5EIU01	SIGNALS & SYSTEMS	L	T	P	Marks
	Total Hours – 40	3	1	0	150

5EIU01 SIGNALS & SYSTEMS

3L+1T **MAX. MARKS-150**

Introduction: Continuous time and discrete time signals and systems, Properties of systems.

Linear time invariant systems- continuous time and discrete time, Properties of LTI systems and their block diagrams.

Convolution, Discrete time systems described by difference equations.

Fourier series representation of signals: Fourier series representation of continuous periodic signal & its properties. Fourier series representation of Discrete periodic signal & its properties. Continuous time filters & Discrete time filters described by Diff. equation.

Fourier transform: The continuous time Fourier transform for periodic and non-periodic signals, Properties of CTFT.

Discrete time Fourier transform for periodic and non-periodic signals, Properties of DTFT.

Z-transform & Laplace transform: The region of convergence for the Z-transform, The Inverse Z-transform, Two dimensional Z transform, Properties of Z transform.

Laplace transform: Properties of Laplace Transform, Application of Laplace transform to system analysis.

Sampling: Mathematical theory of sampling, Sampling theorem, Ideal & Real sampling, Interpolation technique for the reconstruction of a signal from its samples, Aliasing, Sampling in freq. domain, Sampling of discrete time signals.

TEXT BOOKS

1. Signals And Systems, Oppenheim, Willsky, Nawab, PHI.(1992)
2. Signals And Systems M J Roberts, Mc-Graw Hill.(2004)

REFERENCE BOOKS

1. Principles of Linear Systems And Signals, 2e (Intl. Version), Lathi 2nd, Oxford (2002)
2. Signal & Systems 3e, Chen 3rd, Oxford (2004)
3. Fundamentals of Signals And Systems, Wiley (2009)
4. Signals And Systems, P Rao, Mc-Graw Hill (2011)
5. Signals And Systems: A Simplified Approach, Ganesh Rao, 4e, Pearson (2012)
6. Signals And Systems: Continuous And Discrete, Roger E Ziemer, 4e, PHI (1998)
7. Signals And Systems, Ravi Kumar, PHI (2009)
8. Signals & Systems, Iyer, Cengage Learning (2009)

`LECTURE PLAN

Unit	Contents	Contact Hours
	Introduction	**8**
	Continuous time and discrete time signals and systems	2
	Properties of systems	1
	Linear time invariant systems- continuous time and discrete time	2
	Properties of LTI systems and their block diagrams.	1
	Convolution, Discrete time systems described by difference equations.	2
	Fourier series representation of signals	**8**
	Fourier series representation of continuous periodic signal & its properties	3
	Fourier series representation of Discrete periodic signal & its properties	3
	Continuous time filters & Discrete time filters described by Diff. equation	2
	Fourier transform	**8**
	The continuous time Fourier transform for periodic and non-periodic signals	2
	Properties of CTFT	2
	Discrete time Fourier transform for periodic and non-periodic signals	2
	Properties of DTFT	2
	Z-transform & Laplace transform	**8**
	The region of convergence for the Z-transform	1
	The Inverse Z-transform	1
	Two dimensional Z transform	1
	Properties of Z transform	2
	Properties of Laplace Transform	1

	Application of Laplace transform to system analysis	2
	Sampling	**8**
	Mathematical theory of sampling	1
	Sampling theorem	1
	Ideal & Real sampling	1
	Interpolation technique for the reconstruction of a signal from its samples	2
	Aliasing	1
	Sampling in freq. domain	1
	Sampling of discrete time signals	1
	Total	**40**

5EIU01 SIGNALS & SYSTEMS

Course Outcomes

The students of the course should be able to

CO1: Describe different types of signals and system and transformation from time domain to frequency domain. (K2)

CO2: Define equations for Convolution, Fourier Transform, Laplace Transform, Z Transform. (K1)

CO3: Analyze the properties of LTI system, analyze properties of Laplace, Fourier, Z-transforms and Distinguish various transformation. (K4)

CO4: Solve problems of Signals and System, convolutions, various transformations and sampling theory. (K3)

CO5: Explain various types of signals and systems, concept of sampling theorem, various types of conversions. (K2)

CO-PO Mapping **(**3 – Strong, 2 – Moderate and 1 – Weak) See **PO and PSO**

5EIU01 SIGNAL		**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**

S & SYSTEMS	**CO1**	3	3	2			1									
	CO2	3	3	2	1											
	CO3	3	2	2									1			
	CO4	3	3	3												
	CO5	1	2										1			

Content Delivery Method

•Class room lecture (chalk and board), (Marker and board) (D1)

•Visual presentation (D2)

•Tutorial (D3)

CONTROL SYSTEM II

5EIU03	**CONTROL SYSTEM II**	**L**	**T**	**P**	**Marks**
	Total Hours – 37	**3**	**0**	**0**	**150**

5EIU03 CONTROL SYSTEM II

3L+0T **MAX. MARKS-150**

State space Model- Review of vectors and matrices, Canonical Model from Differential Equations and Transfer Functions, Interconnection of Subsystems.

Analysis of Linear State Equations- First Order Scaler Differential Equation, System modes and modal decomposition, State Transition Matrix, Time –varying matrix case, Solution of state equations. Pole placement by state feedback, Ackermann's Formula.

Lyapunov's stability theory for Linear System- Equilibrium points and stability concepts, Stability Definitions, Linear system stability, The Direct method of Lyapunov, Use of Lyapunov's method in feedback design.

Controllability & Observability- Definitions, Controllability/Observability Criteria, Design of state feedback control systems, Full-order and Reduced-order observer Design, Stabilizability and Detectability

Suggested Readings:

1. Modern Control Engineering, Ogata K, Prentice Hall, New Delhi. (2010).
2. Linear System Theory, Hespanha, J.P., Princeton University Press.
3. Mathematical Control Theory, Sontag, E.D., second edition, Springer Verlag, 2014.
4. Ogata K, Discrete Time Control Systems PHI Learning. (2010).
5. Richard Dorf & Robert Bishop,Modern Control Systems, Pearson Education. (2011).
6. M .Gopal, Control Systems: Principles and Design, Mc Graw Hill Publications. (2008).

7. Franklin Powell , Feedback Control Of Dynamical Systems, Pearson Education. (2008).
8. Singh & Janardhanan - Modern control engineering, Cengage learning. (2010).

LECTURE PLAN

Unit	Contents	Contact Hours
	State space Model	**8**
	Review of vectors and matrices	2
	Canonical Model from Differential Equations and Transfer Functions	3
	Interconnection of Subsystems	3
	Analysis of Linear State Equations	**10**
	First order Scaler Differential Equation	1
	System modes and modal decomposition	2
	State Transition Matrix	2
	Time –varying matrix case	1
	Solution of state equations	2
	Pole placement by state feedback, Ackermann's Formula	2
	Lyapunov's stability theory for Linear System	**9**
	Equalibrium points and stability concepts	2
	Stability Definitions, Linear system stability	3
	The Direct method of Lyapunov	2
	Use of Lyapunov's method in feedback design	2
	Controllability & Observability	**10**
	Definitions, Contrallabilty/Observability Criteria	2
	Design of state feedback control systems	3
	Full-order and Reduced-order observer Design	3
	Stabilizability and Detectability	2
	Total	**37**

5EIU03 CONTROL SYSTEM II

Course Outcomes

The students of the course should be able to

CO1: Describe State space model of a system and Lyapunov's stability theory. (K2)

CO2: Define stability, controllability and observability (K1)

CO3: Analyze Analysis of Linear State Equations System modes and modal decomposition (K4)

CO4: Solve Solution of state equations, Pole placement by state feedback, Ackermann's Formula. (K3)

CO5: Explain Lyapunov's stability theory for Linear System, Pole placement by state feedback, (K2)

CO-PO Mapping **(**3 – Strong, 2 – Moderate and 1 – Weak) See **PO and PSO**

5EIU03 CONTROL SYSTEM II		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1	3	2	2												
	CO2	3	3	3	1											
	CO3	3	2	2												
	CO4	3	3	3												
	CO5	3	2	2												

Content Delivery Method

•Class room lecture (chalk and board), (Marker and board) (D1)

•Visual presentation (D2)

•Tutorial (D3)

ELECTRONIC MEASUREMENT & INSTRUMENTATION

5EIU04	**ELECTRONIC MEASUREMENT & INSTRUMENTATION**	**L**	**T**	**P**	**Marks**
	Total Hours – 40	**3**	**1**	**0**	**150**

5EIU04 ELECTRONIC MEASUREMENT & INSTRUMENTATION

3L+1T **MAX. MARKS-150**

SIGNAL GENERATION: Sine wave generators, Frequency synthesized signal generators, Sweep frequency generators.

SIGNAL ANALYSIS: Measurement Technique, Wave Analyzers, Frequency - selective wave analyzer, Heterodyne wave analyzer, Harmonic distortion analyzer, Spectrum analyzer.

SIGNAL CONVERSION: Types of Conversions, SAC, Flash type converter, A/D and D/A converters, comparators, F/V and V/F converters, Fundamentals of optical and magnetic isolators, Data Acquisition Systems, Sample and Hold circuits. Sampling Theory.

ELECTRONIC INSTRUMENTS FOR MEASURING BASIC PARAMETERS: Electronic Voltmeter, Electronic Multimeters, Digital Voltmeter, Q meter, Vector Impedance meter, Vector Voltmeter, RF Power & Voltage Measurements, Digital Storage Oscilloscope, Powerscope, Hall Effect transducers.

TIME MEASUREMENT TECHNIQUES: Time standards; Measurement of time interval between events, order of events, Very low time, period, phase, time constant measurements.

FREQUENCY MEASUREMENT TECHNIQUES: Frequency, ratio and product, high and low frequency measurements, Gating error, Time base error, Trigger level error, High frequency measurements.

INSTRUMENT CALIBRATION & MAINTENANCE: Process instrument calibration, Standards, Laboratories, Validation of standards laboratories, Primary reference standards, Procedure for calibration of plant instruments and master instruments, Types and procedure of maintenance.

Suggested Readings:

1. Electronic Instrumentation and Measurement, Bell, Oxford. (2007).
2. Electronic Instrumentation, H S Kalsi, TMH. (2012).
3. Electronic Measurements and Instrumentation, Lal Kishore, Pearson. (2010).
4. Elements of Electronic Instrumentation and Measurement, Carr, Pearson. (1996).
5. Instrumentation for Engineering Measurements, Dally, Pearson. (2003).
6. Digital Measurement Techniques, T. S. Rathore, Narosa Publishing House. (2003).
7. Monographs on System Design using Integrated Circuits, B. S. Sonde, Tata Mc-Graw Hill. (1992).
8. Digital Signal Processing, D. J. DeFatta, J. G. Lucas and W., J Wiley and Sons. (1987).
9. Student reference manual for Electronic and Instrumentation measurement, Wolf &Smith, PHI Publication. (2003).
10. Principles of measurement and instrumentation, Alan Morris, PHI. (1989).
11. Industrial instruments and control, S.K.Singh , TMH. (2008).
12. Instrumentation Devices and Systems, Rangan C. S., Sarma G. R. and Mani V. S. V., Tata McGraw-Hill Publishing Company Limited. (1997).
13. Measurement Systems, Doebelin E. O. and Manik D. N., Tata McGraw-Hill Publishing Company Limited. (1959).

14. Process Control Instrumentation Technology, Johnson C. D., Prentice Hall of India Private Limited. (2010).
15. Applied Instrumentation, W. G. Andrews- Vol II, Applied Instrumentation, W. G. Andrews- Vol III (1982).
16. Principles of Industrial Instrumentation and Control Systems, Cengage learning. (2011).

Unit	Contents	Contact Hours
	SIGNAL GENERATION And SIGNAL ANALYSIS	**6**
	Sine wave generators	1
	Frequency synthesized signal generators, Sweep frequency generators	1
	Measurement Technique, Spectrum analyzer	1
	Wave Analyzers, Frequency-selective wave analyzer	2
	Heterodyne wave analyzer, Harmonic distortion analyzer	1
	SIGNAL CONVERSION	**9**
	Types of Conversions, SAC, Flash type converter	2
	A/D and D/A converters	2
	comparators, F/V and V/F converters	2
	Fundamentals of optical and magnetic isolators	1
	Data Acquisition Systems	1
	Sample and Hold circuits. Sampling Theory.	1
	ELECTRONIC INSTRUMENTS FOR MEASURING BASIC PARAMETERS	**9**
	Electronic Voltmeter	2
	Electronic Multimeters, Digital Voltmeter	2
	Q meter, Vector Impedance meter, Vector Voltmeter	2
	RF Power & Voltage Measurements, Digital Storage Oscilloscope	2
	Powerscope, Hall Effect transducers	1

	TIME And Frequency MEASUREMENT TECHNIQUES	**8**
	Time standards; Measurement of time interval between events	2
	order of events, Very low time period, phase, time constant measurements	2
	Frequency, ratio and product, high and low frequency measurements	2
	Gating error, Time base error, Trigger level error	1
	High frequency measurements	1
	INSTRUMENT CALIBRATION & MAINTENANCE	**8**
	Process instrument calibration, Standards, Laboratories	2
	Validation of standards laboratories, Primary reference standards	2
	Procedure for calibration of plant instruments and master instruments	2
	Types and procedure of maintenance.	2
	Total	**40**

5EIU04 ELECTRONIC MEASUREMENT & INSTRUMENTATION

Course Outcomes

The students of the course should be able to

CO1: Describe various signal generator, Describe time and frequency measurement techniques (K2)

CO2: Show application of electronic instruments for measuring basic parameters such as voltage, current, frequency, power etc. (K1)

CO3: Analyze signal analysis using Wave Analyzers, Frequency - selective wave analyzer, Heterodyne wave analyzer, Harmonic distortion analyzer, Spectrum analyzer (K4)

CO4: Demonstrate Q-meter, Digital Storage Oscilloscope, Powerscope, Hall Effect transducers. (K3)

CO5: Explain A/D and D/A converters, Data Acquisition Systems (K5)

CO-PO Mapping **(**3 – Strong, 2 – Moderate and 1 – Weak) See **PO and PSO**

5EIU04 ELECTRONIC MEASUREMENT & INSTRUMENTATION		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1	1	1								2		1			
	CO2	1	1													
	CO3	1	1								1		1			
	CO4	1	1								1					
	CO5	1									1					

Content Delivery Method

•Class room lecture (chalk and board) (D1)

•Visual presentation (D2)

•Tutorial (D3)

MICROPROCESSORS

5EIU05	**MICROPROCESSORS**	**L**	**T**	**P**	**Marks**
	Total Hours – 40	**3**	**0**	**0**	**150**

5EIU05 MICROPROCESSORS

3L+0T **MAX. MARKS-150**

Introduction to computer architecture and organization, Architecture of 8-bit and 16-bit microprocessors, Bus configurations, CPU module.

Introduction to Assembly language and machine language programming, Instruction set of typical 8-bit and 16-bit microprocessor, subroutines and stacks programming exercise.

Timing diagrams, Memory families, Memory Interfacing, programmable peripheral interface chips.

Interfacing of input-output ports, programmable interval timer. Serial and parallel data transfer schemes, interrupts and interrupts service procedure.

Programmable interrupt controller. Programmed and interrupt driven data transfer.

Programmable DMA controller, UART. Programming the ports, Timers, serial interface, ADC interface, interrupt programming, programming exercise, Application.

TEXT BOOKS

1. Microprocessors Architecture, Programming & Application, Ramesh S. Gaonkar, (2000).
2. Programming and application with the 8085, 6th Edition, Penram International Publishing House. (2013).

REFERENCE BOOKS

1. Microprocessors and Interfacing –Douglas V' Hall Tata McGraw Hill. (1974).
2. Advanced Microprocessors & Peripherals A K Ray & KM Bhurchandi.(2006).
3. The 8086 Family John Uffenbeck Pearson Edu. (2002).

LECTURE PLAN

Unit	Contents	Contact Hours
I		**6**
	Introduction to computer architecture and organization	2
	Architecture of 8-bit and 16-bit microprocessors	2
	Bus configurations	1
	CPU module	1
II		**9**
	Introduction to Assembly language and machine language programming	2
	Instruction set of typical 8-bit and 16-bit microprocessor	5
	subroutines and stacks programming exercise	2
III		8
	Timing diagrams	3
	Memory families, Memory Interfacing	3
	programmable peripheral interface chips	2
		9
	Interfacing of input-output ports, programmable interval timer	2
IV	Serial and parallel data transfer schemes	2
	interrupts and interrupts service procedure	2

	Programmable interrupt controller	2
	Programmed and interrupt driven data transfer.	1
V		**8**
	Programmable DMA controller, UART	2
	Programming the ports, Timers	2
	serial interface, ADC interface	2
	interrupt programming, programming exercise, Application	2
	Total	**40**

5EIU05 MICROPROCESSORS

Course Outcomes

The students of the course should be able to

CO1: Describe computer architecture and organization, Assembly language and machine language programming (K2)

CO2: Define stack pointer, interrupt, instruction cycle, machine cycle (K1)

CO3: Analyze Timing diagrams, Memory Interfacing, (K4)

CO4: Experiment of various program in Assembly language and machine language using 8085 Microprocessor (K3)

CO5: Explain Architecture of 8-bit and 16-bit microprocessors, Bus configurations, (K2)

CO-PO Mapping **(**3 – Strong, 2 – Moderate and 1 – Weak) See **PO and PSO**

5EIU05 MICROPROCESSORS		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1	1														
	CO2	2	1													
	CO3	1	1													
	CO4	2	1	1			1									
	CO5	1											1			

Content Delivery Method

•Class room lecture (chalk and board) (D1)

•Visual presentation (D2)

•Tutorial (D3)

5EIU08 CONTROL LAB

2P **MAX. MARKS-75**

1. To design I order system on R-C circuit and observe its response with the following inputs and trace the curve. (a) Step (b) Ramp (c) Impulse.
2. To design II order electrical network and study its transient response for step input and following cases:- (a) Under damped System (b) Over damped System (c) Critically damped System.
3. To Study the frequency response of following compensating networks, plot the graph and find out corner frequencies:- (a) Lag Network (b) Lead Network (c) Lag-lead Network.
4. To perform experiment on stepper motor (finding step angle and frequency response etc.)
5. To perform experiment on Potentiometer error detector.
6. To perform experiments on Position control system using dc servomotor.
7. a) To draw the error Vs angle characteristics of Synchro transmitter.
   b) To draw the characteristics of Synchro transmitter and control transformer.
8. To perform experiments on relay control system.
9. a) To find Transfer Function of a.c. servo motor.
   b) To draw Torque Speed Characteristics of a.c. servo motor.
10. a) To find Transfer Function of d.c. servo motor.
    b) To draw Torque Speed Characteristics of armature controlled d.c. servo motor.
11. To identify a system T.F. using its frequency response.
12. To perform experiments on magnetic levitation systems.

