addressing Modes, Instruction Set, Assembler Directives, Generating loops, Delays, Software delay calculations, Programming examples, Programming in C.

Unit II:

Port , Timer/counter & interrupt s of 8051

I/O Ports and structure of all ports.

Timer/ counters, internal block diagram, Calculations for delays, Configuration of timers/ counters for generating delays, frequency measurements, pulse width measurement, event counting. Programming for Timers/Counters in Assembly and C

Interrupt structure, interrupt priority, vector addresses, interrupt configuration and handling, programming for interrupts. Concept of stack memory, working of stack memory and its role in subroutines and interrupt service routines.

Unit III:

Serial Communication & External world interfacing of 8051:

Serial Communication concept, Baud rate calculations, configuration of special function registers, programming for serial communications based on interrupt and polling.

Interfacing of LED Displays and multiplexed LED displays, LCD displays, Keyboards

Interfacing of parallel DAC & ADC, Programming for interfacing

Unit IV:

Real world interfacing to 8051 & Project based learning:

Interfacing of Sensors, Interfacing of Stepper motor, Relays, RTC

Interfacing of Serial ADC and Serial EEPROM

Project based learning of embedded system: Temperature controller to maintain the temperature at constant value with tolerance of +/- 2^0 C using interrupts, traffic light controller, Line tracer robot.

Unit V:

The AVR Microcontroller :

Introduction to AVR family, Features of AT Mega8535 Microcontroller, Architecture, Register File, Memory organization , Stack operation , port operation, Watch Dog timer, The AVR Instruction set & programming in Assembly and C

Interrupts in AVR Atmega8535, Interrupt handling, Interrupt priority

Unit VI:

Timer/counter, UART & ADC of AVR of Atmega8535

8 bit timer/counter 0 with PWM- Block diagram, clock sources, pre-scalar, counter unit, compare unit, compare match output unit , modes of operation, 8 bit timer counter register and programming of timer counter using assembly and C.

UART (Only Asynchronous receiver transmitter and not USART) – Baud Rate generation, frame formats, UART initialization, data transmission & Reception , UART register description

ADC of Atmega 8535 - Features, operation , starting conversion, pre-scaling, changing channel or reference selection, ADC registers and its Configuration .

List of Experiments :

Students are expected to perform Minimum 8 Experiments (5 from 8051 + 3 from AVR)

1. Basic Programs: Arithmetic logical operations, Code Conversions.
2. Basic Programs: Counting/Looping, Stack operations
3. Program for configuration of Timers as timers and counter for:
    a. Pulse width measurement
    b. Frequency measurement
    c. Square wave generation
4. Interfacing of Digital to Analog Converter or Analog to Digital Converter ICs.
5. Interfacing of LCD display.
6. Interfacing of Keyboard .
7. Program for transmitting data serially to PC.

AT Mega8535

8. Basic Programs: Arithmetic logical operations, Code Conversions.
9. A Square wave generation using timer counter in C language.
10. Configuration of ADC of Atmega 8535 using C language.
11. Interfacing of LCD display to AVR using C language.

Text Books:

1. The 8051 Microcontroller & Embedded Systems by M. A. Mazidi & J. G. Mazidi & Mckinlay, Pearson Prentice Hall.
2. Microcontrollers: Theory & Applications by Dr. A. V. Deshmukh, Tata McGraw Hill, Publications
3. Programming and Customizing the AVR Microcontroller by Dhananjay V. Gadre, Tata McGraw Hill Publishing Company Limited, 2003.
4. AVR microcontroller & Embedded System by A. Mazidi , Prentice Hall .

Reference Books:

1. The 8051 Microcontroller Architecture, Programming and Applications by Kenneth J. Ayala , Penram International Publications.
2. The 8051 Microcontroller by Scott Mackenzie , Prentice – Hall of India Private Limited , New Delhi
3. Internet resources for AVR:
    a. Atmel AVR Page:. http://www.atmel.com/images/doc2502.pdf
    b. http://www.atmel.in/Images/doc0856.pdf

306262: Instrumental Methods for Chemical Analysis

Teaching Scheme:	Examination Scheme:	Credits:
Lectures: 4 Hrs/ Week	Paper: (30+70) 100 Marks	Theory: 4
Practical: 2 Hrs/ Week	In semester Assessment: 30 Marks	Oral: 1
	End Semester Assessment: 70 Marks.	
	Oral : 50 Marks	

Prerequisites: Photonics and Instrumentation

Course Objectives:

1. To learn law of photometry
2. To learn and understand instrumentation for all types of spectroscopy
3. To learn separation methods such as chromatography and mass spectroscopy
4. To learn analysers

Course outcomes:

1. To understand working of Different analyzers
2. To understand working of all types of spectrometers which is based on law of photometry

Unit I:

Introduction:

A. Introduction to Chemical Instrumental Analysis, advantages over classical methods, classification, various units used in chemical analysis.
B. Introduction to Electro analytical methods, potentiometry, voltametry, coulometry

Unit II:

Spectrometric Methods-I

A. Laws of Photometry, UV-visible instrument component, photocolorimeters, single and double beam instruments, various types of UV-visible spectrophotometers.
B. Atomic absorption spectrophotometer: Principle, working, hollow cathode lamp, atomizer, back-ground correction.

Unit III:

Spectrometric Methods-II.

A. IR spectroscopy: Principle, IR sources, IR detectors, dispersive and Fourier Transform IR spectroscopy.
B. Atomic Emission Spectroscopy: Principle, types, Flame photometer, DC arc and AC arc excitation, plasma excitation.

Unit IV:

Spectrometric Methods-III and Miscellaneous Instruments

A. Fluorimeters and Phosphorimeters: Principle, spectrofluorimeters, spectrophosporimeter, Raman effect, Raman spectrometer
B. Nuclear Magnetic Resonance (NMR) spectrometry. Chemical shift principle, working of NMR, FT-NMR
C. Gas analysers: CO, $C0_2$, Hydrocarbons, 0_2, NO_X

Unit V:

Separative Methods

A. Mass Spectrometer(MS): Principle, ionisation methods, mass analyzer types - magnetic deflection type time of flight, quadrupole, double focusing, detectors for MS.
B. Chromatography: Classification, Gas chromatography: principle, constructional details, GC detectors, High Predominance Liquid Chromatography (HPLC): principle, constructional details, HPLC detectors

Unit VI:

Radioactive Instrumentation

A. X-ray spectrometry: Instrumentation for X-ray spectrometry, X-ray diffractometer: Bragg's law, Auger emission spectroscopy, Electron spectroscopy for chemical analysis(ESCA) .
B. Radiation detectors: Ionisation chamber, Geiger-Muller counter, proportional counter, scintillation counters.