5EIU08 CONTROL LAB

Course Outcomes

The students of the course should be able to

CO1: Describe State space model of a system (K2)

CO2: Define stability, controllability and observability (K1)

CO3: Analyze Analysis of Linear State Equations System modes and modal decomposition (K4)

CO4: Solve Solution of state equations, Pole placement by state feedback, Ackermann's Formula. (K3)

CO5: Explain Pole placement by state feedback, (K2)

CO-PO Mapping **(**3 – Strong, 2 – Moderate and 1 – Weak) See **PO and PSO**

5EIU08 CONTROL LAB		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1	3	3	2	1	3										
	CO2	3	2	2	2	3										
	CO3	3	2	2	1	3										
	CO4	3	2	2	2	3										
	CO5	3	2	2	1	3										

Content Delivery Method

•Class room lecture (chalk and board) (D1)

•Visual presentation (D2)

•Tutorial (D3)

5EIU09 MICROPROCESSOR LAB

2P **MAX. MARKS-50**

Following exercises are to be done in 8085 assembly language.

1. Arranging a set of data in Ascending order.
2. Arranging a set of data in Descending order.
3. Finding out number of Positive, Negative and Zeros from a Data Set.
4. Searching the Existence of a certain data in a given data.
5. BCD to Binary conversion.
6. Binary to BCD conversion.
7. Design a Up/Down Counter.
8. Multiply Two 8 Bit Numbers using Successive Addition and Shifting method.
9. Find Factorial of a number.
10. Solve the given Algebraic Equation.

11. Generate a Software Delay.
12. Division of 8 bit Unsigned Numbers.
13. A program to display real time clock. Assume a periodic signal is interrupting RST 7.5 signal after every 0.5 seconds.
14. Generate a square wave and rectangular wave of given frequency at the Output pin of 8255 chip.

Course Outcomes

The students of the course should be able to

CO1: Describe computer architecture and organization, Assembly language and machine language programming (K2)

CO2: Define stack pointer, interrupt, instruction cycle, machine cycle (K1)

CO3: Analyze Timing diagrams, Memory Interfacing, (K4)

CO4: Experiment of various program in Assembly language and machine language using 8085 Microprocessor (K3)

CO5: Explain Architecture of 8-bit and 16-bit microprocessors, Bus configurations, (K2)

CO-PO Mapping **(**3 – Strong, 2 – Moderate and 1 – Weak) See **PO and PSO**

5EIU09/ MICROPROCESSOR LAB		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1	1	2	1	1	2										
	CO2	1	1	1	2	2										
	CO3	1	1	2	1	2										
	CO4	2	2	1	2	2										
	CO5	1	1													

Content Delivery Method

•Class room lecture (chalk and board) (D1)

•Visual presentation (D2)

•Tutorial (D3)

5EIU10 TRANSDUCER LAB

2P **MAX. MARKS-75**

1. To draw the characteristics of following temperature transducers:-
   (a)PT 100 (b) Thermistor (c) K Type Thermocouple
2. To perform experiment on ultrasonic depth meter.
3. Water level measurement kit:
   a) To draw I/P vs O/P characteristics.
   b) Study of water level indication.
   c) To plot the curve between error and different measured water level.
4. Load Cell Kit:
   a) To perform experiment and plot curve between load and strain.
   b) To study about excitation.
   c) To plot error curve at different loads.
5. To study Piezo electric vibration pickup.
6. LVDT Kit:
   a) To study excitation and balancing network.
   b) To study phase difference.
   c) To plot curve between displacement and output voltage.
7. Torque measurement Kit:
   a) To study about unbalanced strain.
   b) To plot the curve between torque vs strain.
8. To draw characteristics of LDR.
9. To draw Characteristics of Hall effect sensor.
10. Design of Opto-coupler using photoelectric transducers.
11. To study various pressure sensors like Bourdon tube, Diaphragms, Pressure switches, Bellows etc.

Course Outcomes

The students of the course should be able to

CO1: Describe the characteristics of temperature transducers (K2)

CO2: Design of Opto-coupler using photoelectric transducers (K5)

CO3: Analyze characteristics of LDR, Hall effect sensor (K4)

CO4: Experiment and plot curve between load and strain (K3)

CO5: Explain various pressure sensors like Bourdon tube, Diaphragms, Pressure switches, Bellows etc. (K2)

CO-PO Mapping **(**3 – Strong, 2 – Moderate and 1 – Weak) See **PO and PSO**

5EIU10/		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1	2	1		1	2										
	CO2	1	1		2											
	CO3	1	1	1	2											
	CO4	1	1		2											
	CO5	1	1													

Content Delivery Method

•Class room lecture (chalk and board) (D1)

•Visual presentation (D2)

•Tutorial (D3)

6EIU01	PROCESS CONTROL SYSTEM	L+T	MARKS
	Total Hours-40	3L+1P	150

SYLLABUS

GENERAL CONCEPTS: General Concepts and terminology, Piping and Instrumentation diagram

TYPES OF DYNAMIC PROCESS: Instantaneous, Integral, First and second Order, self-regulating, interacting and non-interacting processes. Dead time elements

MATHEMATICAL MODELING OF SYSTEMS: Liquid Systems (Level and flow), perturbation variable and linearization methods. Response of a thermometer bulb, Concentration response of a stirred tank. Temperature response of a stirred tank, Process lag, load disturbance and their effect on processes.

BASIC CONTROL ACTION: Basic control action, two position, multi Position, continuous controller modes: proportional, integral and Derivative Composite Controller modes PI, PD, PID, Integral wind up and anti-wind up. Response of controllers for different test Input .Selection of control modes for processes like level, temperature and flow.

CONTROLLER TUNING METHODS: Evaluation criteria IAE, ISE, ITAE etc. process reaction curve method, continuous oscillation method, damped oscillation method, auto tuning.

FINAL CONTROL ELEMENTS: Pneumatic control value, construction details and types, value sizing, selection of control valves, Inherent and Installed characteristics valve actuators and positioners.

ADVANCED CONTROL SYSTEM: Cascade control, ratio control, feed forward control. Over-ride, split range and selective control. Multivariable process control, Interaction of control loops.

CASE STUDY: Distillation column, Basic features of composition control schemes. Control of overhead composition, Bottom composition and both product compositions, Location of sensing element, Control of columns with varying feed rates, Pressure control, Control of feed temperature and internal reflux control, boiler drum level control.

TEXT BOOKs:

S.N	Name of books \ authors\publications	year
1.	Peter Harriott, “Process Control”, Tata McGraw Hill, New Delhi,	1985

2.	Surekha Bhanot “Process control principals and applications” , Oxford University press .	2007

REFERENCE BOOKs:

S.N	Name of books \ authors\publications	Year
1.	Principles of Industrial Instrumentation and Control Systems, Alavala, Cengage Learning.	2004
2.	Process dynamics and Control, Sundaram, Cengage Learning	2005

LECTURE PLAN

S.N	CONTENTS	CONTACT HOUR
I	**GENERAL CONCEPTS**:	**7**
	General Concepts and terminology,	1
	Piping and Instrumentation diagram	1.5
	TYPES OF DYNAMIC PROCESS: Instantaneous, Integral, First and second Order,	2
	self-regulating, interacting and non-interacting processes.	1.5
	Dead time elements	1
II	**MATHEMATICAL MODELING OF SYSTEMS:**	**9**
	Liquid Systems (Level and flow), perturbation variable and linearization methods.	2
	Response of a thermometer bulb,	1.5
	Concentration response of a stirred tank.	1.5
	Temperature response of a stirred tank, Process lag,	2
	load disturbance and their effect on processes.	2
III	**BASIC CONTROL ACTION**:	**8**
	Basic control action, two position, multi Position,	2
	continuous controller modes: proportional, integral and Derivative Composite Controller modes	2

	PI, PD, PID, Integral wind up and anti-wind up.	2
	Response of controllers for different test Input .	1
	Selection of control modes for processes like level, temperature and flow.	1
IV	**CONTROLLER TUNING METHODS**:	**8**
	Evaluation criteria IAE, ISE, ITAE etc. process reaction curve method,	1
	continuous oscillation method,	1
	damped oscillation method,	1
	auto tuning.	1
	FINAL CONTROL ELEMENTS:	
	Pneumatic control value,	1
	construction details and types, value sizing, selection of control valves,	2
	Inherent and Installed characteristics valve actuators and positioners.	1
V	**ADVANCED CONTROL SYSTEM:**	**8**
	Cascade control, ratio control, feed forward control.	1
	Over-ride, split range and selective control.	1
	Multivariable process control,	1
	Interaction of control loops.	1
	CASE STUDY:	
	Distillation column,	1
	Basic features of composition control schemes.	0.5
	Control of overhead composition,	0.5
	Bottom composition and both product compositions,	0.5
	Location of sensing element,	0.5
	Control of columns with varying feed rates, Pressure control,	0.5
	Control of feed temperature and internal reflux control, boiler drum level control.	0.5

	Total	40

COURSE OUTCOME

1.	To **discuss** the different types basics control actions and control system(K1)
2.	To **identify** the different types of process control and interaction loop.(K4)
3.	**Ability** to understand and analyze various control modes for various process.(K6)
4.	**Explain** the basic concept of instrumentation and piping terminology.(K3)
5.	To **develop** skills to build and trouble shoot different encountering problems.(K2)

CO – PO Mapping (1. Strong 2. Moderate 3. Low)

Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	2	2								
CO2	1	3	3	1								
CO3	1	2	2	1								
CO4	3	1	2	1								
CO5	2	1	2	2								

Contents delivery method:

Class room lecture (chalk and board)

Visual presentation

Tutorial

FIBER OPTICS AND INSTRUMENTS

6EIU02	**FIBER OPTICS AND INSTRUMENTS**	**L**	**T**	**MARKS**

	Total Hours-40	**3**	**0**	**150**

SYLLABUS

OPTICAL FIBER OVERVIEW- Introduction, Ray theory, Optical fibers: multimode, single mode, step index, graded index, plastic & glass fibers. Transmission Characteristics of Optical Fibers - Introduction, Attenuation, Material absorption loss, Fiber bend loss, scattering, Dispersion (intermodal & intramodal), Dispersion Shifted Fibers, Dispersion Compensating Fibers. Manufacturing of optical Fibers – preparation of optical fiber, Liquid phase techniques, Vapour phase depositions techniques.

OPTICAL FIBER SOURCES- Laser- Emission and absorption of radiation, Einstein relation, Absorption of radiation, Population inversion, Optical feedback, Threshold condition. Population inversion and threshold, working of three levels & four level laser. Basic idea of solid state, semiconductors, gas & liquid laser. Basic concept of Q-switching and mode locking. Light Emitting Diode - Structure, Material, Characteristics, Power & Efficiency.

OPTICAL DETECTORS & CONNECTION - Optical detection principles, quantum efficiency, Responsivity, PIN photo diode, Avalanche photo diodes, Noise in Detectors, Photo Diode Materials. Fiber Alignment, fiber splices, fiber connectors, expanded beam connectors, fiber couplers.

OPTICAL FIBER MEASUREMENTS - Measurements of Fiber Attenuation, Dispersion, Refractive Index Profile, Cut off Wave Length, Numerical Aperture & Diameter. Field measurement through optical time domain reflectometry (OTDR), Laser based systems for measurement of distance, Velocity, Holography.

OPTICAL FIBER APPLICATIONS – Wavelength division multiplexing, DWDM, active and passive components, optical sensors, optical amplifiers, public network applications, military, civil and industrial applications.

TEXT BOOKS:

S.N	Name of books\authors\publication	Year
1.	J.M. Senior, Optical Fiber Communication: Principles and Practice, Pearson Education.	2013
2.	R.P. Khare, Fiber Optics & Optoelectronics, Oxford Publications.	2014

REFERENCE BOOKS:

S.N	Name of books\authors\publication	Year
1	R.P. Khare, Fiber Optics & Optoelectronics, Oxford Publications.	2004
2	J.Gowar, Optical Communication Systems, PHI.	1999

3	A.Ghatak & K.Thygarajan, Introduction to Fiber Optics, Cambridge University Press.	2006
4	Joseph C Palais, Fiber Optics Communication, PHI.	2010
5	Harold Kolimbris, Fiber Optics Communication, Pearson Education.	2009
6	D. Anuradha, Optical Fiber and Laser, Principles and Applications, New Age.	2008

LECTURE PLAN

S.N	CONTENTS	CONTACT HOURS
I	**OPTICAL FIBER OVERVIEW-**	**8**
	Introduction, Ray theory,	1
	Optical fibers: multimode, single mode, step index, graded index,	1.5
	plastic & glass fibers.	0.5
	Transmission Characteristics of Optical Fibers - Introduction,	0.5
	Attenuation, Material absorption loss, Fiber bend loss, scattering,	1
	Dispersion (intermodal & intramodal), Dispersion Shifted Fibers, Dispersion Compensating Fibers.	1.5
	Manufacturing of optical Fibers – preparation of optical fiber,	0.5
	Liquid phase techniques,	0.5
	Vapour phase depositions techniques.	1
II	**OPTICAL FIBER SOURCES-**	**8**
	Laser- Emission and absorption of radiation,	1
	Einstein relation,	1
	Absorption of radiation,	1
	Population inversion, Optical feedback, Threshold condition.	1
	Population inversion and threshold, working of three levels & four level laser.	1
	Basic idea of solid state, semiconductors, gas & liquid laser.	1

	Basic concept of Q-switching and mode locking.	1
	Light Emitting Diode - Structure, Material, Characteristics, Power & Efficiency.	1
III	**OPTICAL DETECTORS & CONNECTION** –	**8**
	Optical detection principles,	1
	quantum efficiency,	1
	Responsivity,	1
	PIN photo diode,	1
	Avalanche photo diodes,	1
	Noise in Detectors,	1
	Photo Diode Materials.	1
	Fiber Alignment, fiber splices, fiber connectors, expanded beam connectors, fiber couplers.	1
	OPTICAL FIBER MEASUREMENTS –	**8**
IV	Measurements of Fiber Attenuation,	1
	Dispersion,	2
	Refractive Index Profile,	1
	Cut off Wave Length,	1
	Numerical Aperture & Diameter.	1
	Field measurement through optical time domain reflectometry (OTDR),	1
	Laser based systems for measurement of distance, Velocity, Holography.	1
V	**OPTICAL FIBER APPLICATIONS –**	**8**
	Wavelength division multiplexing,	2
	DWDM,	1
	active and passive components,	1
		2.5

	optical sensors, optical amplifiers,	1.5
	public network applications, military, civil and industrial applications.	
	Total	40

COURSE OUTCOME

Course outcomes :Student will able to know	
1	To **identify** the basic knowledge of optical fiber communication and its necessity.(K2)
2	**Analysis** of different modes of propagation of optical fiber communication.(K5)
3	To **identify** and discuss different optical detection process.(K3)
4	To **develop** the different optical fiber communication generation sources and detection.(K6)
5	To **understand** the different measuring parameters and instruments.(K1)

CO – PO Mapping (1. Strong 2. Moderate 3. Low)

Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	3	1	2							
CO2	3	1	1	2								
CO3	2	1	3									
CO4	1	3	1	2								
CO5	2	2	2	2	3							

Contents delivery method:

Class room lecture (chalk and board)

Visual presentation

Tutorial

INDUSTRIAL MEASUREMENT

6EIU03	INDUSTRIAL MEASUREMENT	L	T	MARKS
	Total Hours-40	3	0	150

SYLLABUS

TEMPERATURE MEASUREMENTS - Thermocouples, Resistance Temperature detectors: 2-wire, 3-wire systems, Thermistors, Radiation and optical pyrometers, Infrared pyrometers, Calibration of temperature sensors.

PRESSURE MEASUREMENTS - Electric pressure transducers: LVDT, strain guage, Capacitive pressure transducers, Piezo electric pressure transducers, Potentiometric pressure transducer, Low pressure measurement: McLeod gauge, Thermal conductivity: Thermocouple type, Differential pressure transmitters, Calibration of pressure gauge: Dead weight tester.

FLOW MEASUREMENTS - Orifice, Venturi, Flow nozzles and pitot tubes, Rotameters, Vortex flowmeters, Electromagnetic flow meters, Ultrasonic flow meter, thermal flow meter, Mass flow type meters, Shunt flow meters.

LEVEL MEASUREMENTS - Float gauge, Bubbler (Purge) system, Hydrostatic pressure type in open vessels and closed vessels, Differential pressure method, Electrical conductivity method, Capacitance type, Radioactive type, Ultrasonic type.