List of Experiments :

Students are expected to perform Minimum 8 Experiments :

3. Study of filter photometer.
4. Study of flame photometer.
5. Study of optical densitometer.
6. Study of UV-visible spectrophotometer.
7. Study of Mass spectrometer.
8. Study of Gas Chromatograph.
9. Study of HPLC.
10. Study of Atomic Absorption Spectrophotometer.
11. Study of NMR.
12. Study of ESR.

Text Books:

1. Instrumental Methods of Analysis, Willard, Merritt, Dean, Settle, CBS Publishers & Distributors, New Delhi, Seventh edition.
2. Instrumental Methods of Chemical Analysis, Galen W. Ewing, McGraw-Hill Book Company, Fifth edition

Reference Books:

1. Introduction to Instrumental Analysis, Robert D. Braun, McGraw-Hill Book Company.
2. Principles of Instrumental Analysis, Skoog, Holler, Nieman, Saunders College Publishing, 1998.

306263: Control System Components

Teaching Scheme:	**Examination Scheme:**	**Credits:**
Lectures: 4 Hrs/ Week	Paper: (30+70) 100 Marks	Theory: 4
Practical: 2 Hrs/ Week	In semester Assessment: 30 Marks	Oral: 1
	End Semester Assessment: 70 Marks.	
	Oral: 50 Marks	

Prerequisites: DC/AC Motors, Flapper Nozzle Transducer.

Course Objectives:

1. Study of different electrical control system components like relays, switches
2. Study of construction, working and application of various pneumatic components
3. Study of different components used in a hydraulic systems
4. Study of Instrumentation safety methods

Course Outcome:

- Develop electrical circuits for motor operations
- Develop pneumatic circuits for the given application using appropriate pneumatic components
- Develop hydraulic circuits for the given application using appropriate hydraulic components

Unit I:

Industrial Control Devices:

1. Switches:

Construction, symbolic representation, working, application of Toggle switch, Slide switch, DIP switch, Rotary switch, Thumbwheel switch, Selector switch, Push button, Drum switch, Limit switch, Temperature switch, Pressure switch, Level switch, Flow switch.

2. Relays:

Construction, working, specifications/selection criteria and applications of electromechanical relay,

Reed relay, hermetically sealed relay, Solid state relays.

3. Contactors

Construction, working, specifications and applications of contactors. Comparison between relay & contactor.

Unit II:

Sequencing & Interlocking for Motors:

Standard symbols used for Electrical Wiring Diagram, Electrical Wiring Diagram in relation to motors:

- Concept of sequencing & Interlocking .
- Starting, Stopping, Emergency shutdown, (Direct on line, star delta)
- Protection of motors: Short circuit protection, Over load Protection, Low/Under Voltage Protection, Phase reversal Protection, Over temperature Protection.
- Reversing direction of rotation.
- Braking.

- Starting with variable speeds.
- Jogging/Inching

Motor Control Center: Concept and wiring diagrams

Unit III:

Introduction to Pneumatic, Hydraulic & Electrical systems & their Comparison

Pneumatics

Pneumatic components

- Pneumatic Power Supply and its components
- Pneumatic relay (Bleed & Non bleed, Reverse & direct)
- Single acting & Double acting cylinder
- Special cylinders: Cushion, Double rod, Tandem, Multiple position, Rotary
- Filter Regulator Lubricator (FRL)
- Pneumatic valves (direction controlled valves, flow control etc)
- Special types of valves like relief valve, pressure reducing etc.
- Time delay valve
- Air motors

Pneumatic Circuits

- Standard Symbols used for developing pneumatic circuits
- Sequence diagram (step-displacement) for implementing pneumatic circuits
- Different Pneumatic Circuits: Reciprocating, Sequencing, Anti-cycle repetition, Block transfer, Speed regulation etc

Unit IV:

Hydraulics

Hydraulic components:

- Hydraulic supply
- Hydraulic pumps
- Actuator (cylinder & motor)
- Hydraulic valves

Hydraulic Circuits

- Standard Symbols for developing hydraulic circuits
- Different Hydraulic Circuits: Meter in, Meter out, Reciprocating, speed control, Sequencing of cylinders, Direction control etc

Unit V:

Auxiliary components

Construction, working & applications of: Synchros, Feeders, Dampers, Alarm annunciator, High/low selectors, Flow totalizer, Computing relays, Seals, Snubber.

Circuit Breaker: Need of Circuit Breaker, Operating Principle, and Types. **Fuses:** Desirable characteristics, Materials according to rating, Terminology (Fusing Current, Current rating of fuse element, fusing factor) & Types of fuses.

Unit VI:

Fluidic Control Devices:

Characteristics, Principle of Operation, Bistable & Proportional Amplifier & applications.

Safety in Instrumentation & Control Systems:

Hazardous Area & Material classification as per NEC Standards, Explosion Proof Housing, Encapsulation, Sealing, & Immersion, Purging systems.

Intrinsic Safety: -Definition, Designing for intrinsic Safety, Isolation or Encapsulation (Series & Shunt Protective elements, & Zener barrier)

List of Experiments :

Students are expected to perform Minimum 8 Experiments :

1. Implementation of Logic Gates using relays.
2. Study of various pneumatic and hydraulic components and power supplies.
3. Implementation and testing of Pneumatic circuits.
4. Implementation and testing of Hydraulic circuits.
5. Study of Synchro transmitter and receiver system
6. Study of Pressure/temperature/level/flow Switches (any two).
7. Study of Motor control Center based on industrial visit.
8. Study and Calibration of P/I converter.
9. Demonstration & study of auxiliary components like, flow totalizer, Alarm annunciator, computing relay (any two)
10. Designing intrinsic safety circuits (Zener barriers)

Text Books:

1. Industrial Electronics, Petruzella, McGraw-Hill
2. Pneumatic Instrumentation, Majumdhar, TMH
3. Industrial Hydraulics, Pipenger
4. Process Control, Instrument Engineering Hand book, B.G. Liptak, Butterworth-Heinemann Ltd

Reference Books:

1. Pneumatics, Festo Didactic
2. Hydraulics, Festo Didactic

306264: Control System Design

Teaching Scheme:	Examination Scheme:	Credits:
Lectures: 4 Hrs/ Week	Paper: (30+70) 100 Marks	Theory: 4
Practical: 2 Hrs/ Week	In semester Assessment: 30 Marks	Practical: 1
	End Semester Assessment: 70 Marks.	
	Practical: 50 Marks	

Objectives:

- To understand the user specification and analyze the system in time and frequency domain.
- To design the compensator for the required specifications.
- To tune PID controllers using classical approach (analytical and experimental) to satisfy the user requirements.
- To Analyze and design the control systems using modern control approach.
- To analyze performance of the system.

Outcomes: After completion of this course students are able to

1. Analyze the system in time and frequency domain.
2. Design the compensator for required specifications using classical mathematical tools.
3. Tune the PID controllers using classical approach.
4. Design the controllers using direct synthesis approach.
5. Design the state feedback controllers and observers.
6. Analyze the controller performance using performance indices.

Unit I:

Compensators and compensator design (root locus approach):

Need of compensators, types of compensators (series, feedback and feed-forward – introduction only). Types of series compensators (lead, lag, lag-lead) and their transfer functions, Electrical lead, lag and lag- lead compensating networks. Root locus approach: Effect of addition of zero, addition of pole. Design of lead, lag and lag-lead compensator using root locus approach.

Unit II:

Compensator design (Frequency response approach)

Frequency response of lag, lead and lag-lead compensator. Compensator design using Bode plot approach: Lead, lag and lag-lead compensator design using Bode plot approach.

Unit III:

Control actions and Controller tuning

Control actions (ON-OFF, proportional, integral, derivative, proportional plus integral, proportional plus derivative, proportional plus integral plus derivative, Controller tuning by Ziegler-Nichols methods (step response reaction curve method and frequency response method), Cohen Coon tuning method, Obtaining controller settings (k_p,T_i,T_d) through Ziegler-Nichols frequency response method

using Routh array and Bode plot approaches.

Unit IV:

Controller Design

Design of PI/PD/PID controller for getting required performance specifications (damping factor, natural frequency, steady state error, phase margin, static error constants) using root locus and Bode plot approaches, Direct synthesis of controller, controller design for systems with and without dead time through controller synthesis formula.

Unit V:

Analysis of control system in state space

State transition matrix: Definition, derivation and properties, computation by Laplace transform method, Cayley Hamilton method, Similarity transformation method, solution of state equation, diagonalisation of plant matrix through similarity transformations, Vander monde's matrix, concept of controllability: definition, derivation for the necessary and sufficiency condition for complete state controllability, controllability matrix, concept of observability: definition, derivation for the necessary and sufficiency condition for complete state observability, observability matrix,

Unit VI:

Design concepts in state space

State variable feedback, control system design via pole placement: necessary and sufficiency condition, derivation for state feedback gain matrix K through sufficiency condition, Ackermann formula, coefficient comparison method. State observer: necessity, types, theory, principle of duality between state feedback gain matrix K and observer gain matrix K_e , design of full order state observer, concept of performance indices: ISE, IAE, ITAE, ITSE.

List of Experiments :

Students are expected to perform Minimum 8 Experiments :

1. Study of magnitude and phase characteristics of lead, lag and lag-lead compensator.
2. Design a lead / lag compensator for getting desired specifications by root locus approach.
3. Design a lead / lag compensator for getting desired specifications by Bode plot approach.
4. Simulation of controller settings of P,PI,PID controllers (k_p,T_i,T_d) obtained through Ziegler-Nichols first and second method, Cohen-Coon method.
5. Design of PI/PD/PID controller for getting required performance specifications (damping factor, natural frequency, steady state error, phase margin, static error constants) using root locus and Bode plot approaches.
6. Design a controller using direct controller synthesis for getting specified closed loop response.
7. Conversion of transfer function model to state space and vice-versa.
8. Check for complete state controllability and complete state observability of a given system.
9. Design a state feedback controller through pole placement.
10. Design full order state observer using principle of duality between state feedback gain matrix K and observer gain matrix K_e.

11. Performance comparison two controller tuning methods (experiment number 4) based on performance indices such as ISE, IAE, ITAE and ITSE.

Text Books:

1. B. S. Manke, “Control System Design”, 1st ed., Khanna Publishers, New Delhi, 2007.
2. I. J. Nagrath, M. Gopal, “Control System Engineering”, 3rd ed., New Age International Publishers, 1999.
3. K. Ogata, “Modern Control Engineering”, 2nd ed., PHI, New Delhi, 1994.

Reference Books:

1. Norman S. Nise, “Control System Engineering”, 4th ed., John Wiley and Sons, 2003.
2. B. C. Kuo, “Automatic Control Systems”, 3rd ed., PHI New Delhi, 1979.
3. Graham C. Goodwin, Stefan F. Graebe and M. E. Salgado, “Control system Design”, PHI, New Delhi, 2002.

306265: Industrial Organisation and Management

Teaching Scheme:	Examination Scheme:	Credits:
Lectures: 3 Hrs/ Week	Paper: (30+70) 100 Marks In semester Assessment: 30 Marks End Semester Assessment: 70 Marks.	Theory: 3

Course Objectives:

- To get awareness about various domains in Industrial Management.
- To understand concept of Quality Management, Financial Management and Project Management.
- To learn Human Resource Management as one of the major tasks in industry.
- To promote Entrepreneurship.