DENSITY MEASUREMENTS - Ultrasonic densitometer, radiation densitometer, Impulse wheel methods.

RECORDER- Operating mechanism, Chart drive mechanism, Strip chart recorders, Circular chart recorders, X-Y type recorders, Magnetic tape recorders.

TEXT Books:

S.N	Name of books\authors\publications	Year
1.	Industrial Instrumentation ,S K Singh,New Age.	2003

REFERENCE Books:

S.N	Name of books\authors\publications	Year
1	Transducer and Instrumentation DVS Murty PHI Publication.	2004
2	Electronic Measurements & Instrumentation, Oliver & Cage, TMH.	1971
3	Instruments Transducers, Neubert, Oxford.	1986
4	Elements of Electronic Instrumentation & Measurements, Joseph J. Carr, Pearson.	2002
5	Fundamentals of Instrumentation and Measurements, Dominique Placko, Wiley.	2013
6	Instrumentation Devices & Systems. Rangan, Sarma & Mani, MVGraw Hill.	1997
7	Industrial Instrumentation ,Krishnaswamy .K,New Age.	2005

LECTURE PLAN

S.N	CONTENTS	Contact Hours
I	**TEMPERATURE MEASUREMENTS** –	8
	Thermocouples,	1
	Resistance Temperature detectors: 2-wire, 3-wire systems,	2
	Thermistors,	1
	Radiation and optical pyrometers,	2
	Infrared pyrometers,	1
	Calibration of temperature sensors.	1
II	**PRESSURE MEASUREMENTS** –	**9**
	Electric pressure transducers: LVDT, strain guage,	1
	Capacitive pressure transducers,	1
	Piezo electric pressure transducers, Potentiometric pressure transducer,	1
	Low pressure measurement: McLeod gauge,	1
	Thermal conductivity: Thermocouple type,	2
	Differential pressure transmitters,	2
	Calibration of pressure gauge: Dead weight tester.	1
III	**FLOW MEASUREMENTS** –	**8**
	Orifice, Venturi, Flow nozzles and pitot tubes,	2
	Rotameters, Vortex flowmeters,	1
	Electromagnetic flow meters,	1
	Ultrasonic flow meter,	1
	thermal flow meter,	1
	Mass flow type meters,	1
	Shunt flow meters.	1
IV	**LEVEL MEASUREMENTS** –	**8**

	Float gauge, Bubbler (Purge) system,	2
	Hydrostatic pressure type in open vessels and closed vessels,	2
	Differential pressure method,	1
	Electrical conductivity method,	1
	Capacitance type, Radioactive type, Ultrasonic type.	2
	DENSITY MEASUREMENTS –	**3**
	Ultrasonic densitometer,	1
	radiation densitometer,	1
	Impulse wheel methods.	1
V	**RECORDER**-	**4**
	Operating mechanism,	0.5
	Chart drive mechanism,	0.5
	Strip chart recorders,	0.5
	Circular chart recorders,	0.5
	X-Y type recorders,	1
	Magnetic tape recorders.	1
	Total	**40**

COURSE OUTCOME

Course outcomes :student will able to know	
1	**Distinguish** between the various types of measurement parameters that are available.(K4)
2	To **identify** the various measurement techquines and select the best suitable one.(K2)
3	**Explain** the basic idea of different measurement process used.(K5)
4	**Analysis** of temperature , pressure , flow , density and level measurement can be done .(K1)

5	Build **ability** to troubleshoot different measurement related issues.(K3)

CO – PO Mapping (1. Strong 2. Moderate 3. Low)

Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	2	2	2							
CO2	2	2		1	3							
CO3	2	3	2	2	2							
CO4	2	1	2	3								
CO5	1	2	1	3	1							

Contents delivery method:

Class room lecture (chalk and board)

Visual presentation

Tutorial

BIOMEDICAL INSTRUMENTS

6EIU04	**BIOMEDICAL INSTRUMENTS**	**L**	**P**	**MARKS**
	Total Hours-40	3	1	150

SYLLABUS

HUMAN BODY SUBSYSTEMS- Brief description of neural, muscular, cardiovascular and respiratory systems; their electrical, mechanical and chemical activities.

TRANSDUCERS AND ELECTRODES- Principles and classification of transducers for Bio-medical applications, Electrode theory, different types of electrodes, Selection criteria for transducers and electrodes.

BIOPOTENTIALS- Electrical activity of excitable cells, ENG, EMG, ECG, ERG, ECG. Neuron potential.

CARDIOVASCULAR SYSTEM MEASUREMENTS- Measurement of blood pressure, blood flow, cardiac output, cardiac rate, heart sounds, Electrocardiograph, phonocardiograph, Plethysmograph, Echocardiograph.

INSTRUMENTATION FOR CLINICAL LABORATORY Measurement of pH value of blood, ESR measurement, hemoglobin measurement, O2 and CO2 concentration in blood, GSR measurement. Spectrophotomentry, chromatography, Hematology,

MEDICAL IMAGING: Diagnostic X-rays, CAT, MRI, thermography, ultrasonography, medical use of isotopes, endoscopy.

PATIENT CARE, BIOTELEMETRY AND SAFETY MEASURES Elements of Intensive care monitoring basic hospital systems and components, physiological effects of electric current shock hazards from electrical equipment, safety measures, Standards & practices. Biomedical Telemetry: Introduction, block diagram and description of single channel/multi channel telemetry systems.

THERAPEUTIC AND PROSTHETIC DEVICES - Introduction to cardiac pacemakers, defibrillators, ventilators, muscle stimulators, diathermy, heart lung machine, Hemodialysis, Applications of Laser.

APPLICATIONS OF BIOPOTENTIALS: Electrocardiographic diagnostic criteria for Identification of cardiac disorders, Electrocardiographic pattern of ischemia, Atrial abnormalities, Ventricular enlargement, Abnormal ECG patterns, Clinical applications of EEG, EMG, ERG

COMPUTER APPLICATIONS: data acquisition and processing, remote data recording and management. Real time computer applications

TEXT BOOKs:

S.N	Name of books\author\publication	Year
1	L. Cromwell, F. J. Weibell, and L. A. Pfeiffer, Biomedical Instrumentation and Measurements, Pearson Education	1990
2	J. J. Carr and J. M. Brown, Introduction to Biomedical Equipment Technology, 4th ed., Pearson Education,	2001

REFERENCE BOOKs:

S.N	Name of books \author\publication	Year

1	Biomedical Instrumentation Systems ,Chatterjee, Cengage learning Pub.	2011
2	Aston, "Principles of Biomedical Instrumentation and measurements", McGraw Hill publishing Company.	1990
3	L.A. Geddes and L.E. Baker, Principles of Applied Biomedical Instrumentation , John Wiley & Sons,	1989
4	Richard Aston, Principles of Biomedical Instrumentation and Measurement , Merrill Publishing	1990
5	Jacobson B. and Webster J.G., Medical Clinical Engineers , Prentice Hall Inc.,.	1979

LECTURE PLAN

S.N	CONTENTS	CONTACT HOURS
I	**HUMAN BODY SUBSYSTEMS-**	**3**
	Brief description of neural, muscular, cardiovascular and respiratory systems;	1.5
	their electrical, mechanical and chemical activities.	1.5
II	**TRANSDUCERS AND ELECTRODES-**	**3**
	Principles and classification of transducers for Bio-medical applications,	1
	Electrode theory, different types of electrodes,	1
	Selection criteria for transducers and electrodes.	1
III	**BIOPOTENTIALS-** Electrical activity of excitable cells, ENG, EMG, ECG, ERG, ECG. Neuron potential.	2
IV	**CARDIOVASCULAR SYSTEM MEASUREMENTS-**	**5**
	Measurement of blood pressure, blood flow,	1
	cardiac output, cardiac rate, heart sounds,	1
	Electrocardiograph,	1
	phonocardiograph, Plethysmograph,	1
	Echocardiograph.	1
V	**INSTRUMENTATION FOR CLINICAL LABORATORY**	4
	Measurement of pH value of blood,	0.5
	ESR measurement, hemoglobin measurement,	1

	O2 and CO2 concentration in blood,	0.5
	GSR measurement	0.5
	. Spectrophotomentry,	0.5
	chromatography,	0.5
	Hematology,	0.5
VI	**MEDICAL IMAGING**:	**4**
	Diagnostic X-rays, CAT, MRI,	1
	thermography,	1
	ultrasonography,	1
	medical use of isotopes, endoscopy.	1
VII	**PATIENT CARE, BIOTELEMETRY AND SAFETY MEASURES**	**7**
	Elements of Intensive care monitoring basic hospital systems and components,	2
	physiological effects of electric current shock hazards from electrical equipment,	1
	safety measures, Standards & practices.	1
	Biomedical Telemetry: Introduction, block diagram and description of single channel/multi channel telemetry systems.	3
VIII	**THERAPEUTIC AND PROSTHETIC DEVICES** –	**5**
	Introduction to cardiac pacemakers,	0.5
	defibrillators,	1
	ventilators,	0.5
	muscle stimulators,	0.5
	diathermy,	0.5
	Heart lung machine,	1
	Hemodialysis,	0.5
	Applications of Laser.	0.5
IX	**APPLICATIONS OF BIOPOTENTIALS**:	**4**
	Electrocardiographic diagnostic criteria for Identification of cardiac disorders,	1
	Electrocardiographic pattern of ischemia,	1
	Atrial abnormalities,	0.5
	Ventricular enlargement,	0.5
	Abnormal ECG patterns,	0.5
	Clinical applications of EEG, EMG, ERG	0.5
X	**COMPUTER APPLICATIONS**:	**3**
	data acquisition and processing,	1
	remote data recording and management.	1
	Real time computer applications	1
	Total	40

COURSE OUTCOME

Course outcome	Student will able to
1.	To **develop** the basic idea of human body systems and basic functions.(K6)

2.	**Learn** different types of sensors and electrodes that may be used for the betterment of human body system.(K1)
3	To **develop** the understanding of different types of biomedical instruments used for human body .(K3)
4	To **apply** the use biomedical instrument in day to day life.(K2)
5	To **analysis** the multiple application of biomedical instrument devices.(K4)

CO – PO Mapping (1. Strong 2. Moderate 3. Low)

MAPPING	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	2	1	2							
CO2	2	1	3	2	2							
CO3	1	2	1	2	3							
CO4	3	2	1	3	1							
CO5	1	2	1	2	3							

Contents delivery method:

Class room lecture (chalk and board)

Visual presentation

Tutorial

MICROCONTROLLER AND EMBEEDED SYSTEM

6EIU05	**MICROCONTROLLER AND EMBEEDED SYSTEM**	**L**	**T**	**Max Marks**
	Total Hours -40	**3**	**1**	**150**

SYLLABUS

THE 8051 MICROCONTROLLER: Introduction, The 8051 microcontroller hardware, I/O pins, Ports, External memory, Counters and Timers, Serial data.

8051 ASSEMBLY LANGUAGE PROGRAMMING: Addressing modes, External data moves, Stack, Push and Pop opcodes, Logical operations, Byte level and bit level logical operations. Arithmetic operations, Jump and call instructions, Interrupts & returns.

REAL TIME CONTROL: Interrupts, Multiple sources of interrupts, Non maskable sources of interrupts, Interrupt structure in 8051, Timers, Free running counter & Real Time control.

SYSTEM DESIGN: Serial I/O interface, Parallel I/O ports interface, Digital and Analog interfacing methods, LED array, keyboard, Printer, Flash memory interfacing.

INTRODUCTION TO EMBEDED SYSTEM: Application of Microcontrollers in interfacing, MCU based measuring instruments. Real Time Operating System for System Design, Multitasking System, Task Definition in a Multitasking System, Round Robin Scheduling, Full Preemptive Scheduling, Basic study and Features of Commercial RTOS :WINCE and Embedded Linux.

TEXT BOOKs:

S.N	Name of books\authors\publications	Year
1	Kenneth J.Ayala, "The 8051 Micro controller", Penram Interfacing Publishing,	1996

REFERENCE BOOKs:

S.N	Name of author\books\publications	Year
1	Myke Predko, "Programming and Customizing the 8051 micro controller", Tata-McGraw Hill, 3rd	2002
2	Rajkamal, "Embedded Systems" TMH 2004	2004
3	The 8051 Microcontrollers & Embedded Systems,Mazidi, ,PHI 2004	2004
4	David E. Simon, "An Embedded Software Primer", Pearson Education 1999	1999
5	The 8051 Microcontroller w/CD,Ayala, Cengage learning 1999	1999
6	The 8051 Microcontroller & Embedded Systems using Assembly and C w/CD, Ayala/Gadre, Cengage	2007
7	Embedded Systems & Robots: Projects Using the 8051 Microcontroller	2006

LECTURE PLAN

S.N	CONTENTS	Contact hours
I	**THE 8051 MICROCONTROLLER**:	**8**
	Introduction, The 8051 microcontroller hardware, I/O pins, Ports, External memory,	2
	Counters and Timers,	3
	Serial data.	3

II	**8051 ASSEMBLY LANGUAGE PROGRAMMING:**	**8**
	Addressing modes,	2
	External data moves, Stack, Push and Pop opcodes,	2
	Logical operations, Byte level and bit level logical operations. Arithmetic operations, Jump and	1.5
	call instructions,	0.5
	Interrupts & returns.	2
III	**REAL TIME CONTROL**:	**8**
	Interrupts,	2
	Multiple sources of interrupts,	1
	Non maskable sources of interrupts,	2
	Interrupt structure in 8051,	1
	Timers,	1
	Free running counter & Real Time control.	1
IV	**SYSTEM DESIGN**:	**8**
	Serial I/O interface,	2
	Parallel I/O ports interface,	2
	Digital and Analog interfacing methods,	2
	LED array, keyboard, Printer, Flash memory interfacing.	2
V	**INTRODUCTION TO EMBEDED SYSTEM:**	**8**
	Application of Microcontrollers in interfacing,	2
	MCU based measuring instruments.	1
	Real Time Operating System for System Design, Multitasking System,	1
	Task Definition in a Multitasking System,	1
	Round Robin Scheduling,	1
	Full Preemptive Scheduling,	1
	Basic study and Features of Commercial RTOS :WINCE and Embedded Linux.	1

Total	**40**

COURSE OUTCOME

Course outcomes : student will able to	
1.	To **discuss** the basic knowledge of microprocessor& microcontroller and its need.(K3)
2.	To **identify and analyze** the architecture of microcontroller with application.(K2)
3.	**Ability** to understand and write the programming using 8051 microcontroller.(K6)
4.	**Explain** the basic concept of data transfer and their conversion(K1)
5.	To **develop** the understanding of embedded system designing.(K4)

CO – PO Mapping (1. Strong 2. Moderate 3. Low)

Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	2	3							
CO2	1	2	3	2	2							
CO3	1	2	3	1	1							
CO4	1	1	2	2	3							
CO5	2	1	3	1	3							

Contents delivery method:

Class room lecture (chalk and board)

Visual presentation

Tutorial

CONTROL SYSTEM COMPONENTS

6EIU06.1	CONTROL SYSTEM COMPONENTS	L	T	MARKS
	Total Hours-40	3	0	150

SYLLABUS

Motors : Types , working principle , charactertics and mathematical model of following motors AC/DC motors , stepper , servo , linear ,synchronous ,generator and alternator

Types, working principle , characteristics and working principle of following: Switchs , toggle , slides , DIP switch , Rotary switch, Thumbwheel switch , selector switch , Limit switch , proximity , combinational switches, zero speed ,belt sway , pull cords, Relays , electrochemical , solid stste relays, relay pacakage , contactors , comparsion between relay and contractors , contractor size and ratings timers : on delay , off delay and retentive.

Sequencing and interlocking for motors : Concept of sequencing and interlocking , standard symobls used for electrical wiring diagram , electrical wiring diagram for starting ,stopping, , emergency shutdown ,, protection devices ,over under voltage protection ,phase reversal protection , high temperature and high current protection , over speed , reversing direction of rotation ,breaking , starting with variable speeds , jogging inching motors control center , concept and wiring diagram

Pneumatics components: pneumatic power supply and its components, pneumatic relays (bleed and non bleed, reverse and direct) , single acting and double acting cylinders , special cylinders (cushion , double rod , tandem, multiple position, rotary), filter regulator lubricator, pneumatic valves (direction controlled valves , flow control etc.), special type of valves , relief valve , pressure reducing valve , hydraulic component : hydraulic supply hydraulic pumps , actuator , hydraulic valves.