Course Outcomes:

After successfully completing the course students will be able to :

1. Get overview of Management Science aspects useful in Industry.
2. Get motivation for Entrepreneurship

Unit I:

Industrial Management and Business organization:

Definition of business, characteristics and classifications, objectives, types of business organizations- characteristics, levels of management, characteristics and objectives. Hierarchical structure and organization of group, Functions of management- *forecasting, organizing, directing, motivating, planning, co-ordinating, controlling, communication, leadership etc.*

Developing Business environment: SWOT analysis, BCG Matrix, Porter's 5 forces of competition. Management techniques for developing strategy viz., Balanced score card, Performance Management and analysis techniques viz. Ishikawa diagrams, Business process Re-engineering

Unit II:

Quality, Inspection and Environment Management :

Quality Circles/ Forums, Quality Objectives, use of Statistical Process Control, Introduction to ISO 9000

Inspection: objectives, Principles, standards, Qualities of inspector, Role of R & D, Innovation, Business expansion, Diversion, Mergers and Takeovers

Environmental pollution:- ecology, factors causing pollution, effect of pollution on human health, Air pollution control, sources of pollution water pollution and control, solid waste management

Environmental norms: ISO 14000

Unit III:

Production Planning, Inventory Control and Supply Chain Management:

Manufacturing Excellence, Outsourcing, Production planning techniques, Purchase and Inventory Management, inventory control using Economic Order Quantity, Minimum Order Quantity, Ordering

Level, store keeping, Finished goods, semi finished goods, raw material handling and storage, Value Addition, Supply Chain concepts and management for leveraging profit

Unit IV:

Human Resources Management:

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

Unit V:

Financial Management:

Capital Structure, Fixed & Working Capital, Sources of finance, Assets management,

Introduction to capital budgeting, Methods of capital budgeting**:** Budget definition and concept, objective of budget, type of budget, preparation of budget, Balance Sheet, function of money market and capital Market

Unit VI:

Professional and Business ethics, IT and e-business:

Concept of Ethics, ethics and morals, business ethics, Professional ethics. Need for professional and business ethics.

Introduction to Management Information System (MIS), Enterprise Resource Planning Systems (ERP), e-business and strategies

Text Books:

1. Industrial organization and Engineering Economic- T. R. Banga and S. C. Sharma, Khanna Publication.
2. Industrial Engineering and Management- O.P. Khanna, Dhanpat Rai Publication.

Reference Books:

1. Business Poly – Azar Kazmi
2. Resisting Intellectual property – Halbert, Taylor & Francis – 2007 – PHI
3. Management in Engineering- Gail Freeman- Bell and James Balkwill (PHI).
4. The New Era of Management – R. L. Daft, THOMSON (India Edition)
5. Modern Economic Theory- Dewett K. K.
6. Elementary Economic Theory- Dr. R. D. Gupta.
7. Business organization and Management- M.C. Shukla.

306266: Numerical Methods

Teaching Scheme:	**Examination Scheme:**	**Credits:**
Practical: 2 Hrs/ Week	Term Work: 25 Marks	Term Work: 1

Prerequisites: Required knowledge of programming language C / MATLAB.

Objectives:

- To understand fundamental methods required for scientific data analysis.
- To apply a range of mathematical and technical concepts and methods to Control Engineering.
- Understand fundamentals methods required for scientific data analysis

Outcome:

1. Apply range of mathematical and technical concepts to applications.
2. Methods to learn control engineering.
3. Able to find numerical solution.
4. Able to solve numerical methods using software (C/Matlab).
5. Able to develop the algorithm to implement mathematical solutions of any Problem

List of Experiment:

Write and execute a program using C//MatLab/SciLab with algorithm and flowchart

1. To find the roots of non-linear equation using Bisection method & Newton's method.
2. To fit the curve by least – square approximation.
3. To solve the system of linear equations using Gauss-Elimination method.
4. To integrate numerically using Trapezoidal rule.
5. To Integrate numerically using Simpson's rules.
6. To find numerical solution of ordinary differential equations by Euler's method.
7. To find numerical solution of ordinary differential equations by Runge-Kutta method.
8. To find the largest Eigen value of a matrix by power-method.

Note: All Practical's are compulsory

Reference Book:

1. E. Balguruswami, "Numerical Methods", Tata McGraw Hill Publication.

2. M. K. Jain, S. R. K. Tyengar, R. K. Jain, "Numerical Methods for Scientific and Engineering Computation", New Age International Publishers

306267: Seminar

Teaching Scheme:	**Examination Scheme:**	**Credits:**
Practical: 1 Hr/ Week	Term- Work : 25 marks	Term Work: 1

The term work will consist of a report prepared by every student on the seminar topic allotted to them and presentation. The student is expected to submit the seminar report in standard format approved by the University. The topic for the seminar should necessarily be out of syllabus and relevant to the latest trends in Instrumentation and Control.

SEMESTER- II

306268: Digital Signal Processing

Teaching Scheme:	Examination Scheme:	Credits:
Lectures: 4 Hrs/ Week	Paper: (30+70) 100 Marks	Theory: 4
Practical: 2 Hrs/ Week	In semester Assessment: 30 Marks	Practical: 1
	End Semester Assessment: 70 Marks.	
	Practical: 50 Marks	

AIM: To study the digital signal processing algorithms.

Prerequisite: Z-transforms and its properties, Fourier transforms and its properties.

Course objectives:

- To learn the basic concepts and properties of discrete-time signals and systems.
- To learn the frequency domain characteristics of discrete-time signals and systems.
- To design and implement digital filter design techniques.

Course outcomes:

The students will able

1. To compute the response of discrete-time systems to various input signals.
2. To evaluate and analyze the frequency domain characteristics of discrete-time systems
3. To design and implement different frequency selective FIR and IIR filters.

Unit I:

Introduction, signals and systems

Basic elements of Digital Signal Processing (DSP), analog to digital conversion (ADC), comparison between DSP and Analog Signal Processing (ASP) with applications of DSP. Discrete-time signals and systems: classification of signals, sampling process/theorem, aliasing effect and reconstruction, classification of systems, input-output description of systems, Block-digram representation of discrete-time systems.

Unit II:

Analysis of discrete-time systems

Linear convolution, causality and stability of discrete time systems, autocorrelation, crosscorrelation, z-transform and its properties, solving difference equations and analysis of discrete-time systems in z-domain, transfer function, pole-zero plot. Implementation of discrete-time systems: Structures for the realization, Finite Impulse Response (FIR) and Infinite Impulse Response (IIR) structures.