TEXT BOOKS:

S.N	Name of books\authors\publications	Year
1	B. L. Theraja , A text book of electrical echnology , S Chand and company ,	1959
2	S.R. majumdhar , Pneumatics systems , Tata McGraw Hill	2009

REFERENCE BOOKS:

S.N	Name of books\author\publications	Year
1	Industrial Electronics , Tata McGraw Hill ,	1996

LECTURE PLAN

S.N	CONTENTS	CONTACT HOURS
I	**Motors** :	**6**
	Types , working principle ,	1
	character tics and mathematical model of following motors AC/DC motors ,	2
	stepper , servo , linear ,	2
	synchronous ,generator and alternator	1
II	**Types, working principle , characteristics and working principle of following:**	**10**
	Switchs , toggle , slides , DIP switch ,	1
	Rotary switch, Thumbwheel switch ,	2
	selector switch , Limit switch ,	1
	proximity , combinational switches,	1
	zero speed ,belt sway , pull cords,	1
	Relays , electrochemical , solid state relays, relay pacakage ,	2
	contactors , comparsion between relay and contractors , contractor size and	1
	ratings timers : on delay , off delay and retentive.	1
III	**Sequencing and interlocking for motors :**	**12**
	Concept of sequencing and interlocking ,	1
	standard symobls used for electrical wiring diagram ,	1
	electrical wiring diagram for starting ,stopping, , emergency shutdown ,	2
	protection devices ,over under voltage protection ,	2
	phase reversal protection ,	1

	high temperature and high current protection ,	1
	over speed , reversing direction of rotation ,breaking ,	1
	starting with variable speeds ,	1
	jogging inching motors control center ,	1
	concept and wiring diagram	1
IV	**Pneumatics components:**	**12**
	pneumatic power supply and its components,	1
	pneumatic relays (bleed and non bleed, reverse and direct) ,	2
	single acting and double acting cylinders ,	1
	special cylinders (cushion , double rod , tandem, multiple position, rotary),	2
	filter regulator lubricator,	1
	pneumatic valves (direction controlled valves , flow control etc.),	2
	special type of valves , relief valve , pressure reducing valve ,	1
	hydraulic component : hydraulic supply hydraulic pumps , actuator , hydraulic valves.	2
	TOTAL	40

COURSE OUTCOME

Course outcomes :Student will able to know	
1.	**Ability** to understand different types motors , actuators , relays and switches.(K3)
2.	**Explain** the basic concept of semiconductor devices, stepper motor and DC motor.(K1)
3.	**Ability** to deal with sequencing and interlocking of motors.(K4)
4.	**Learn** about pneumatic components and its applications.(K5)
5.	**Apply** the concept on various engineering projects.(K2)

CO – PO Mapping (1. Strong 2. Moderate 3. Low)

Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	3	1							
CO2	2	3	2	1	1							
CO3	1	3	2	1	3							
CO4	1	2	3	2	2							
CO5	1	3	2	3	1							

Contents delivery method:

Class room lecture (chalk and board)

Visual presentation

Tutorial

ROBITICS

6EIU06.2	ROBITICS	L	T	MARKS
	Total Hours-40	3	0	150

SYLLABUS

INTRODUCTION- Introduction: Basic concepts, definition and origin of robotics, different types of robots, robot classification, applications, robot specifications

INTRODUCTION TO AUTOMATION – Components and subsystems, basic building block of automation, manipulator arms, wrists and end effectors. Transmission elements: Hydraulic, pneumatic and electric drives. Gears, sensors, materials, user interface, machine vision, implications for robot design, controllers.

KINEMATICS, DYNAMICS AND CONTROL- Object location, three dimensional transformation matrices, inverse transformation, kinematics and path planning, Jacobian work envelope, manipulator dynamics, dynamic stabilization, position control and force control, present industrial robot control schemes.

ROBOT PROGRAMMING- Robot programming languages and systems, levels of programming robots, problems peculiar to robot programming, control of industrial robots using PLCs.

AUTOMATION AND ROBOTS- Case studies, multiple robots, machine interface, robots in manufacturing and non-manufacturing applications, robot cell design, selection of a robot.

TEXT Books:

S.N	Name of books\authors\publications	Year
1	Spong and Vidyasagar, "Robot Dynamics and Control", John Wiley & Sons	1990
2	Asfahl C.R, "Robots and Manufacturing Automation", John Wiley & Sons, New York,	1992

REFERENCE Books:

S.N	Name of books\author\publications	Year
1	Klafter R.P, Chmiclewski T.A, Negin M, "Robotics Engineering: Integrated approach", Prentice Hall,	1990
2	Y. Koren -Robotics for Engineers McGraw Hill	1983
3	Mikell P, Weiss G.M, Nagel R.N and Odrey N.G, "Industrial Robotics", McGraw Hill, New York.	1986
4	Deb S.R, "Robotics Technology and Flexible Automation", Tata McGraw Hill, New Jersey	1992
5	Asfahl -Robots & Manufacturing Automation Wiley Easter	1998
6	Richard D. Klafter -Robotic Engineering, , Prentice Hall	1989
7	Asada and Slow time -Robot Analysis and Intelligence, , Wiley Inter-Science.	1998
8	John J Craig -Introduction to Robotics, , Pearson Edu.	2005
9	Mark W. Spong and M. Vidyasagar -Robot Dynamics & Control –, John Wiley & Sons	2003

LECTURE PLAN

S.N	CONTENTS	Contact hours
I	**INTRODUCTION-**	**6**
	Introduction: Basic concepts, definition and origin of robotics,	2
	different types of robots,	1
	robot classification,	1
	applications,	1
	robot specifications	1
II	**INTRODUCTION TO AUTOMATION** –	**10**
	Components and subsystems,	2
	basic building block of automation,	2
	manipulator arms, wrists and end effectors.	2
	Transmission elements: Hydraulic, pneumatic and electric drives.	2

	Gears, sensors, materials, user interface, machine vision, implications for robot design, controllers.	2
III	**KINEMATICS, DYNAMICS AND CONTROL-**	**10**
	Object location, three dimensional transformation matrices,	2
	inverse transformation, kinematics and path planning,	2
	Jacobian work envelope,	1
	manipulator dynamics,	1
	dynamic stabilization,	1
	position control and force control,	2
	present industrial robot control schemes.	1
IV	**ROBOT PROGRAMMING-**	**7**
	Robot programming languages and systems,	2
	levels of programming robots,	2
	problems peculiar to robot programming,	2
	control of industrial robots using PLCs.	1
V	**AUTOMATION AND ROBOTS-**	**7**
	Case studies, multiple robots, machine interface,	2
	robots in manufacturing and non-manufacturing applications,	2
	robot cell design,	2
	selection of a robot.	1
	total	**40**

COURSE OUTCOME

Course outcomes :student will able to know	
1.	To **learn** the basics of robot designing.(K5)
2.	To **deal** with the depth of modern technology and utilize its knowledge.(K2)

3.	To have the clear **concept** of automation , microcontroller and kinematics.(K3)
4.	To **design** their own robots for simple application with cost effective and little effort.(K1)
5.	To **apply** their knowledge in real life.(K4)

CO – PO Mapping (1. Strong 2. Moderate 3. Low)

Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3	1	2	3							
CO2	2	2	1	2	3							
CO3	3	3	2	1	2							
CO4	2	2	3	1	2							
CO5	2	1	3	2	2							

Contents delivery method:

Class room lecture (chalk and board)

Visual presentation

Tutorial

RANDOM VARIABLE AND STOCHASTICS PROCESS

6EIU06.3	**RANDAM VARIABLE& STOCHASTICS PROCESS**	**L**	**P**	**MARKS**
	Total Hours-40	3	0	150

SYLLABUS

PROBABILITY - Introduction, definitions, conditional probability, combined experiments.

RANDOM VARIABLES - Introduction, Distribution and density functions, Discrete and continuous random variables, (Gaussian), Exponential, Rayleigh, Uniform, Bernoulli, Binominal, Poisson, discrete Uniform and conditional distributions. Functions of one random variable: distribution, mean, variance, moments and characteristics functions.

MULTIPLE RANDOM VARIABLES -distributions, Pne function of two random variables, Two functions of two random variables, Joint moments, Joint characteristics functions, Conditional distributions, conditional

expected values, statistical independence. Multiple random variables: multiple functions of multiple random variables, jointly Gaussian random variables, sums of random variable, Central limit theorem.

STOCHASTIC PROCESSES - Definitions, Random process concept, Statistics of stochastic processes: mean, autocorrelation, strict and wide sense stationary, random processes and Linear Systems.

STOCHASTIC PROCESSES IN FREQUENCY DOMAIN – Power spectrum of stochastic processes, Transmission over LTI systems, Gaussian and White processes, Properties of power spectral density.

TEXT BOOKs:

S.N	Name of books\authors\publications	Year
1	1. Probability, Random Variables And Random Signal Principles, Peebles, TMH.	2002
2	2. Probability, Statistics And Random Processes, Veerarajan, TMH,	2002

REFERENCE BOOKs:

S.N	Name of books\authors\publications	Year
1	Probability, Random Variables And Random Processes, Schum's Outlines, TMH	2008
2	Digital Telephony, Bellamy, Wiley	2006
3	Schaum's Outline of Theory and Problems of Transmission Lines,TMH	1968
4	Probability, Random Variables And Stochastic Processes, Papoulis, TMH	2002
5	Probability & Statistics In Engg., Hines, Wiley	2003
6	An Introduction To Probability Theory & Its App., Feller, Wiley	2008
7	Probability and Statistics for Engineering and the Sciences , Devore, Cengage learning	2009
8	Introduction to Probability and Statistics, Mendenhall , Cengage learning	2011

LECTUTRE PLAN

	CONTENTS	CONTACT HOURS

	PROBABILITY –	**7**
	Introduction, definitions,	2.5
	conditional probability,	2.5
	combined experiments.	2
	RANDOM VARIABLES –	**8**
	Introduction, Distribution and density functions,	1
	Discrete and continuous random variables,	1
	Gaussian, Exponential, Rayleigh, Uniform,	2
	Bernoulli, Binominal, Poisson,	1
	discrete Uniform and conditional distributions.	1
	Functions of one random variable: distribution, mean, variance, moments and characteristics functions.	2
	MULTIPLE RANDOM VARIABLES –	**9**
	distributions, Pne function of two random variables,	1
	Two functions of two random variables,	1
	Joint moments, Joint characteristics functions,	1
	Conditional distributions, conditional expected values,	1
	statistical independence.	1
	Multiple random variables: multiple functions of multiple random variables,	2
	jointly Gaussian random variables,	0.5
	sums of random variable,	0.5
	Central limit theorem.	1
	STOCHASTIC PROCESSES –	**7**
	Definitions, Random process concept,	1
	Statistics of stochastic processes: mean, autocorrelation,	2
	strict and wide sense stationary,	2
	random processes and Linear Systems.	2
	STOCHASTIC PROCESSES IN FREQUENCY DOMAIN –	**9**
	Power spectrum of stochastic processes,	3
	Transmission over LTI systems,	2
	Gaussian and White processes,	2
	Properties of power spectral density.	2
	total	**40**

COURSE OUTCOME

Course outcome	Student will able to
1.	To **develop** the basic skill to understand probability and random variables in day to day life.(K3)
2.	The **ability** to deal with different variable random process and their functionability.(K1)
3.	To d**evelop** the knowledge regarding stochastics process and its application.(K5)

4.	To **learn** the different relation between the different variable random process.(K4)
5.	To increase the **ability** to apply the knowledge in daily life problems.(K2)

CO – PO Mapping (1. Strong 2. Moderate 3. Low)

Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	3	1							
CO2	2	1	3	1	2							
CO3	3	3	1	2	2							
CO4	1	2	1	3	2							
CO5	2	1	2	3	3							

Contents delivery method:
Class room lecture (chalk and board)
Visual presentation
Tutorial

MICROPROCESSOR AND MICROCONTROLLER LAB

6EIU07	MICROPROCESSOR AND MICROCONTROLLER LAB	2P	MAX MARKS
			50

List of experiments

Following exercises are to be done in 8051 Assembly Language.

Simple programs

1. Add 'N' 8 Bit Numbers
2 .Transfer Data from Code Memory to Internal Memory
3 .Convert a given Hex number to BCD
4. Implement a Four Variable Boolean Function using K-Map Minimization.
5 .Convert deg. Centigrade to deg. Fahrenheit.

Complex programs

6 .16 bit Multiplication (use add and shift method)
7 .Find Largest and Smallest Numbers among 10 Numbers.
8 .Using Look up Table and DPTR as the Base find Square of a Number in the Accumulator
9 .Implement a Mathematical Calculator which executes various Arithmetic operations based on the choice entered in register R4.

8051 Interfacing Programs

10. Interface LED Bank with 8051 to flash LED's using timer.
11 .Interface Seven Segment Display with 8051.
12 .Interface Stepper Motor with 8051 in Continuous and Step mode

13 .Interface D/A converter with 8051. 14 .Interface A/D converter MCP3204 with 8051 using SPI.

CO – PO Mapping (1. Strong 2. Moderate 3. Low)

1.

Lab outcome		Student will able to										
1.		Students will be **able** to do programming on 8051 microcontroller.										
2.		**learn** the basic knowledge regarding simple programming in microcontrollers and microprocessor.										
3.		Students will be **able** to do microprocessor and microcontroller based projects.										
4.		To **learn** the interfacing technique with the help of 8051 interfacing programs.										
5.		To **apply** these knowledge in practical life and numerous projects.										
MAPPING	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	2	1	3							
CO2	3	1	3									
CO3	3	2	1	2	3							
CO4	2	1	2	3								
CO5	1	3	2	2								

ELECTRONICS INSTRUMENT LAB

6EIU08	ELECTRONICS INSTRUMENT LAB	2P	MAX MARKS
			75

Contents

Measurement of following parameters of op-amp :

1.(a) Input impedance.
(b) Output impedance.
(c) Input & Output offset voltage.
(d) Input bias currents.
(e) Slew rate.
(f) Supply voltage rejection ratio (SVRR).
(g) Common mode rejection ratio (CMRR).
(h) Gain Bandwidth product.
(i) Power consumption.
(j) Transient response.

Study & make the following circuits on breadboard using op-amplifiers.

2 (a) Differentiator
(b) Integrator
3 (a) Wein's Bridge Oscillator
(b) RC Phase shift Oscillator
4 Following filters for first order response.
(a) High pass filter
(b) Low pass filter
(c) Notch filter
5 Wave generators –
(a) Square wave generator
(b) Saw tooth Generator
6 Instrumentation amplifier.

7 A Comparator.
8 (a) Voltage to current converter.
(b) Current to voltage converter.
9 Frequency divider
Study and make the following circuits on bread board using 555 timer & determine the o/p frequency and Duty cycle:
10. (a) Astable multivibrator
(b) Monostable multivibrator
(c) Bistable multivibrator

Lab outcome	Student will able to
1.	To be able to **apply** the theatrical knowledge in practical life and solve many problems.
2.	To **learn** the concept of electronics designing.
3.	The **ability** to understand the multiple uses of a simple op-amp.
4.	To be **able** to make projects using IC and know its applications.
5.	To have the **practical** knowledge of basic circuits of electronics designing.

CO –PO Mapping (1. Strong 2. Moderate 3. Low)

mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	1	3							
CO2	2	1	3	2								
CO3	2	1	3									
CO4	2	3			1							
CO5	2	1		3								

CONTROL SYSTEM SIMULATION LAB -1

6EIU09	CONTROLSYSTEM SIMULATION LAB -1	L	MAX MARKS
		2P	50

CONTENTS

1. Introduction to `Matlab'. Computing control software, defining systems in TF, ZPK form.
2 .Use of for, while loops in Matlab programming.
3 .(a). Plot step response a given TF and system in state-space. Take different valves of damping ratio and natural undamped frequency and observe the difference.

(b). Plot ramp and impulse response for the same.
4. For a given 2nd order system write a program to obtain time response specifications maximum overshoot, peak time, settling time etc.
5. Write a program to check for the stability of a given closed loop system by
(a) Finding close loop poles (b) using Routh's stability criterion.
6. Sketch the root locus for a given system and determine the system gain. Also simulate the same using MATLAB.
7. Sketch the Bode plot (actual and asymptotic) for a given system and analyse the stability. Also simulate the same using MATLAB and find the values of GM and PM for different values of gain.
8 .Design of lead controller to satisfy given specifications using bode plot.
9. Use MATLAB to plot Nyquist plot for a given system and comment upon stability.
10. To design a PID controller for the given system to meet desired specifications. Observe the response using MATLAB.

Lab outcome	Student will able to
1.	To **understand** the control system and its different types practically.
2.	To **develop** the understanding of MATLAB programming.
3.	To **plot** the bode plot, Nyquist plot for the given system.
4.	To **find** out the root locus of the system practically.
5.	To **develop** the practical understand of the subject.

CO –PO Mapping(1. Strong 2. Moderate 3. Low)

mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	3	1								
CO2	3	2	1	2								
CO3	2	3	1	2								
CO4	2	1	2	3								
CO5	1	3	2	3								

PROCESS CONTROL LAB

6EIU10	**PROCESS CONTROL LAB**	**2P**	**MAX MARKS**
			75

Contents

1. To perform experiments on Linear system simulator.
2. To draw response of temperature controlled process for On/Off, P, PI, PID Controller.
3. Tuning of controllers on a pressure loop.
4. To study the design and application of Lag compensator circuits.
5. To study the design and application of Lead compensator circuit.
6. To study process simulator.
   (a) To perform experiments on P, PI, PD, PID controller with Process simulation.
   (b) To study the effect of loading the process.
7. To study the operation of linear & equal percentage type control valves and determine the Following:-
   (i) Valve flow coefficient
   (ii) characteristics of control valve
   (iii) Rangeability of control valves.
8. To perform experiments on Ratio Control Scheme and Cascade Control Scheme on liquid level and flow system.
9. To plot and analyze step/impulse response of a first order system in
   (i) Non interacting mode (ii) Interacting mode.
10. (a) Study of basic logic operations, timer, counter, arithmetic operations in PLC.
    (b) Problem solving In PLC.
    (c) To perform experiments on PLC controlled process.

Lab outcome	Student will able to
1.	To **analyze** different types of process simulation.
2.	To **design** the step and impulse response of the PLC control system.
3.	To **study** the process simulation and know the effect of various loading process.
4.	To **understand** the basic logic operations and arithmetic operation on PLC.
5.	To **develop** the problem solving technique using PLC.

CO –PO Mapping (1. Strong 2. Moderate 3. Low)

mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3	1								
CO2	2	1	3	2								
CO3	3	1	2	2								
CO4	1	2	1	3								
CO5	2	3	1	2								

PROFESSINOAL ETHICS AND DISASTER MANAGEMENT

6EIU11	PROFESSIONAL ETHICS AND DISASTER MANAGEMENT		MAX MARKS
		2P	50

CONTENTS

1.**Issues on ethics and values**: Moral and ethical values, classification of values , value system, deterioration of social values, social norms & social control.

2.**Profession , professionalism &ethics**: Professional responsibilities, competencies and expectations .Role of a professional , person, professional accountability and professional ethics .

3. **Ethics in engineering and disaster management**: Engineering professionals , role of engineers ,technology & society ,engineering as social experimentation , engineering ethics.

4. **Types of disasters:** Environmental, economic & social disasters ; causes , impact and prevention , Case studies.

5. **Thoughts of ethics**

Text books:

S.N	Name of books\author\publications	Year
1	Engineering Ethics: Concepts & Cases by Harris, Cengage Learning	2013

Course outcome	Student will able to
1.	To **develop** the professional knowledge as well as technical knowledge.
2	To **learn** how to behave in a right manner.
3.	To **develop** good moral character.
4.	To **understand** the importance of human values and ethics.
5.	To **value** the moral ethics.

CO – PO Mapping(1. Strong 2. Moderate 3. Low)

mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						3		2	1			
CO2							1	3			2	
CO3							2		1	3		
CO4							1	3	2			
CO5							3		1	2		

ELECTRONICS INSTRUMENTATION & CONTROL

SYLLABUS

7EI1A NEURAL NETWORKS AND FUZZY LOGIC CONTROL

L:-3 T:-0 **M.M.-100**

NEUROPHYSIOLOGY: Introduction: Elementary neurophysiology – From neurons to ANNs - Neuron model McCulloch-Pitts model, Hebbian Hypothesis; limitations of single-layered neural networks.
Applications Of Neural Networks: Pattern classification, Associative memories, Optimization, Applications in Image Processing-Iris, finger print & face, Applications in decision making.

THE PERCEPTRON: The Perceptron and its learning law. Classification of linearly separable patterns. Linear Networks: Adaline - the adaptive linear element. Linear regression. The Wiener-Hopf equation. The Least-Mean-Square (Widrow-Hoff) learning algorithm. Method of steepest descent. Adaline as a linear adaptive filter. A sequential regression algorithm.

Multi-Layer Feedforward Neural Networks: Multi-Layer Perceptrons. Supervised Learning. Approximation and interpolation of functions. Back-Propagation Learning law. Fast training algorithms. Applications of multilayer perceptrons: Image coding, Paint-quality inspection, Nettalk.

FUZZY LOGIC: Introduction -Uncertainty & precision, Statistics and random process, Uncertainty in information, Fuzzy sets and membership.
Membership Functions: Features of membership function. Standard forms and boundaries, Fuzzification, Membership value assignment – Intuition, Inference, Neural networks.
Fuzzy To Crisp Conversions: Maximum membership principle.

DEFUZZIFICATION METHODS- Centroid method, Weighted average
method, Meanmax membership.
Fuzzy Rule Based Systems: Natural language, linguistic hedges, Rule based system –Canonical rule forms, Decomposition of compound rules, Likelihood and truth qualification Aggregation of Fuzzy rules. Graphical techniques of reference.

FUZZY CONTROL SYSTEM- Simple Fuzzy Logic controller, General FLC, Control System Design Problem Control (Decision) Surface, Assumptions in a Fuzzy Control System Design, Special forms of FLC system models, Industrial application: Aircraft Landing Control Problem.
Fuzzy Engineering Process Control: Classical Feedback Control, Classical PID Control, Multi-input, Multi-output (MIMO) Control Systems, Fuzzy Statistical Process Control

Text Books

S.No.	Name of Book/publication/Authors	Publication Year
1.	S.N. Sivanandam, S. Sumathi and S.N. Deepa -Introduction to Neural Networks using MATLAB 6.0, Tata McGraw-Hill	2006
2.	Timothy J. Ross -Fuzzy Logic with Engineering Applications, Third Edition	1995

Reference Books

S.No.	Name of Book/publication/Authors	Publication Year
1	Artificial Neural Network,Robert Schalloff, TMH	1997
2	Fundamental Of Neural Network Architecture And Application,Laurene V. Fausett,Pearson	1993
3	Neural Network Algorithm And Programing Tech,James A Freeman,Pearson	1991
4	Neural N/W For Pattern Recognition,Cristopher, M.Bhishop,Oxford	1995
5	Fuzzy Neuro Approach To Agent Application,Lee ,Raymond S.T.,New Age	2008
6	Fuzzy Logic and Neural Networks: Basic Concept And Application,A Lavala, Chemakesava R.,New Age	2012

LECTURE PLAN

7EI1A	**Neural Networks & Fuzzy Logic Control**	**L**	**T**	**P**	**Marks**
	Total Hours - 40	**3**	**0**	**0**	**100**

Contents

Unit	Contents	Contact Hours
I	**NEUROPHYSIOLOGY & APPLICATIONS OF NEURAL NETWORKS**	**6**
	Introduction: Elementary neurophysiology	1
	Neuron model McCulloch-Pitts model	1
	Hebbian Hypothesis; limitations of single-layered neural networks	1

	Application in Pattern classification, Associative memories, Optimization	1
	Applications in Image Processing-Iris, finger print & face	1
	Applications in decision making	1
II	**THE PERCEPTRON, LINEAR NETWORKS & MULTI-LAYER FEEDFORWARD NEURAL NETWORKS**	**10**
	The Perceptron and its learning law	1
	Classification of linearly separable patterns	1
	Adaline - the adaptive linear element, Linear regression.	1
	The Wiener-Hopf equation. The Least-Mean-Square (Widrow-Hoff) learning algorithm.	1
	Method of steepest descent. Adaline as a linear adaptive filter. A sequential regression algorithm	1
	Multi-Layer Perceptrons, Supervised Learning.	1.5
	Approximation and interpolation of functions. Back-Propagation Learning law	1.5
	Fast training algorithms. Applications of multilayer perceptrons: Image coding, Paint-quality inspection, Nettalk.	2
III	**FUZZY LOGIC, MEMBERSHIP FUNCTIONS & FUZZY TO CRISP CONVERSIONS**	**8**
	Introduction -Uncertainty & precision	1
	Statistics and random process, Uncertainty in information	1
	Fuzzy sets and membership	1
	Features of membership function	1
	Standard forms and boundaries	1
	Fuzzification, Membership value assignment – Intuition, Inference	1.5
	Neural networks & Maximum Membership Principle	1.5
IV	**DEFUZZIFICATION METHODS & FUZZY RULE BASED SYSTEMS**	**8**
	Centroid method	1
	Weighted average method	1
	Meanmax membership	1
	Natural language, linguistic hedges	1

	Rule based system –Canonical rule forms, Decomposition of compound rules	2
	Likelihood and truth qualification Aggregation of Fuzzy rules	1
	Graphical techniques of reference	1
V	**FUZZY CONTROL SYSTEM & FUZZY ENGINEERING PROCESS CONTROL**	**8**
	Simple Fuzzy Logic controller	1
	General FLC, Control System Design Problem Control (Decision) Surface	1.5
	Assumptions in a Fuzzy Control System Design, Special forms of FLC system models	1
	Industrial application: Aircraft Landing Control Problem	1.5
	Classical Feedback Control	1
	Classical PID Control, Multi-input, Multi-output (MIMO) Control Systems	1
	Fuzzy Statistical Process Control	1
	Total	**40**

Course Outcomes

The students of the course should be able to

CO1 – Discuss the elementary neurophysiology with the study of Neurons and different models & applications for Neural Networks**.** (K2)

CO2 - Describe the perceptron, the linear networks & the Multi-Layer Feed forward Neural Networks (K2).

CO3 – Explain the Fuzzy Logics, their uncertainty & precision & the Membership Function. (K6)

CO4 - Illustrate the Defuzzification Methods & Fuzzy Rule based Systems (K4).

CO5 – Examine Fuzzy Control Systems & Fuzzy Engineering Process Control & their applications (K3)

CO-PO Mapping (3-Strong, 2-Moderate and 1- Weak)

7EI1A / Neural Networks		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1	3		2		1										

& Fuzzy Logic Control	CO2	3			2	1										
	CO3	3			2	1										
	CO4	2	3		1											
	CO5	3		2	1											

Content Delivery Method

- Class room lecture (chalk and board) (D1)
- Visual presentation (D2)
- Tutorial (D3)

SYLLABUS

7EI2A DIGITAL SIGNAL PROCESSING

L:-3 T:-1 **M.M.-100**

SAMPLING - Discrete time processing of Continuous-time signals, continuous time processing of discrete-time signals.
Changing the sampling rate using discrete-time processing.

TRANSFORM ANALYSIS OF LTI SYSTEMS - Introduction, The frequency response of LTI systems, System functions for systems characterized by LCCD (Linear Constant Coefficient Difference) equations.
All-pass system, Minimum-Phase systems, linear systems with linear phase.

STRUCTURES FOR DISCRETE-TIME SYSTEMS- Block diagram and signal flow graph representation of LCCD equations.
Basic structures for IIR and FIR systems, Transposed forms.

FILTER DESIGN TECHNIQUES - Introduction, Analog filter Design: Butterworth & Chebyshev
IIR filter design by impulse invariance & Bilinear transformation.
Design of FIR filters by Windowing: Rectangular, Hanning, Hamming & Kaiser.

DFT, FFT- The Discrete Fourier transform (DFT), Properties of the DFT, Linear Convolution using DFT. Efficient computation of the DFT: Decimation–in-Time and Decimation-in frequency FFT Algorithms.

Text Books

S.No.	Name of Book/publication/Authors	Publication Year
1.	Proakis, Manolakis, "Digital Signal Processing: Principals, Algorithms And Applications", 4th ed., Pearson Education.	2006
2.	Oppenheim, Schafer, "Discrete Time Signal Processing", 3rd ed. , PHI	2010

Reference Books

S.No.	Name of Book/publication/Authors	Publication Year
1	Digital Signal Processing: A Modern Introduction,_Ambardar, cengage learning.	2011
2	Introduction to Digital Signal Processing using MATLAB,_Schilling.	2011

3	Sanjit K Mitra, “Digital Signal Processing”, 4th ed., TMH	2013
4	Tan, Jiang, “Digital Signal Processing: Fundamentals and Applications”,2nd ed., Elsevier	2008
5	Ifeachor, Jervis, “Digital Signal Processing”, 2nd ed., Pearson Education.	2009

LECTURE PLAN

7EI2A	DIGITAL SIGNAL PROCESSING	L	T	P	Marks
	Total Hours – 40	3	1	0	100

Contents

Unit	Contents	Contact Hours
I	**SAMPLING**	**7**
	Discrete time processing of Continuous-time signals.	2.5
	Continuous time processing of discrete-time signals.	2.5
	Changing the sampling rate using discrete-time processing.	2
II	**TRANSFORM ANALYSIS OF LTI SYSTEMS**	**7**
	Introduction	1
	The frequency response of LTI systems	1
	System functions for systems characterized by LCCD (Linear Constant Coefficient Difference) equations	2
	All-pass system	1
	Minimum-Phase systems	1

	Linear systems with linear phase	1
III	**STRUCTURES FOR DISCRETE-TIME SYSTEMS**	**7**
	Block diagram and signal flow graph representation of LCCD equations.	2
	Basic structures for IIR systems	1.5
	Basic structures for FIR systems	1.5
	Transposed forms	2
IV	**FILTER DESIGN TECHNIQUES**	**10**
	Introduction	1
	Analog filter Design: Butterworth & Chebyshev	2
	IIR filter design by impulse invariance.	1
	IIR filter design by Bilinear transformation	1
	Design of FIR filters by Windowing: Rectangular	2
	Hanning Window	1
	Hamming & Kaiser Window	2
V	**DFT, FFT**	**9**
	The Discrete Fourier transform (DFT)	2
	Properties of the DFT	2
	Linear Convolution using DFT	1
	Efficient computation of the DFT: Decimation–in-Time FFT Algorithms	2
	Decimation-in frequency FFT Algorithms	2
	Total	**40**

Course Outcomes

The students of the course should be able to

CO1 - Evaluate Sampling, Discrete time processing of Continuous-time signals & continuous time processing of discrete-time signals**.** (K6)

CO2 – Deduce Transform Analysis, Frequency Response of LTI Systems. Study of All-pass system, Minimum-Phase systems, linear systems with linear phase (K4).

CO3 – Explain the Structures for Discrete-Time Systems, IIR and FIR systems. (K6)

CO4 - Illustrate various Filter Designing Techniques (K4).

CO5 - Interpret Discrete Fourier Transform (DFT) & FFT Algorithms (K2)

CO-PO Mapping (3-Strong, 2-Moderate and 1- Weak)

7EI2A / DIGITAL SIGNAL PROCESSING		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1	2	3	1												
	CO2	3	2		1											
	CO3	3		2	1											
	CO4		1	3		2										
	CO5	2		1		3										

Content Delivery Method

- Class room lecture (chalk and board) (D1)
- Visual presentation (D2)
- Tutorial (D3)

SYLLABUS

7EI3A DIGITAL IMAGE PROCESSING

L:-3 T:-1 **M.M.-100**

DIGITAL IMAGE FUNDAMENTALS: Image sensing and acquisition, Image sampling and quantization, Representing digital images, Spatial and gray-level resolution.
Spatial operations, Vector & matrix operations, Zooming and Shrinking of digital images. RGB and HSI Color models.

BASIC IMAGE OPERATIONS: Intensity transformation functions, Histogram equalization, Spatial filtering for image smoothing.
Image sharpening by first and second order derivatives, Image smoothing and sharpening using frequency domain filters.

IMAGE RESTORATION: Image restoration model, Noise Models, Spatial and frequency properties of noise, noise probability density Functions.
Noise only- spatial filter, Mean, order Statistic and adaptive filters, Concepts of inverse and Wiener filtering.

MORPHOLOGICAL IMAGE PROCESSING: Erosion and Dilation, Opening and closing, morphological algorithms for Boundary extraction, thinning, pruning, smoothing and thickening.

IMAGE SEGMENTATION AND COMPRESSION: Edge based segmentation, Edge detection masks, Gradient operators.
Thresholding, Region growing, Watershed transform.
Fundamentals of image compression; Loss-less compression techniques; Lossy compression techniques, compression standards.

Text Books

S.No.	Name of Book/publication/Authors	Publication Year
1.	Gonzalez, Woods and Eddins, "Digital Image Processing", 3rd ed. , Pearson Education	2010
2.	Anil K Jain, "Fundamentals of Digital Image Processing", 4th ed., Prentice Hall	2010

Reference Books

S.No.	Name of Book/publication/Authors	Publication Year
1	Tamal Bose, "Digital Signal and Image Processing", ", 3rd ed. , John Wiley	2005
2	Sonaka,Hlavac and Boyle, "Image Processing, Analysis and Machine Vision", 3rd ed. , Cengage Learning	2013
3	Pratt, "Digital Image Processing", 4th ed. , John Wiley	2001
4	Image Processing, Analysis, and Machine Vision,_ Sonka, cengage learning	2006

LECTURE PLAN

7EI3A	DIGITAL IMAGE PROCESSING	L	T	P	Marks
	Total Hours – 40	**3**	**1**	**0**	**100**

Contents

Unit	Contents	Contact Hours
I	**DIGITAL IMAGE FUNDAMENTALS**	**6**
	Image sensing and acquisition	1
	Image sampling and quantization	1
	Representing digital images, Spatial and gray-level resolution	1
	Spatial operations, Vector & matrix operations	1
	Zooming and Shrinking of digital images	1
	RGB and HSI Color models	1
II	**BASIC IMAGE OPERATIONS**	**8**
	Intensity transformation functions.	1
	Histogram equalization.	1
	Spatial filtering for image smoothing.	1
	Image sharpening by first and second order derivatives	2.5
	Image smoothing and sharpening using frequency domain filters	2.5
III	**IMAGE RESTORATION**	**8**
	Image restoration model & Noise Models	1
	Spatial and frequency properties of noise	1
	noise probability density functions	1
	Noise only- spatial filter, Mean, order Statistic and adaptive filters	2.5
	Concepts of inverse and Wiener filtering	2.5

IV	**MORPHOLOGICAL IMAGE PROCESSING**	**8**
	Erosion and Dilation	1.5
	Opening and closing	1.5
	Morphological algorithms for Boundary extraction	2
	Pruning, smoothing and thickening	3
V	**IMAGE SEGMENTATION AND COMPRESSION**	**10**
	Edge based segmentation.	1
	Edge detection masks.	1
	Gradient operators.	1
	Thresholding & Region growing.	1.5
	Watershed transform.	1.5
	Fundamentals of image compression	1
	Loss-less compression techniques	1
	Lossy compression techniques	1
	Compression standards	1
	Total	**40**

Course Outcomes

The students of the course should be able to

CO1 - Evaluate Digital Image Fundamentals, different operations performed on the image**.** (K5)

CO2 – Analyse the basic Image operations (K2).

CO3 – Infer about the Image Restoration & Noise Models. (K4)

CO4 - Illustrate the Morphological Image Processing Algorithms (K4).

CO5 – Explain the different Image segmentation & Compression techniques in detail (K6)

CO-PO Mapping (3-Strong, 2-Moderate and 1- Weak)

7EI3A / DIGITAL IMAGE PROCESSING		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1	3		2	1											
	CO2	2	3	1												
	CO3	3		2	1											
	CO4	1		2		3										
	CO5	3			1	2										

Content Delivery Method

- Class room lecture (chalk and board) (D1)
- Visual presentation (D2)
- Tutorial (D3)

SYLLABUS

7EI4A ANALYTICAL & ENVIRONMENTAL INSTRUMENTATION

L:-3 T:-0 **M.M.-100**

SPECTROSCOPIC ANALYSIS- Absorption and reflection techniques, Atomic techniques emission, absorption and fluorescence, X-ray spectroscopy, Photo acoustic spectroscopy, Microwave spectroscopy, Mass spectrometers.