Unit III:

Frequency analysis of discrete-time signals

Frequency response of LTI systems, ideal frequency selective filters, magnitude and phase response, Discrete-time Fourier Series, properties of DFS, The Discrete Time Fourier Transform (DTFT), symmetry properties and theorems of DTFT. Energy density spectrum and power density spectrum.

Unit IV:

Discrete Fourier Transform (DFT)

Discrete Fourier transform (DFT), properties of DFT, symmetry properties, circular convolution, linear filtering methods based on DFT, Frequency analysis of signals using DFT, Efficient computation of DFT, Fast Fourier Transform (FFT) algorithms: radix-2 decimation-in-time (DIT) and decimation-in-frequency (DIF)FFT algorithms.

Unit V:

Design of digital IIR filters from analog filters

Introduction to analog IIR filters, Butterworth approximation, Chebyshev approximation. Design of digital IIR filter: impulse invariance method, bilinear transformation, approximation derivative method. Frequency transformations in analog and digital domain.

Unit VI:

Design of FIR filters

Introduction to FIR filters, linear phase filters, symmetric and anti symmetric filters, FIR design by Fourier approximation, window method, frequency sampling method, comparison between FIR and IIR filters.

List of Experiments :

Students are expected to perform minimum 10 experiments using MATLAB or equivalent software:

1. Write a Program to generate the basic signals.
2. Write a Program to implement the basic operations on the given signals.
3. Write a Program to implement Linear Convolution of the two given sequences.
4. Write a Program to obtain the auto-correlation and Cross-correlations of the given sequences.
5. Write a Program to obtain the transfer function and plot is pole-zero plot
6. Write a Program to find the DTFT of the given sequence and plot its magnitude and phase plot.
7. Write a Program to find the DFT of the given sequences. Plot its magnitude and phase plot. Also find its IDFT to obtain the original sequence.
8. Write a Program to obtain the circular convolution of the two given sequences.
9. Write a Program to obtain the linear convolution using circular convolution of two given sequences.
10. Write a Program to obtain the DFT of the given sequences using DIT-FFT algorithm and plot its magnitude and phase spectrum.
11. Write a Program to obtain the DFT of the given sequences using DIF-FFT algorithm and plot its magnitude and phase spectrum.
12. Write a Program to design and implement FIR filters using difference windowing methods.
13. Write a Program to design and implement IIR filters (Using Butterworth or Chebyshev approximations).

Text Books:

1. A. V. Oppenheim and R. W. Schafer, “Discrete Time Signal Processing”, Pearson Education.
2. J. G. Proakis and D. J. Manolakis, “Digital Signal Processing: Principles, Algorithms and Applications”, PHI, 2000.
3. P. Ramesh Babu, “Digital Signal Processing”, Sci- Tech Publications.
4. A. Nagoor Kani, “ Digital Signal Processing”, Mc Graw Hill Publications, 2nd Edition.

Reference Books:

1. B. Porat, “A Course in Digital Signal Processing”, J. Wiley and Sons.
2. J. R. Johnson, “Introduction to Digital Signal Processing”, PHI.
3. Rabiner, Gold, “Theory and Applications of Digital Signal Processing”, TMH.
4. S. K. Mitra, “Digital Signal Processing-A Computer Based Approach”, MGH
5. E. C. Ifeachor and B. W. Jervis, “Digital Signal Processing-A practical Approach”, Addison-Wesley publication

306269: Process Loop Components

Teaching Scheme:	Examination Scheme:	Credits:
Lectures: 4 Hrs/ Week	Paper: (30+70) 100 Marks	Theory: 4
Practical: 2 Hrs/ Week	In semester Assessment: 30 Marks	Practical: 1
	End Semester Assessment: 70 Marks.	
	Practical: 50 Marks	

Prerequisites: Basics of Feedback Control System

Course Objectives:

- To Understand the basic concepts of Process control.
- To study the need, construction, working , types of process control components like transmitters, controllers, converters, control valves.
- Study of Programmable Logic controller as an automation tool.
- To Develop ability to program Programmable Logic controller

Course Outcome:

1. Configuration and calibration of process control components like transmitters, convertors
2. Select of transmitter, convertor, Control action and final control element for the given application
3. Demonstrate PLC programming skill for industrial application.

Unit I:

a. Fundamentals of process control:

Elements of process control loop, Concept of Process variables, set point, controlled variable, manipulated variable, load variable. Representation of Process loop components using standard symbols (basics with reference to control loop), and Examples of process loops like temperature, flow, level, pressure etc.

b. Transmitters:

Need of transmitter (concept of field area & control room area), Need for standardization of signals, Current, voltage, and pneumatic signal standards, Concept of live & dead zero.

Types of transmitters:

Two and four wire transmitters, Electronic and Pneumatic transmitters

Electronic Capacitive Differential Pressure Transmitter: Types, Mounting (Installation), Manifold, Calibration setup, Application of DPT for Level measurement, Zero elevation, suppression, Square root extractor.

SMART: Comparison with conventional transmitter, Block schematic, Introduction to Wireless transmitters.

Unit II:

Controller Basics

Process Characteristics

- Process load, Process lag, Self Regulation, Distance/velocity lag (dead time), Capacity.

Control System Parameters

- Error, Variable Range, Control Lag, Cycling, Direct/Reverse Action.

Control Actions

Discontinuous: ON/OFF, Multiposition Control, Floating Control.

Continuous: Proportional (offset), Integral (Reset windup), Derivative, Proportional- Integral, Proportional- Derivative, Proportional- Integral-derivative, Antireset windup, Rate before Reset, Concept of Bump less transfers in PID controller, Effect of process characteristics on PID combination, Selection & application of controller actions.

Unit III:

Tuning of controller: Different Criteria like Quarter Amplitude Decay Ratio, Loop disturbance, Optimum Control, Measure of Quality, Stability Criteria.

Tuning Methods: Process Reaction Curve (open loop), Ziegler Nichols (closed loop), & Frequency Response Method.

Digital PID controllers: Velocity & Position algorithm, Block Schematic, Faceplate of Digital controller, Introduction to Direct Digital Control.

Current to pneumatic converter & Pressure to Current converter

Unit IV:

Programmable Logic Controller (PLC)

Continuous versus Discrete Process Control, Relay based ladder diagram using standard symbols, Limitations of relay based system. Architecture of PLC, Types of Input & Output modules (AI, DI, DO, AO), Wiring diagram, Interfacing pneumatic & Hydraulic systems to PLC, Fixed & Modular PLC (Rack, slot, grouping), PLC specifications, PLC manufacturers, PLC Basic instructions, Timers (ON delay, OFF delay & Retentive) & Counters with timing diagrams, PLC ladder diagram, PLC programming for process applications, Introduction to analog programming.

Unit V:

Control valve

Necessity, comparison with other final control elements,

Control valve Characteristics: (Inherent & Installed)

Control valve terminology: Rangeability, Turndown, valve capacity, viscosity index, AO, AC (Fail Safe Action) etc. Classification of control valve based on: valve body. Construction, type of actuation, application etc. Construction, Advantages, Disadvantages & applications of Globe: Single, double, 3way, angle, Gate, Needle, Diaphragm, Rotary valves, Ball, Butterfly.

Types of actuators: Construction, Advantages, Disadvantages & applications: Spring

Diaphragm & Smart actuators.

Control valve accessories:

Positioners: Applications/Need, Types, Effect on performance of Control valves. Solenoid valves, Hand wheel.

Unit VI:

Control Valve Sizing

C_v sizing concept & basic equations

Designing control valve for gas, vapor and liquid services: Valve sizing by ANSI/ISA 75.01 STD, Valve capacity testing by ANSI/ISA 75.02

Effect and remedies of cavitations and flashing.

Control valve noise generation and remedies

High temperature and High-pressure service valves

Control valve dynamic performance.

Control valve application & selection

List of Experiments :

Students are expected to perform Minimum 8 Experiments :

1. Study of D.P. Transmitter and its application for flow or level.
2. Study of Square Root Extractor.
3. Study and Calibration of I/P converter
4. Study & verification of different control actions (P, I, D, PI, PD, PID) for step Input.
5. Tuning of PID controller
6. Study of Control valve & plot the characteristics of Control valve
7. Control valve design using any software package.
8. Study of PLC and PLC Programming.
9. Study & Implementation of cascading of Timers and Counters
10. Interfacing PLC to hydraulic & pneumatic circuits

Text Books:

1. Process control and Instrument technology, C.D.Johnson, TMH
2. Instrumentation for Process measurement and control, N.A. Anderson, CRC Press
3. Introduction to Programmable Logic Controller, Gary Dunning, DELMAR Cengage Learning.
4. Programmable Logic Controller, Webb, PHI
5. Process Control, Instrument Engineering Hand book, B.G. Liptak, Butterworth-Heinemann Ltd

Reference Books:

1. Tuning of Industrial control systems, ISA
2. Control valve Handbook, ISA
3. Process Instruments and Controls Handbook, Douglas M. Considine, McGraw-Hill.
4. Programmable Logic Controller, NIIT
5. Fundamentals of Process Control Theory, Paul Murrill, ISA
6. Lessons In Industrial Instrumentation, By Tony R. Kuphaldt, Version 0.4 – Released January 11, 2009.

306270: Unit Operations and Power Plant Instrumentation

Teaching Scheme:	**Examination Scheme:**	**Credits:**
Lectures: 4 Hrs/ Week	Paper: (30+70) 100 Marks	Theory: 4
	In semester Assessment: 30 Marks	
	End Semester Assessment: 70 Marks	

AIM:

The course is designed to familiarize the student with the functions and instrumentation available in a modern power generation plant.

COURSE OBJECTIVES:

- To provide knowledge of Basics knowledge & Understanding of various Unit Operations used in Industry.
- To provide an overview of different methods of power generation with a particular stress on thermal power generation.
- To bring out the various measurements involved in power generation plants.
- To provide knowledge about the different types of devices used for analysis.
- To impart knowledge about the different types of controls and control loops.
- To familiarize the student with the methods of monitoring different parameters like speed, vibration of turbines and their control.

Unit I:

Basics of Chemical engineering unit operations like; Fluid flow processes, including fluids transportation, filtration, and solids fluidization., Heat transfer processes, including evaporation, condensation, and heat exchange, Mass transfer processes, including gas absorption, distillation, extraction, adsorption, and drying, Thermodynamic processes, including gas liquefaction, and refrigeration, Mechanical processes, including solids transportation, crushing and pulverization, and screening and sieving. Basic concepts behind pumps, compressors, fans, blowers etc**.**

Unit II:

A. **Heat Transfer:** Importance of heat transfer in Chemical Engineering operations, Principles of heat flow in fluids, Heat transfer to fluids without phase change, Heat Transfer to fluids with phase change, Heat Exchange equipment, Evaporation Principle & types of evaporation, Crystallization: Definition, Nucleation and Crystal Growth.

B. Mass Transfer: Distillation: Vapor- Liquid Equilibrium, Ideal Solutions, Relative volatility, Azeotropic mixtures, Methods Of distillation: Flash, Continuous, Multi-component system, Material balance and Analysis of Fractionating column by McCabe Thiele method.

Drying: Theory and Mechanism of Drying, Steady and Unsteady Drying, moisture content, total time of drying, Characteristics, Classification and selection of Industrial dryers.

Unit III:

A. Energy sources, their availability, worldwide energy production, energy scenario of India. Introduction to Power generation: **Classification:** Renewable and non-renewable energy generation resources. **Renewable: S**mall Hydro, modern biomass, wind power, solar, geothermal and bio-fuels. **Nonrenewable:** fossil fuels (coal, oil and natural gas) and nuclear power.

Hydroelectric Power Plant: Site selection, Hydrology, classification of Hydropower plants, Types of Turbines for hydroelectric power plant, pumped storage plants, storage reservoir plants.

Wind Energy: Power in wind, Conversion of wind power, types of wind turbine, and modes of operation, wind mill, wind pumps, wind farms, safety.

Solar Energy: Solar resource, solar energy conversion systems: Solar PV technology: Block diagram of PV system, advantages and limitations. Solar thermal energy system: Principle, solar collector and its types, solar concentrator and its types, safety.