GAS ANALYSIS - Infrared and ultraviolet absorption analyzers, Paramagnetic oxygen analyzers, Thermal conductivity analyzers and Chemiluminescence analyzers.

CHROMATOGRAPHY- Paper and thin layer chromatography. Basic parts of gas chromatography, Types of columns, Detection systems- thermal conductivity, Flame ionization, Electron capture detector. Types of liquid
chromatography, Liquid chromatography, Column and detection systems.

ENVIRONMENTAL POLLUTION MONITORING- Air pollutants, Air pollution monitoring instruments- carbon mono oxide, sulpher dioxide, nitrogen oxide, hydro carbon & ozone. Smoke monitor, Dust monitor, Visible emission monitoring system.

LIQUID ANALYSIS- PH meter, Conductivity meter, Analyzers for measurement of ammonia, silica, sodium and dissolved oxygen.

Text Books

S.No.	Name of Book/publication/Authors	Publication Year
1.	Instrumentation technology, Jones E.B., Newnes-Butterworths.	1974

Reference Books

S.No.	Name of Book/publication/Authors	Publication Year
1	Instrument Engineer's Hand Book, Process Meas. & Analysis, Bela G. Liptak, Butterworth-Heinemann Ltd.	1995
2	Mechanical & Industrial Measurements, Jain R.K., Khanna Publications	1988
3	Handbook of Analytical Instruments, Khandpur R.S., Tata McGraw Hill.	2006
4	Principles of instrumental Analysis, Douglas A Skoog, Cengage Leaning.	1998

LECTURE PLAN

7EI4A	**ANALYTICAL & ENVIRONMENTAL INSTRUMENTATION**	**L**	**T**	**P**	**Marks**
	Total Hours – 40	**3**	**0**	**0**	**100**

Contents

Unit	Contents	Contact Hours
I	**SPECTROSCOPIC ANALYSIS**	**6**
	Absorption and reflection techniques, Atomic techniques emission	1
	Absorption and fluorescence	1
	X-ray spectroscopy	1
	Photo acoustic spectroscopy	1
	Microwave spectroscopy	1
	Mass spectrometers	1
II	**GAS ANALYSIS**	**8**
	Infrared and ultraviolet absorption analyzers	2
	Paramagnetic oxygen analyzers	2
	Thermal conductivity analyzers	2
	Chemiluminescence analyzers	2
III	**CHROMATOGRAPHY**	**10**
	Paper and thin layer chromatography	1
	Basic parts of gas chromatography	1
	Types of columns, Detection systems- thermal conductivity	2
	Flame ionization	1
	Electron capture detector	1
	Types of liquid chromatography, Liquid chromatography	2
	Column and detection systems	2
IV	**ENVIRONMENTAL POLLUTION MONITORING**	**10**
	Air pollutants	1
	Air pollution monitoring instrument- carbon mono oxide	1.5
	Air pollution monitoring instrument- sulpher dioxide	1.5
	Air pollution monitoring instrument- nitrogen oxide	1.5

	Air pollution monitoring instrument- hydro carbon & ozone	1.5
	Smoke monitor	1
	Dust monitor	1
	Visible emission monitoring system	1
V	**LIQUID ANALYSIS**	**6**
	PH meter	1
	Conductivity meter	1
	Analyzers for measurement of ammonia	1
	Analyzers for measurement of silica	1
	Analyzers for measurement of sodium	1
	Analyzers for measurement of dissolved oxygen	1
	Total	**40**

Course Outcomes

The students of the course should be able to

CO1 - Discuss the various Spectroscopic analysis**.** (K2)

CO2 – Analyse the different Gas analyzers. (K2)

CO3 - Infer about the basics of Chromatography. (K4)

CO4 - Illustrate the Environmental Pollution Monitoring & systems to control. (K4)

CO5 - Investigate the PH meter, Conductivity meter & various Analyzers to study Liquid Analysis. (K4)

CO-PO Mapping (3-Strong, 2-Moderate and 1- Weak)

7EI4A / ANALYTICAL & ENVIRONMENTAL INSTRUMENTATION		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1	3		2	1											
	CO2	2	3	1												
	CO3	3		2	1											
	CO4	2		1		3										
	CO5	1	3			2										

Content Delivery Method

- Class room lecture (chalk and board) (D1)
- Visual presentation (D2)
- Tutorial (D3)

SYLLABUS

7EI4A INSTRUMENTATION IN INDUSTRIES

L:-3 T:-0 M.M.-100

PROCESS INDUSTRIES INSTRUMENTATION – Organisation for Instrument Engineering, Instrument department functions & responsibilities, Process industries instrumentation, Man power classifications, Power plant training in instrumentation, Standardisation of instrumentation, Specialised process plant instrumentation.

C&I IN CHEMICAL REACTORS – Classifications, Temperature Control Schemes, Reactor Temperature Control, Reactor Temperature Control with recirculation. Cascade Temperature Control with heating & cooling capability. Pressure Control Schemes – Reactor Pressure Control by modulating gas make up, Reactor Pressure Control by throttling flow of vent gas, Continuous Control of Reactor Pressure.

C& I IN HEAT EXCHANGERS – Classifications.
Steam Heaters Control Schemes –Feedback control of steam heated exchanger, Control valve in condensate line, Pumping traps, Steam trap replaced by level control, By pass control.

Condensers Control Schemes– Condenser on temperature control, Condenser on Pressure Control, Condenser control by changing the wetted surface area, Hot gas by-pass control.

Reboilers & Vaporizers Control Schemes – Temperature – Pressure cascade control loop on steam heater, Temperature- Flow cascade control loop on steam reboiler.

C&I IN EVAPORATORS, DRYERS AND PUMPS – Principles & Classifications, Control Schemes of Evaporators- Horizontal tube, Forced circulation, Short tube vertical, Falling film, Long tube vertical, Agitated film evaporators.

DRYERS- Principles & classifications of dryers, Control of batch and continuous dryers,
PUMPS - Classification & Control schemes for pumps.

STEAM POWER PLANT INSTRUMENTATION – Selection of instrumentation, Power plant measurement (primary & secondary), Automatic control systems : Feed water control, Steam temperature control, Auxiliary control systems, Interlocks, Data logging & Computing equipments.

Text Books

S.No.	Name of Book/publication/Authors	Publication Year
1.	Instrument Engineer's Hand Book: Process Control, Bela G. Liptak, Chilton Book Co. Radnor, Pennsylvania	1995

Reference Books

S.No.	Name of Book/publication/Authors	Publication Year
1	Industrial Instrumentation ,Krishnaswamy .K,New Age	2005
2	Fundaments Of Industrial Instrumentation And Process Control ,Willium Dunn,TMH	2009
3	Process Systems Analysis And Control,Donald Coughanowr,TMH	2010
4	Process/Industrial Instruments And Control Hand Book,Gregory Mcmillan,TMH	2009
5	Process Control - Principles And Applications,Bhanot,Oxford	2008
6	Process Dynamics Control ,Dale E. Seborg,Oxford	2010
7	Advanced Process Control: Beyond Single Loop Control,Cecil Smith,Oxford	2010
8	Instrument Engineer's Hand Book: Process Measurement & Analysis, Bela G. Liptak, Butterworth-Heinemann Ltd.	1995
9	Industrial Instrumentation ,S K Singh,New Age	2010

LECTURE PLAN

7EI5A	**INSTRUMENTATION IN INDUSTRIES**	**L**	**T**	**P**	**Marks**
	Total Hours – 40	**3**	**0**	**0**	**100**

Contents

Unit	Contents	Contact Hours
I	**PROCESS INDUSTRIES INSTRUMENTATION**	**7**

	Organization for Instrument Engineering, Instrument department functions & responsibilities	1.5
	Process industries instrumentation	1
	Man power classifications	1
	Power plant training in instrumentation	1.5
	Standardization of instrumentation	1
	Specialized process plant instrumentation	1
II	**C&I IN CHEMICAL REACTORS**	**8**
	Classifications	1
	Temperature Control Schemes & Reactor Temperature Control	1.5
	Reactor Temperature Control with recirculation	1
	Cascade Temperature Control with heating & cooling capability	1.5
	Pressure Control Schemes – Reactor Pressure Control by modulating gas make up	1
	Reactor Pressure Control by throttling flow of vent gas	1
	Continuous Control of Reactor Pressure	1
III	**C& I IN HEAT EXCHANGERS**	**9**
	Classifications	1
	Steam Heaters Control Schemes- Feedback control of steam heated exchanger	1
	Control valve in condensate line	1
	Pumping traps, Steam trap replaced by level control, By pass control	1
	Condensers Control Schemes– Condenser on temperature control	1
	Condenser on Pressure Control	1
	Condenser control by changing the wetted surface area, Hot gas by-pass control	1
	Reboilers & Vaporizers Control Schemes – Temperature – Pressure cascade control loop on steam heater	1
	Temperature- Flow cascade control loop on steam reboiler.	1
IV	**C&I IN EVAPORATORS, DRYERS AND PUMPS**	**9**
	Principles & Classifications	1

	Control Schemes of Evaporators- Horizontal tube	1.5
	Forced circulation, Short tube vertical	1.5
	Falling film, Long tube vertical, Agitated film evaporators.	1.5
	DRYERS- Principles & classifications of dryers	1.5
	Control of batch and continuous dryers	1
	PUMPS - Classification & Control schemes for pumps	1
V	**STEAM POWER PLANT INSTRUMENTATION**	**7**
	Selection of instrumentation	1
	Power plant measurement (primary & secondary)	1
	Automatic control systems : Feed water control	1
	Steam temperature control	1
	Auxiliary control systems	1
	Interlocks, Data logging & Computing equipments	2
	Total	**40**

Course Outcomes

The students of the course should be able to

CO1 - Establish the basics of Process Industries Instrumentation (K5)

CO2 – Analyse the fundamentals of C& I in a range of Chemical Reactors. (K2)

CO3 - Interpret the principle C& I measures used in Heat Exchangers. (K3)

CO4 - Illustrate the C&I measures in Evaporators, Dryers & Pumps. (K4)

CO5 - Investigate the Instrumentation in Steam Power Plants & the use of equipments & control schemes. (K4)

CO-PO Mapping (3-Strong, 2-Moderate and 1- Weak)

7EI5A / INSTRUMENTATION IN INDUSTRIES		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1	2		3	1											
	CO2	2	3		1											
	CO3	3		2	1											
	CO4	2	3			1										
	CO5	1	3			2										

Content Delivery Method

- Class room lecture (chalk and board) (D1)
- Visual presentation (D2)
- Tutorial (D3)

SYLLABUS

7EI6.1A MICROWAVE ENGINEERING

L:-3 T:-0 **M.M.-100**

INTRODUCTION - Introduction to Microwaves and their applications, Transit time effect. Rectangular Wave-guides: Solution of Wave equation modes in rectangular waveguides, Basic idea of TE and TM modes, TEM mode of propagation.

MICROWAVE COMPONENTS - Theory and application of cavity resonators. Coupling to cavity, Q of Cavity resonators, Attenuators, Tees, Hybrid rings, Wave guide corners, Bends and twists, phase shifters, directional couplers, isolators, circulators.

MICROWAVE GENERATORS AND AMPLIFIERS - Theory of Velocity Modulation. Operation And Characteristics of Two-Cavity Klystron Amplifier, Reflex Klystron, TWT, Magnetrons.

MICROWAVE SOLID STATE DEVICES - Principle of working and applications of IMPATT diode; hot Carrier Diode, PIN Diode, Tunnel diode, Gun Diode, MASER amplifiers, CCD.

MICROWAVE MEASUREMENTS - Detection of Microwaves, Basic Methods of Measurement of Frequency, Power, Scattering Parameters, VSWR, Impedance.

Text Books

S.No.	Name of Book/publication/Authors	Publication Year
1.	Microwave Engineering, Annapurna Das, Sisir Das, TMH.	2009
2.	Microwave Devices And Circuits, 3, Samuel Y. Liao,Pearson	2006

Reference Books

S.No.	Name of Book/publication/Authors	Publication Year

1	Foundations For Microwave Engineering – R.E. Collin, R.E. Collin, Wiley	2001
2	Microwave Engineering By, Pozar, Wiley	2009
3	Microwave Devices And Circuit Design, Ganesh Prasad Srivastava, Vijay Laxmi Gupta, PHI	2006
4	Microwave Semiconductor Devices, Roy Mitra, PHI	2003
5	Microwave Engineering,_Raghuvanshi, cengage learning	2013

LECTURE PLAN

7EI6.1A	**MICROWAVE ENGINEERING**	**L**	**T**	**P**	**Marks**
	Total Hours – 40	**3**	**0**	**0**	**100**

Contents

Unit	Contents	Contact Hours
I	**INTRODUCTION**	**8**
	Introduction to Microwaves and their applications	1.5
	Transit time effect	1
	Rectangular Wave-guides: Solution of Wave equation modes in rectangular waveguides	2
	Basic idea of TE and TM modes	1.5

	TEM mode of propagation	2
II	**MICROWAVE COMPONENTS**	**8**
	Theory and application of cavity resonators	1
	Coupling to cavity	1.5
	Q of Cavity resonators, Attenuators	2
	Tees, Hybrid rings, Wave guide corners	1.5
	Bends and twists, phase shifters, directional couplers, isolators, circulators	2
III	**MICROWAVE GENERATORS AND AMPLIFIERS**	**8**
	Theory of Velocity Modulation	2
	Operation And Characteristics of Two-Cavity Klystron Amplifier	2
	Reflex Klystron	2
	TWT, Magnetrons	2
IV	**MICROWAVE SOLID STATE DEVICES**	**8**
	Principle of working and applications of IMPATT diode	2
	Hot Carrier Diode, PIN Diode	2
	Diode, Gun Diode	2
	MASER amplifiers, CCD	2
V	**MICROWAVE MEASUREMENTS**	**8**
	Detection of Microwaves	2
	Basic Methods of Measurement of Frequency	1.5
	Basic Methods of Measurement of Power	1.5
	Basic Methods of Measurement of Scattering Parameters	1.5
	Basic Methods of Measurement of VSWR, Impedance	1.5
	Total	**40**

Course Outcomes

The students of the course should be able to

CO1 – Establish the introduction to microwaves & their applications. (K5)

CO2 – Analyse the different microwave components. (K2)

CO3 - Interpret the microwave generators & amplifiers. (K3)

CO4 - Illustrate the microwave solid state devices in detail. (K4)

CO5 - Investigate the different parameters of microwave measurements. (K4)

CO-PO Mapping (3-Strong, 2-Moderate and 1- Weak)

7EI6.1A / MICROWAVE ENGINEERING		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1	3		2	1											
	CO2			3	2	1										
	CO3	3	2	1												
	CO4	1	2		3											
	CO5	1	3	2												

Content Delivery Method

- Class room lecture (chalk and board) (D1)
- Visual presentation (D2)
- Tutorial (D3)

SYLLABUS

7EI6.2A ADVANCED MICROPROCESSORS

L:-3 T:-0 **M.M.-100**

The 8086 Microprocessor Family: 8086 ARCHITECTURE- Hardware specifications, Pins and signals, Internal data operations and Registers, Minimum and maximum mode, System Bus Timing, Linking and execution of Programs.

Software & Instruction Set: Assembly language programming: addressing mode and instructions of 8086, Strings, Procedures and Macros, 8086 interrupts. Assembler Directives and operators.

Analog Interfacing: A/D and D/A converter interfacing, keyboard and display interfacing, RS 232 & IEEE 488 communication standards. An 8086 based Process Control Systems.

Digital Interfacing: Programmable parallel ports, Interfacing microprocessor to keyboard and alphanumeric displays, Memory interfacing and Decoding, DMA controller.

Multiprocessor Configurations: - Multiuser / Multi tasking operating system concepts, 8086 based Multiprocessor systems. Introduction and basic features of 286, 386, 486 & Pentium processors.

Text Books

S.No.	Name of Book/publication/Authors	Publication Year
1.	A Nagoor Kani "Microprocessors and Microcontrollers" Mc Graw Hill Education 2ed.	2012
2.	Douglas V. Hall "Microprocessors and Interfacing Programming and Hardware" Tata Mc Graw Hill.	2000

Reference Books

S.No.	Name of Book/publication/Authors	Publication Year
1	A. Ray & K. Bhurchandi. "Advanced Microprocessors and Peripherals. Tata Mc Graw Hill,	2012
2	A Nagoor Kani "Microprocessors and Microcontrollers" Mc Graw Hill Education 2ed.	2012
3	Introduction to Microprocessors, A. P. Mathur Mc Graw Hill	2011
4	The Intel Family of Microprocessors: Hardware and Software Principles and Applications, Antonakos, cengage learning	2012
5	The 8086 Microprocessor: Programming & Interfacing the PC, Ayala, cengage learning	2007

LECTURE PLAN

7EI6.2A	ADVANCED MICROPROCESSORS	L	T	P	Marks
	Total Hours – 40	**3**	**0**	**0**	**100**

Contents

Unit	Contents	Contact Hours
I	**THE 8086 MICROPROCESSOR FAMILY**	**8**
	8086 architecture- Hardware specifications, Pins and signals	1.5
	Internal data operations and Registers	1.5
	Minimum and maximum mode	1
	System Bus Timing	1
	Linking and execution of Programs.	3
II	**SOFTWARE & INSTRUCTION SET**	**8**
	Assembly language programming: addressing mode and instructions of 8086	3
	Strings, Procedures and Macros	2
	8086 interrupts	1.5
	Assembler Directives and operators	1.5
III	**ANALOG INTERFACING**	**8**
	A/D and D/A converter interfacing	2
	Keyboard and display interfacing	2

	RS 232 & IEEE 488 communication standards	2
	An 8086 based Process Control Systems	2
IV	**DIGITAL INTERFACING**	**8**
	Programmable parallel ports.	1.5
	Interfacing microprocessor to keyboard and alphanumeric displays.	3
	Memory interfacing and Decoding.	2
	DMA controller.	1.5
V	**MULTIPROCESSOR CONFIGURATIONS**	**8**
	Multiuser / Multi tasking operating system concepts.	2.5
	8086 based Multiprocessor systems	2.5
	Introduction and basic features of 286, 386, 486 & Pentium processors	3
	Total	**40**

Course Outcomes

The students of the course should be able to

CO1 – Generalise the architecture of 8086 microprocessors in detail . (K5)

CO2 – Deduce the assembly language programming & instructions of 8086 microprocessor. (K4)

CO3 - Interpret the analog interfacing of 8086 microprocessor. (K3)

CO4 - Illustrate the digital interfacing of 8086 microprocessor. (K4)

CO5 - Investigate the study of multiprocessors based on 8086 & other processors.. (K4)

CO-PO Mapping (3-Strong, 2-Moderate and 1- Weak)

7EI6.2A / ADVANCED MICROPROCESSORS		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1	3	2	1												
	CO2	2	3		1											
	CO3	1	2	3												
	CO4	2	3		1											
	CO5	1	2			3										

Content Delivery Method

- Class room lecture (chalk and board) (D1)
- Visual presentation (D2)
- Tutorial (D3)

SYLLABUS

7EI6.3A ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS

L:-3 T:-0 M.M.-100

Introduction to Artificial Intelligence: Intelligent Agents, State Space Search, Uninformed Search, Informed Search, Two Players Games, Constraint Satisfaction Problems.

Knowledge Representation: Knowledge Representation and Logic, Interface in Propositional Logic, First Order Logic, Reasoning Using First Order Logic, Resolution in FOPL.

KNOWLEDGE ORGANIZATION: Rule based System, Semantic Net, Reasoning in Semantic Net Frames, and Planning.

KNOWLEDGE SYSTEMS: Rule Based Expert System, Reasoning with Uncertainty, Fuzzy Reasoning

KNOWLEDGE ACQUISITION: Introduction to Learning, Rule Induction and Decision Trees, Learning Using neural Networks, Probabilistic Learning Natural Language Processing.

Text Books

S.No.	Name of Book/publication/Authors	Publication Year
1.	Elaine Rich and Kevin Knight, Artificial Intelligence 3/e, TMH	1991
2.	PADHY: ARTIFICIAL INTELLIGENCE & INTELLIGENT SYSTEMS, Oxford.	2005

Reference Books

S.No.	Name of Book/publication/Authors	Publication Year
1	James A Anderson, An introduction to Neural Networks. Bradford Books	1995
2	Dan. W Patterson, Artificial Intelligence and Expert Systems,PHI	1990
3	Kumar Satish, “Neural Networks” Tata Mc Graw Hill	2004
4	S. Rajsekaran & G.A. Vijayalakshmi Pai, “Neural Networks,Fuzzy Logic and Genetic Algorithm:Synthesis and Applications” Prentice Hall of India.	2006
5	Siman Haykin,”Neural Netowrks”Prentice Hall of India	1990
6	Artificial Intelligence, Kaushik, cengage learning	1997

LECTURE PLAN

7EI6.3A	ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS	L	T	P	Marks
	Total Hours – 40	**3**	**0**	**0**	**100**

Contents

Unit	Contents	Contact Hours
I	**INTRODUCTION TO ARTIFICIAL INTELLIGENCE**	**9**
	Intelligent Agents, State Space Search	2.5
	Uninformed Search, Informed Search	2.5
	Two Players Games	2
	Constraint Satisfaction Problems	2
II	**KNOWLEDGE REPRESENTATION**	**5**
	Knowledge Representation And Logic	1
	Interface in Propositional Logic	1
	First Order Logic	1
	Reasoning Using First Order Logic	1
	Resolution in FOPL	1
III	**KNOWLEDGE ORGANIZATION**	**10**
	Rule based System	2.5
	Semantic Net	2.5
	Reasoning in Semantic Net Frames	2.5
	Planning	2.5
IV	**KNOWLEDGE SYSTEMS**	**8**
	Programmable parallel ports.	1.5
	Interfacing microprocessor to keyboard and alphanumeric displays.	3
	Memory interfacing and Decoding.	2
	DMA controller.	1.5
V	**KNOWLEDGE ACQUISITION**	**9**

	Introduction to Learning	2
	Rule Induction and Decision Trees	2
	Learning Using neural Networks	2.5
	Probabilistic Learning Natural Language Processing	2.5
	Total	**40**

Course Outcomes

The students of the course should be able to

CO1 – Generalise the basic introduction to Artificial Intelligence. (K5)

CO2 – Deduce the knowledge representation & Logic. (K4)

CO3 - Interpret the knowledge organization in detail. (K3)

CO4 - Illustrate the different knowledge systems of artificial intelligence. (K4)

CO5 - Investigate the study of knowledge acquisition for Learning & processing. (K4)

CO-PO Mapping (3-Strong, 2-Moderate and 1- Weak)

7EI6.3A / ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1	3	2		1											
	CO2	1	3	2												
	CO3	3	2	1												
	CO4	2		3	1											
	CO5	1			3	2										

Content Delivery Method

- Class room lecture (chalk and board) (D1)
- Visual presentation (D2)
- Tutorial (D3)

7EI7A CONTROL SYSTEMS SIMULATION LAB II

7EI7A	CONTROL SYSTEMS SIMULATION LAB II	L	P	MARKS
	Total Hours-36		2	**75**

List of Experiments

The Lab work includes exercises based on following in MATLAB

1. Representation of a system in State Space, Conversion from TF to State Space, Discretising the given Continuous Time System.
2. Representing the System in various Canonical Forms
3. Diagonalisation, Finding Eigen values, Eigenvectors
4. Computation of State Transition Matrix
5. Plotting State Responses for given inputs.
6. Check for Controllability, Observability of the System.
7. Pole placement design using state feedback.
8. Design Full Order Observer to Estimate States for the given System
9. Design Reduced Order Observer for the given System
10. Using Combined Estimator and Control Law Plot the Response for the given System
11. Simulate different systems for plotting responses in SIMULINK.

Lab outcome:-

1. **Understand and apply** the representation of a system in state space & various canonical forms.(k1)
2. **Examine** state transition matrix & plot state responses for given inputs.(K3)
3. **Analyze** controllability & observability of the given system. (k4)
4. **Design** Full & reduced order observer for the given system. (K5)
5. **Develop** simulations for different systems in SIMULINK.(k3)

CO-PO Mapping (3.strong 2. Moderate 1. low)

Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
LO1	2	2	1	1	3							
LO2												
LO3	2	3	2	1	1							
LO4	2	2	1		3							
LO5	3	2	1	1								

7EI8A ANALYTICAL INSTRUMENTATION LAB

7EI8A	**ANALYTICAL INSTRUMENTATION LAB**	**L**	**P**	**MARKS**
	Total Hours-36		2	**75**

List of Experiments

1. To measure pH value of given solution using pH meter.
2. To determine suspended particular matter using right volume air samples.
3. Find out concentration of (Na or K) by flamephoto meter in the given sample.
4. To measure transmittance and absorption of a solution using Single beam spectrophoto meter.
5. To study water analysis kit & measure pH, temperature, conductivity, dissolved O_2 of a given solution.
6. To measure the conductivity of solution indicator controller.
7. To study the analysis of flue gases.
8. To study ion selective electrode.
9. To study pH monitor and controller.
10. To study silica analyzer and zirconia based oxygen analyzer.
11. To study gas/ liquid chromatograph.

Lab outcome:-

1. **Understand and use** of pH meter, pH monitor & controller.(k1)
2. **Examine** pH, temperature, conductivity, dissolved O_2 of a given solution.(K3)
3. **Analyze** flue gases, concentration through flamephoto meter, transmittance & absorption through spectrophoto meter. (k4)
4. **Illustrate** ion selective electrode. (K2)
5. **Estimate** the use of silica analyzer and zirconia based oxygen analyzer, gas/ liquid chromatograph .(K2)

CO-PO Mapping (3.strong 2. Moderate 1. low)

Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
LO1	2	2	1	1	3							
LO2												
LO3	2	3	2	1	1							
LO4	2	2	1		3							
LO5	3	2	1	1								

7EI9A INDUSTRIAL ECONOMICS & MANAGEMENT

7EI9A	INDUSTRIAL ECONOMICS & MANAGEMENT	L	P	MARKS
	Total Hours-36		2	**50**

List of Experiments

1. Framework of industrial economics – organizational forms and alternative motives of the firm, industrial efficiency, theory of profitability, market structure, principles of costing.

2. Approaches to industrial location analysis, Productivity analysis, Input-Output analysis, Concentration of economic power. New Industrial Policy – Critical analysis, Role of technology and entrepreneurship in industrial development.
3. Industrial project appraisal- classification of industries, industrial legislations in India, recent trends in MNCs, LPG, FDI & joint ventures, methods of project evaluation-NPV, CBA, IRR, break-even analysis.

4. Management – Principles of management, functions of management planning, organizing, staffing, directing, controlling, coordinating, decision making.

5. Emerging issues – Total quality management, JIT , quality circle, KANBAN, benchmarking, six sigma, quality management, ,ISO 9000, ISO 14000 , Customer relationship management (CRM) .

Text Books

S.No.	Name of Book/publication/Authors	Publication Year
1.	Subburay, Total quality management, TMH	2011
2.	Barthwal R.R- industrial economics. Wiley eastern limited	-

Reference Books

S.No.	Name of Book/publication/Authors	Publication Year
1	Tirole jean – the theory of industrial organization . MIT PRESS	-
2	Ahluwalia I.J – industrial growth in india . Oxford university press	-
3	Divine P.J and R.M jones et Al- an introduction In industrial economics .George allen &Unwin limited London	-
4	Peter F. drucker – principles and practice of management . Prentice hall ltd .	-

Lab outcome:-

1. **Illustrate** the framework of industrial economics.(K4)
2. **Analyze** approaches to industrial location, Productivity, Input-Output**.** (K4)
3. **Deduce** the industrial legislation in India in detail. (K4)
4. **Interpret** the study of Management & its policies in detail. (K2)
5. **Generalize** the emerging issues in industries & customer relationship management (CRM) .(K5)

CO-PO Mapping (3.strong 2. Moderate 1. low)

Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
LO1												
LO2												
LO3												
LO4												
LO5												

8EI1A INDUSTRIAL ELECTRONICS

8EI1A	Industrial Electronics	L	T	P	Marks
	Total Hours - 40	3	1	0	100

Contents

Unit	Contents	Contact Hours
I	**SEMICONDUCTOR POWER DEVICES**	**7**
	Basic characteristics and working of Power diodes, Diac, SCR, Triac	4
	Power Transistor, MOSFETs, IGBT,and GTO	3
II	**RECTIFIERS & INVERTERS**	**8**
	Working principle of single and three phase bridge rectifiers	5
	Voltage and Current source inverters	3
III	**POWER SUPPLIES**	**10**
	Principle of operation of choppers, Step up, Step down and reversible choppers	4
	High frequency electronic ballast, Switch mode Power Supply	3
	Fly back converter, forward/buck converter, Boost converter and buck- boost converter.	2
	Uninterruptible Power Supply.	1
IV	**MOTOR CONTROL**	**8**
	Introduction to speed control of DC motors using phase controlled converters and choppers.	4
	Basic idea of speed control of three phase induction motors using voltage and frequency control methods.	4
V	**STEPPER MOTORS**	**7**
	Variable reluctance, Permanent magnet and hybrid stepper	4
	Induction and dielectric heating control.	3
	Total	**40**

Course Outcomes

The students of the course should be able to

CO1: Describe the basics of power electronics devices (K2).
CO2: Develop enhanced version of rectifier and inverters (K3).
CO3: Classify various power supplies and convertors (K4).
CO4: Illustrate the basic concepts of different types of motor controls (K2).
CO5: Employ the stepper motor in different environment (K3).

CO-PO Mapping (3-Strong, 2-Moderate and 1- Weak)

8EI1A / Industrial Electronics		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1	3	2													
	CO2	2	2	3	2	1										
	CO3	2	2	1	3											
	CO4	2	2	3												
	CO5	2	1	3	1	1										

Content Delivery Method

- Class room lecture (chalk and board) (D1)
- Visual presentation (D2)
- Tutorial (D3)

Text Books

S.No.	Name of Book/publication/Authors	Publication Year
1	Power Electronics Principles & Applications, Joseph Vithayathil, TMH	2010
2	Power Eletronics, Ravish Singh, TMH	2012

Reference Books

S.No.	Name of Book/publication/Authors	Publication Year
1	Industrial Electronics And Control, Ttti, TMH	2001
2	Power Electronics: Converters Applications., Mohan, Robbins, Wiley	1995
3	Power Electronics, Moorthi, Oxford	2005
4	Elements Of Power Electronics, Krein, Oxford	1998
5	Power Electronics, R.S.Murthy, Pearson	2012
6	Power Electronics: Circuits, Devices And Applications	2004

8EI2A NONLINEAR CONTROL SYSTEMS

8EI2A	**NonLinear Control Systems**	**L**	**T**	**P**	**Marks**
	Total Hours - 40	**3**	**1**	**0**	**100**

Contents

Unit	Contents	Contact Hours
I	**INTRODUCTION**	**6**
	Nonlinear Control, Common Nonlinearities in Control systems	3
	Points of Differences in Linear And Nonlinear System Behavior,	3
II	**PHASE PLANE ANALYSIS**	**6**
	Phase Portraits, Singular Points, Construction of Phase Portraits, Method of Isoclines, Symmetry in Phase Portraits	3
	Jump Resonance, Limit Cycles, Existence of Limit Cycles, Poincare-Bendixson Theorem	3
III	**DESCRIBING FUNCTIONS FUNDAMENTALS**	**8**
	Describing functions of Common Nonlinearities-computing describing functions	4
	Describing functions of Common Nonlinearities- describing functions analysis of non linear systems-stability analysis	4
IV	**FUNDAMENTALS OF LYAPUNOV THEORY**	**8**
	Nonlinear Systems and Equilibrium points, Concepts of Stability	2
	Concepts of Stability, Linearization and Local Stability Lyapunov's Direct Method	4
	Equilibrium Point Theorems, Krasovskii's method- variable gradient method	2
V	**NONLINEAR CONTROL SYSTEM DESIGN**	**8**
	Feedback Linearization and the Canonical Form, Input State Linearization, Input-Output Linearization	4
	Gain Scheduling, Sliding Control, Model Reference Adaptive Control	4
	Total	**40**

Course Outcomes

The students of the course should be able to

CO1: Demonstrate knowledge of the effects of non-linearities on the operation of control system(K3).
CO2: Define fundamentals of describing functions (K1).
CO3: Examine the stability analysis nonlinear systems by Lyapunov' s method (K4).
CO4: Enumerate various Linearization forms (K1).
CO5: Develop design skills in optimal control problems (K3).

CO-PO Mapping (3-Strong, 2-Moderate and 1- Weak)

8EI2A/ NonLinear Control Systems		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1	3	1	1												
	CO2	2	3	1												
	CO3	2	3	1	3											
	CO4	1	3													
	CO5	2	3	3	1	2										

Content Delivery Method

- Class room lecture (chalk and board) (D1)
- Visual presentation (D2)
- Tutorial (D3)

Text Books

S.No.	Name of Book/publication/Authors	Publication Year
1.	Jean-Jacques E. Slotine, "Applied Nonlinear Control", Prentice Hall Englewood Cliffs,	1991

Reference Books

S.No.	Name of Book/publication/Authors	Publication Year
1	Vidyasagar.M, "Nonlinear System Analysis",Prentice Hall Englewood Cliffs,New Jersey	1978
2	M. Gopal "Digital Control & State variable Methods", Tata McGraw Hill	2003

8EI3A DISTRIBUTED CONTROL SYSTEM

8EI3A	Distributed Control System	L	T	P	Marks
	Total Hours - 40	3	0	0	100

Contents

Unit	Contents	Contact Hours
I	**INTRODUCTION**	**6**
	Hierarchical organization for a process computer control and computer system for a	1

	manufacturing complex.	
	Centralized and distributed control concept. Lower level and higher level computer tasks and duties. Functional requirement of DPCS.	2
	Aims of plant automation and distributed computer control systems and subsystems	1
	DPCS system configuration and integration with PLCs and computers	2
II	**ARCHITECTURE**	**8**
	Overviews of DPCS, systems architectures, database organization.	2
	DPCS elements, comparison of different DPCS systems, state of the art in DPCS	3
	configuration of control unit, different cards (I/O, O//P, Memory, PLC etc) system implementation concepts, work stations and its key functions and function chart	3
III	**DCS DISPLAYS**	**8**
	Standard and user defined displays, continuous process display.	2
	Ground display, overview display, detail display, graphic display, trend display, loop display, alarm summary display, annunciator display, batch/sequence display, tuning display, tuning panel, instrument faceplate.	6
IV	**DATA COMMUNICATIONS LINKS AND PROTOCOL**	**10**
	Communication Hierarchy (point to point to field bus) Network requirements, ISO reference model	2
	Transmission media, network Transmission media, network topologies, internetworking, data transmission, bus access methods, error handling.	3
	Field buses, MAP and TOP Protocols. Features and capabilities of Field buses. FB standardization, comparison of MODBUS, PROFIBUS and FIPBUS, HART protocol	3
	IEEE project 1002 on LAN implementation.	2
V	**DCS CONTROL FUNCTIONS**	**8**
	Control unit, sequential control, system maintenances, utility, switch instrument, batch system builder, graphic builder, feedback control builder	6
	Security, and process reporting function	2
	Total	**40**

Course Outcomes

The students of the course should be able to

CO1: Describe fundamentals of Distribute control systems (K1).