Nuclear Power Plant: Nuclear power generation, control station and reactor control.

Unit IV:

A. Thermal Power Plant- Method of power generation, layout and energy conversion process, material handling systems.

B. Boiler: Types of boilers like FBC, CFBC, DIPC, Fluidized Bed, boiler safety standards, Combustion control, air to fuel ratio control, three element drum level control, steam temperature and pressure control, burner management systems, boiler interlocks. Instrumentation for Boiler ancillaries viz. water treatment, electro-static precipitator, soot blower, economizer, de aerator, super heater, chemical dosing systems, air pre-heater, coal and ash handling systems, fuel storage and distribution, Bag House Filters.

Unit V:

Excess Air –Combustion Chemistry and products of Combustion- Requirements of Excess Combustion air –Calculation of efficiency of boilers –Input /output method – Heat loss method.

Types of Turbines, Turbine instrumentation and control, start-up and shut-down, thermal stress control, condition monitoring & power distribution instrumentation. Synchronous, Induction generators Speed, Vibration, shell temperature monitoring and control-steam pressure control – lubricant oiltemperature control – cooling system

Unit VI:

Comparison of thermal power plant, hydroelectric power plant, wind, solar, nuclear power plant on the basis of: Performance, efficiency, site selection, Economics-capital and running, safety standards, pollution, effluent management and handling. Power plant safety, Pollution monitoring, control Sound, Air, smoke, dust, study of Electrostatic precipitator

Text Books:

1. McCabe, W.L., Smith, J.C., and Harriot, P., “Unit Operations in Chemical Engineering”, McGraw-Hill VII Edn., 2004.
2. Boiler Control Systems, David Lindsley, Mc-Graw Hill
3. Power Plant Engineering, P.K.Nag, 3rd edition, 2010. McGraw Hill.
4. Power Plant Instrumentation, K. Krishnaswamy, M. PonniBala, PHI Learning Pvt. Ltd., 2011

Reference Books:

1. Process Control, B.G. Liptak
2. Power Plant Engineering, Domkundwar
3. Non-conventional energy resources.by B. H. Khan, McGraw Hill, New Delhi.
4. Renewable energy Technology.Chetan Singh Solanki, Prentice Hall Publication.
5. Solar Energy, by S. P. Sukhatme, Tata McGraw Hill, New Delhi.
6. Nonconventional Energy Sources. G. D. Rai, Khanna Publication.
7. Energy Management Handbook: W.C. Taeruer
8. Pollution: M.N.Rao and H.V. Rao.

306271: Instrument and System Design

Teaching Scheme:	Examination Scheme:	Credits:
Lectures: 4 Hrs/ Week	Paper: (30+70) 100 Marks	Theory: 4
Practical: 2 Hrs/ Week	In semester Assessment: 30 Marks	Oral: 1
	End Semester Assessment: 70 Marks.	
	Oral: 50 Marks	

Prerequisites: Basic Electronics Engineering

Course Objectives:

- To learn and understand basic electronics system design and related standards
- To learn and understand concept of grounding, shielding, EMI/EMC and ESD effects
- To learn and understand application based ICs and some basics of PCB technology

Course Outcomes:

1. Designing of signal conditioning circuits.
2. Identify application areas of the special ICs and their designing.
3. Basic PCB designing

Unit I:

Basic concepts of instrument design:

Functional requirements and instrument specifications, Basics of standards used, NEMA and IP standards with special reference to packaging standards, Operational environment, Prototyping and testing.

Unit II:

Guidelines for enclosure, components and accessories:

Grounding and shielding techniques, noise in electronic circuits, EMI and EMC, Source of EMI, Protection against EMI, EMI and EMC effects minimization methods, ESD, Protection against ESD, Control panel layout, Ergonomics and Asthetics.

Unit III:

Analog system design guidelines and application:

Single chip devices instrumentation amplifiers AD620, Linear opto isolator HCNR201, V to I converters XTR110, Signal conditioners AD594/595, Phase angle control TCA785.

Unit IV:

Digital system design guideline and application:

Single chip devices, Phase Locked Loop CD4046, Programmable counters ICM 7217, Digital Panel meters ICL7107, Optoisolator MCT2E, Power drivers ULN2803, CMOS Key Encoder MM74C922, DTMF Decoder MT8870 .

Unit V:

Printed circuit board design guidelines:

General components layout scheme, PCB size, Mechanical stress, Design rules for analog and digital circuit PCB's, Single, Double, Multi layer and SMD boards, Artwork CAD packages, Soldering materials and techniques, Testing and Debugging.

Unit VI:

System performance and documentation:

Concept of reliability definition, Distinction between Quality and reliability, failures, Availability, Maintainability, (MTBF, MTTF, MTTR) Life Cycle and Bathtub curve, Reliability Modelling Exponential, Weibull and Gamma Distribution, Hazard rate and Derivation of MTTF Failure Density Function, Cumulative Distribution Function, Reliability, Importance of documentation in system design. Quality Assurance.

List of Experiments :

Students are expected to perform Minimum 8 Experiments and a Mini Project in a group of three students using any of the Integrated Circuit mention in the syllabus.

- Power supply for loop powered transmitters.
- Study and application of linear optoisolator HCNR201.
- Study and application of instrumentation amplifiers AD620.
- Study and application of signal conditioners AD594.
- Frequency multiplier using PLL CD4046.
- Study and application of ICL7107.
- Study and application of ULN2803.
- Study and application of optoisolator MCT2E.
- Study and application of TCA785.
- Study and application of MT8870.
- Designing of PCB on above any one application.

Text Books:

1. Electrostatic Discharge and Electronic Equipment, Warren Boxleitner IEEE press.
2. Printed Circuit Boards, Walter C. Bosshart, CEDT series, TMH.
3. Reliability Engineedng,.E. Baiguruswamy.
4. Noise Reduction Techniques, Ott.

Reference Books:

1. Process Control, B. G. Liptak.
2. Machine Design, V. B. Bhandari, Tata McGraw Hill.
3. Machine design Pandya Shah
4. Data manual for analog and digital lCs by - National semiconductors, Analog Devices, SGS Thompson, Texas, Motorola.

306272: Bio- Medical Instrumentation

Teaching Scheme:	Examination Scheme:	Credits:
Lectures: 4 Hrs/ Week	Paper: (30+70) 100 Marks	Theory: 4
Practical: 2 Hrs/ Week	In semester Assessment: 30 Marks	Oral: 1
	End Semester Assessment: 70 Marks.	
	Oral: 50 Marks	

Prerequisites: Required knowledge of basic body functioning.

Objectives:

- Learn the basics of physiology and anatomy of cardiovascular, nervous and respiratory system of Human body and their biopotentials measurement.
- To learn various biosensors and biotransducres.
- Design a system to acquire and measure bio potentials.
- To Understand the working of ECG, EEG recorders.
- To learn functioning of sensory organs and related instruments.

Course Outcomes:

1. Learn working of various biomedical instruments
2. Able to calibrate and design biomedical instruments to record various physiological parameters.

Unit I:

Bio-potential Measurement:

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

Bio-transducers:

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

Unit II:

Cardiovascular System:

Heart Structure, Cardiac Cycle, ECG Theory, ECG Electrodes, Electrocardiograph, Vector cardiograph

Analog Signal Processing of Bio-signals, Amplifiers, Transient Protection, Interference Reduction, Movement Artifact Circuits, Active Filters, Rate Measurement, Averaging and Integrator Circuits, Transient Protection Circuits

Unit III:

Cardiovascular Measurements:

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

Unit IV:

Central Nervous System :

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 V:

Special Senses:

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,)

Unit VI:

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

List of Experiments :

Students are expected to perform Minimum 8 Experiments.

- To study bio electrodes.
- To study various preamplifier used in biomedical applications.
- To Study and Check Specifications of an ECG Recorder.
- To Design and Implement basic ECG Amplifier/ Calibrator.
- To Measure Blood Pressure Using Sphygmomanometer, Calibration of BP apparatus
- Study of Audiometer.
- To study Phonocardiogram.
- To record/monitor heart sounds using Stethoscope.
- To Develop a Photo-plethysmography Sensor for Pulse Rate Measurement.
- To study the oxygenators.
- To Design a Notch Filter for Power Line Frequency.
- To study blood flow meters.
- To Implement a Heart Rate Meter.

- To Study EEG/EMG

Text Books:

1 Human Physiology- The Mechanism of Body Function By Vander, Sherman, TMH Ed.1981
2 Introduction To Biomedical Equipment Technology By Carr & Brown
3 Biomedical Instrumentation and Measurements By Cromwell, 2nd edition, Pearson Education.
4 Handbook of Biomedical Instrumentation By R. S. Khandpur, TMH

Reference Books:

1 Biomedical Digital Signal Processing, Tompkins, PHI
2 Biomedical Instrumentation, Arumugam
3 Text book of clinical Ophthalmology- Ronald Pitts Crick, Pang Khaw, 2nd Edition, World Scientific publication. ISBN 981-238-128-7

306273: Mini Project

Teaching Scheme:	**Examination Scheme:**	**Credits:**
Practical: 2 Hrs/ Week	Term- Work : 50 marks	Term Work: 1

Course Objectives:

- To undertake & execute a Mini Project through a group of students.
- To understand the "Product Development Cycle", through Mini Project.
- To plan for various activities of the project and distribute the work amongst team members.
- To learn budget planning for the project.
- To inculcate electronic hardware implementation skills by –
  a. Learning PCB artwork design using an appropriate EDA tool.
  b. Imbibing good soldering and effective trouble-shooting practices.
  c. Following correct grounding and shielding practices.
  d. Knowing the significance of aesthetics & ergonomics while designing electronic product.
- To develop students abilities to transmit technical information clearly and test the same by delivery of Seminar based on the Mini Project.
- To understand the importance of document design by compiling Technical Report on the Mini Project work carried out.

Course Outcomes:

The student will be able to

- Planning and implementation of hardware/ software project .
- Prepare the budget for hardware requirement .
- Demonstrate the project .
- Work as a team member.

Maximum Group Size:

Minimum 2 and maximum 3 students can form a group for the mini project.

Project Type:

The selected mini project must be based on development of a prototype electronic system/product mandatorily having a hardware component with supporting software.

The Assessment Scheme will be:

a. **Continuous Assessment 25 marks** *(based on regular interaction, circuit development)*

b. **End Semester 25 marks** *(based on implementation, testing, results, poster presentation, and demonstration)*

Execution steps for Mini Projects:

1. Complete Paper work Design using datasheets specifying:
    a. Selection criteria of the components to be used.
    b. Specifications of system i/p and desired o/p.
    c. Module based hardware design.
    d. Test points at various stages in various modules
2. The circuit should be simulated using any of the standard simulation software available (either complete circuit to be simulated, if possible or an appropriate part of the circuit can be simulated).
3. Algorithm and the flow chart of the software part must be defined.
4. Result verification for hardware and testing the algorithms.
5. Comparison with the paper design to identify the discrepancies, if any. Justification of the same must be given.
6. Verified circuit should be assembled and tested on breadboard or general purpose board.
7. Simulation results and/or the snapshots indicating the current and voltage readings or detailing the test point results at various stages must be preserved and included in the project report.
8. Art work / layout of the circuit using standard layout tools.
9. Assembling and testing of circuit on final PCB.
10. Design and fabrication of suitable enclosure and outside fittings such as switches, Buttons, knobs, meters, indicators, displays etc.
11. Final testing of the circuit using the earlier defined test points.
12. Preparing Bill of components and materials.
13. Drawing entire circuit diagram (component level), outlining various blocks indicating test points, inputs and outputs at various stages on A3 graph sheet.

Domains for projects may be from the following, but not limited to:

- Instrumentation and Control Systems
- Electronic Systems
- Biomedical Electronics
- Power Electronics
- Embedded Systems
- Mechatronic Systems
- Agriculture Instrumentation.

A project report with following contents shall be prepared:

- Title
- Specifications
- Block diagram

- Circuit diagram
- Selection of components
- Simulation results
- PCB artwork
- Layout versus schematic verification report
- Testing procedures
- Enclosure design
- Test results
- Conclusion