CO1: Determine the architecture of distributed control systems (K4).
CO1: Classify various DCS displays **(K3)**.
CO1: Analyse industrial data transmission protocols (wired and wireless) and ISO/OSI reference models (K4).
CO1: Interpret the DCS control functions **(K2).**

CO-PO Mapping (3-Strong, 2-Moderate and 1- Weak)

8EI3A/ Distributed Control System		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1	3	2													
	CO2	2	3	1	3											
	CO3	2	3													
	CO4	2	3	3	1	2										
	CO5	2	1													

Content Delivery Method

- Class room lecture (chalk and board) (D1)
- Visual presentation (D2)

Text Books

S.No.	Name of Book/publication/Authors	Publication Year
1	John.W. Webb Ronald A Reis, "Programmable Logic Controllers – Principles and Applications", 4th Edition, Prentice Hall Inc., New Jersey.	1988
2	Lukcas M.P, "Distributed Control Systems", Van Nostrand Reinhold Co., New York.	1986

Reference Books

S.No.	Name of Book/publication/Authors	Publication Year
1	Frank D. Petruzella, "Programmable Logic Controllers", 2nd Edition, McGraw Hill , New York.	1997
2	Deshpande P.B and Ash R.H, "Elements of Process Control Applications", ISA Press, New York	1995
3	Curtis D. Johnson, "Process Control Instrumentation Technology", 7th Edition, Prentice Hall, New Delhi	2002
4	Krishna Kant, "Computer-based Industrial Control", Prentice Hall, New Delhi	1997
5	Process/Industrial Instruments And Control Hand Book,Gregory Mcmillan,TMH.	2009
6	Process Control - Principles And Applications,Bhanot, Oxford	2008
7	Process Dynamics Control ,Dale E. Seborg, Oxford	1994
8	Advanced Process Control: Beyond Single Loop Control,Cecil Smith, Oxford	2010

8EI4.1A WIRELESS COMMUNICATION

8EI4.1A	Wireless Communication	L	T	P	Marks
	Total Hours - 40	3	0	0	100

Contents

Unit	Contents	Contact Hours
I	**RADAR FUNDAMENTALS**	**8**
	Basic Radar System, Accuracy & Resolution, Radar Range Equitation, Radar Display,	2
	Radar Classifications, Basic Block Diagram of CW Radar, FM CW Radar	3
	Moving Target Indicator Radar, Pulse Doppler Radar & Tracking Radar, Range & Velocity Resolution of Radar	3
II	**PROPAGATION PHENOMENON**	**8**
	Fundamentals of fading, Multipath channels, Fresnel zone clearance, bending of radio beam, Effective earth radius	3
	Spread Spectrum signals: Direct-sequence spread spectrum signals, p-n sequences, Frequency – hopped spread spectrum signals	4
	Code-division multiplexing	1
III	**MULTIPLE ACCESS TECHNIQUES**	**8**
	FDMA, TDMA and CDMA with reference to mobile radio and satellite systems.	3
	TDMA based networks, OFDM and its characteristics, Packet radio multiple access techniques.	2
	CDMA based networks: Architecture, Air interface, Call processing, power control, Rake receiver concept and performance of CDMA system.	3
IV	**CELLULAR WIRELESS NETWORKS**	**8**
	GSM: Introduction, overview of the GSM systems, GSM codec, channel coding and interleaving, radio like control.	3
	Cordless systems and WLL, Mobile IP, Wireless access protocol	2
	Wireless LANs: Technology, IEEE 1002.11 standards, Broadband Wireless 1002.16, Blue tooth, Wi-Fi, Wi-Max, Zigbee & RFID technology.	3

V	**SATELLITE COMMUNICATION**	**8**
	Elements of satellite communication: Frequency bands, Transmission and Multiple access	2
	Satellite orbit and description- orbital period and velocity, effects of orbital inclination, Azimuth and elevation, Coverage angle and slant range, Satellite Link: basic link analysis, Geostationary orbit, Satellite description.	4
	Earth Station antenna, high-power amplifier, low-noise amplifier, up converter, down converter, monitoring and control, reliability.	2
	Total	**40**

Course Outcomes

The students of the course should be able to

CO1: Describe the fundamental concept of wireless communication (K2).
CO2: Outline the concepts about propagation phenomena of wireless signals(K1).
CO3: Distinguish between various multiple access techniques (K3).
CO4: Apply the fundamentals of design and function of cellular wireless networks. Likes – GSM, WLL, Mobile IP, Wireless access protocol. Wireless LAN's: Technology, IEEE 802.11 standards and Blue tooth. Broadband Wireless 802.16. (K3)
CO5: Analyse the concepts of working of satellite communication(K4).

CO-PO Mapping (3-Strong, 2-Moderate and 1- Weak)

8EI4.1A / Wireless Commu-nication		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1	3	1													
	CO2	2	3	1	3											
	CO3	2	3													
	CO4	2	2	3	2	1										
	CO5	2	3	1	1											

Content Delivery Method

- Class room lecture (chalk and board) (D1)
- Visual presentation (D2)

Text Books

S.No.	Name of Book/publication/Authors	Publication Year
1	William Stallings, Wireless Communication and Networks, PE	2013
2	Rappaport, T.S., Wireless Communications, PE	2013

Reference Books

S.No.	Name of Book/publication/Authors	Publication Year
1	Gottapu Sasibhushana Rao, Mobile Cellular Communications, PE	2013
2	Singal, T.L, Wireless Communication, TMH	2011
3	Vijay Kr. Garg, Wireless Communications and Networking, Morgan Kauffmann Elsevier	2013
4	Blake, Wireless Communication Technology, Cengage Learning	2013
5	W.C.Y. Lee, Mobile Cellular Telecommunications, TMH	2011
6	Wireless Communications and Networking, Price, TMH	2014
7	Pratt, Bostain, Satellite Communications, Wiley India	2011
8	Mark Zhuang, Wireless Communications and Networking, PHI	2003
9	Simon Haykin, Modern Wireless Communications, PE	2005
10	Price, Fundamentals of Wireless Networking, TMH	2012

8EI4.2A MEMS AND NANOTECHNOLOGY

8EI4.2A	**MEMS and Nanotechnology**	**L**	**T**	**P**	**Marks**
	Total Hours - 40	**3**	**0**	**0**	**100**

Contents

Unit	Contents	Contact Hours
I	**Introduction to Nanoelectronics**	**8**
	Top Down and Bottom UP Approach, Nanotechnology Potentials,	1
	Idea of band structure – Metals, Insulators and Semiconductors. Effect of crystal size on density of states and band gap	3
	Electronic structure of nanoparticles. Nanostructured crystals, Size and dimensionality effects - Single electron tunneling	2
	Applications - Superconductivity, Graphenes and CNT.	2
II	**Nano Fabrication and Patterning Techniques**	**9**

	Si processing methods, Cleaning/etching, Oxidation, Gettering, doping, Epitaxy	2
	CVD & MOCVD, Physical Vapor Deposition (PVD), Liquid Phase Techniques, Self assembly and catalysis	3
	Etching: Wet and Dry, Nanolithography, Nanoimprinting, X- Ray Lithography(XRL), Particle beam lithography(e-beam, FIB, shadow mask evaporation),	4
III	**General Characterization Techniques**	**9**
	X- Ray Diffraction studies – Bragg's law – particle size – Scherrer's equation,	2
	Infrared Spectroscopy of Semiconductors, Raman Spectroscopy, Dynamic Light Scattering (DLS), NMR Spectroscopy, ESR Spectroscopy	4
	Photo electron spectroscopy(XPS)- SEM,TEM,STM, Atomic force microscopy(AFM).	3
IV	**Electrical, Magnetic, Mechanical and Optical Properties and Applications**	**7**
	Electronic and electrical properties -One dimensional systems-Metallic nanowires	2
	Quantum dots -Two dimensional systems - Quantum wells.	1
	Magnetic properties -Transport in a magnetic field. Mechanical properties, Optical properties,	2
	Evolving interfaces of Nano in NanoBiology, Nano Sensors and Nanomedicines	2
V	**MEMS and Microsystems**	**7**
	Evolution of Micro Fabrication – Micro Systems and Microelectronics, Application of MEMS in Various Fields	3
	Introduction – Substrate and Wafer, Active Substrate Material. Silicon as a substrate material, MEMS packaging	2
	Case study on pressure sensor with packaging.	2
	Total	**40**

Course Outcomes

The students of the course should be able to

CO1: Outline the fundamental concept of Nanoelectronics (K1).
CO2: Explain the fabrication and the MEMS manufacturing technologies (K2).
CO3: Identify general characterization techniques in nanotechnology (K4).
CO4: Interpret the fundamental concepts of nanotechnology and its applications (K3).
CO5: Illustrate learning via a case study (K2).

CO-PO Mapping (3-Strong, 2-Moderate and 1- Weak)

8EI4.2A/ MEMS and		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3

Nanotechnology	CO11	3	2	1												
	CO2	2	2	3												
	CO3	2	3	2	3											
	CO4	2	1													
	CO5	3	2	3	2	2										

Content Delivery Method

- Class room lecture (chalk and board) (D1)
- Visual presentation (D2)

Text Books

S.No.	Name of Book/publication/Authors	Publication Year
1	Nano Essentials, T Pradeep, Mc Graw Hill	2008
2	Nanotechnology-Enabled Sensors, Kourosh Kalantar-zadehand Benjamin Fry, Springer	2007

Reference Books

S.No.	Name of Book/publication/Authors	Publication Year
1	Fundamental of Nanoelectronics, George W. Hanson, Pearson	2009
2	Principal of Nanotechnology, G. A. Mansoori, Wiley	2005
3	Mems and Micro Systems, Mahalik, TMH	2007
4	MEMS, Gabriel, Wiley	2006
5	MEMS, A.R. Jha, CRC	2008
6	Nano Fabrication, CRC	2012
7	MEMS & Microsystems, Design and Manufacture, Tai-Ran HSU, TMH	2013

8EI4.3A COMPUTER NETWORKS

8EI4.3A	**Computer Networks**	**L**	**T**	**P**	**Marks**
	Total Hours - 40	**3**	**0**	**0**	**100**

Contents

Unit	Contents	Contact Hours
I	**Queuing Theory**	**7**
	Pure birth, Pure death & Birth-death processes,	2
	Mathematical models for M/M/1, M/M/∞, M/M/m, M/M/1/K and M/M/m/m queues. Little's formula.	5
II	**Physical and Data link layer**	**8**
	OSI model & TCP/IP reference models	2
	Line coding schemes, Packet & Circuit switching, Virtual circuit network,	2
	Framing, Simplex protocol, Simplex stop & wait protocol, Sliding window protocol, Go back N protocol, selective repeat,	3
	HDLC, PPP	1
III	**MAC Sublayer**	**9**
	Static & dynamic channel allocation, Multiple Access Protocols: ALOHA, slotted ALOHA, CSMA, Token Bus, Token Ring, FDDI	4
	IEEE standards 1002.3 & 1002.5, Virtual circuit network: frame relay & ATM frame and protocol architecture,	3
	Network connection devices: Hubs, Bridges, switches, Routers and Gateways	2
IV	**Network Layer**	**8**
	IPv4 & IPv6 addressing and datagram, Internetworking	3
	Non-adaptive & Adaptive routing algorithms,	2
	Distance vector routing and Link state routing algorithms, OSPF and BGP	3
V	**Transport and Application Layer**	**8**
	Client server paradigm, TCP frame format, Data traffic descriptors	2
	Data traffic descriptors, QoS, Congestion and its control algorithms, Improving QoS by different queuing schemes, leaky bucket and token bucket implementation	3
	Domain name, DNS in the internet	1
	SMTP, FTP, WWW, HTTP	2
	Total	**40**

Course Outcomes

The students of the course should be able to

CO1: Describe the Fundamental concept of Computer Networking. (K2)
CO2: Define the concepts about Data link layer. (K1)
CO3: Define the concepts of Medium layer. (K1)
CO4: Outline the concepts of Network layer. (K1)
CO5: Explain the concepts of ATM Networks (K2)

CO-PO Mapping (3-Strong, 2-Moderate and 1- Weak)

8ECA/ Computer Networks		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1	3	1													
	CO2	2	2	2	1											
	CO3	2	2	2	1											
	CO4	2	2	2	1											
	CO5	2	3	3												

Content Delivery Method

- Class room lecture (chalk and board) (D1)
- Visual presentation (D2)

Text Books

S.No.	**Name of Book/publication/Authors**	**Publication Year**
1.	Forouzan, "Data Communications and Networks", 5th ed., Mcgraw-Hill	1988

Reference Books

S.No.	**Name of Book/publication/Authors**	**Publication Year**
1	Tanenbaum, "Computer Network", 5th ed., Pearson Education	2012
2	Leon Garcia, Widjaja, "Communication Networks', 2nd ed., Mcgraw-Hill	2003
3	Stallings, "Data and Computer Communications", 10th ed., Pearson Education	2013
4	Bertsekas, Gallager, "Data Networks", 2nd ed., PHI	1992
5	Computer Networks, Dave, cengage learning	2003
6	Fundamentals of Networking and Data Communications, White, cengage	2013

8EI5A INDUSTRIAL ELECTRONICS LAB

8EI5A	**Industrial Electronics Lab**	**L**	**T**	**P**	**Marks**
	Total Hours - 40	**0**	**0**	**3**	**100**

Contents

S.No.	Contents
1	Study the characteristics of SCR and observe the terminal configuration, Measure the breakdown voltage, latching and holding current. Plot V-I characteristics.
2	Perform experiment on triggering circuits for SCR. i.e. R-triggering, R-C triggering and UJT triggering circuit.
3	Study and test AC voltage regulators using triac, antiparallel thyristors and triac & diac.
4	Study and obtain the waveforms for single-phase bridge converter.
5	Perform experiment on single phase PWM inverter.
6	Perform experiment on buck, boost and buck-boost regulators.
7	Control speed of a dc motor using a chopper and plot armature voltage versus speed characteristic.
8	Control speed of a single-phase induction motor using single phase AC voltage regulator.
9	i) Study single-phase dual converter. ii) Study speed control of dc motor using single-phase dual converter.
10	Study single-phase cyclo-converter.
11	Perform experiment on Motor control – open loop & closed loop.
12	Design, observe and perform experiment on various type of pulse generation from DSP/ FPGA Platform. Perform experiment for PWM inverters and choppers.

Course Outcomes

The students of the course should be able to

CO1: Explain the basic operation of various power semiconductor devices (K2)
CO2: Relate theoretical and practical analysis of AC-AC, DC-AC converters and also converter fed to AC&DC drives (K1).
CO3: Analyse the power electronic circuits and characteristics of SCR and SCR firing CKTs (K4).
CO4: Apply theoretical learning to practical experiments (K3).

CO-PO Mapping (3-Strong, 2-Moderate and 1- Weak)

8EI5A/ Industrial Electronics Lab		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1	3	1													
	CO2	2	3	1												
	CO3	2	1	1	3											
	CO4	2	1	1	2	3										

Content Delivery Method

- Visual presentation (D2)

Reference

- Lab Manual

8EI6A REAL TIME CONTROL SYSTEM LAB

8EI6A	Real Time Control System Lab	L	T	P	Marks
	Total Hours - 40	0	0	2	50

S.No.	Contents
1	Characteristics of control valve
2	Closed loop response of flow control loop.
3	Closed loop response of level control loop
4	Closed loop response of temperature control loop
5	Operation of on-off controlled thermal process. Response of on-off controller
6	Response of P+I+D controller. Tuning of PID controller
7	Measurement & Control of level using PID.
8	Measurement & Control of flow using PID
9	Measurement & Control of pressure using PID.
10	Measurement & Control of flow using PLC.
11	Measurement & Control of level using PLC.
12	Measurement & Control of pressure using PLC.
13	Measurement & Control of temperature using PLC.
14	Using SCADA for process control: • preparation of process graphics • tagging trends • reporting • process monitoring and control
15	Study of Communication and Configuration of HART Field Devices: • Communicate with HART device • Re-ranging of HART Field Devices • Basic setup of HART Device

	• Detailed setup of HART Device
16	Study of Process Calibrator: • Test & Calibration of Process Indicators & Controllers using • Resistance, RTD, Thermocouple • mili Volts, 4-20 mA, • Frequency & Volt • Error calculation.
17	Study of thermal Imager: Non-contact type temperature measurement of Process, Machines, Material etc.
18	Study of Vibration Analyzer: Measurement and Analysis of vibration in electrical and mechanical machines.
19	Familiarization with the Instrumentation and Process Control Training System (IA- FLTP): Process Workstation, Instrumentation Workstation, PID Controller, ON/OFF Controller, Programmable Logic Controller, Signal Isolator, Flow Meter, Level Transmitter, Temperature Sensor, Emergency Push-Button, Pneumatic Unit, Trend Recorder, Pressure Gauge, Pressure Transmitter, Pneumatic Control Valve, Accessories, Basic Setup.
20	I.S.A. Standard and Instrument Symbols. Introduction to Measurement instruments.
21	Study of Interacting systems and Non-interacting systems.

Course Outcomes

The students of the course should be able to

CO1: Demonstrate the ability to apply what they have learned theoretically in the field of control (K3)
CO2: Deduce the measurement and perform control of parameters with PID and PLC controllers (K4).
CO3: Examine the Instrumentation and Process Control Training System(K1).
CO4: Extend learning to basic understanding of industrial tools like SCADA used in the industry (K2).

CO-PO Mapping (3-Strong, 2-Moderate and 1- Weak)

8EI6A/ Real Time Control System Lab		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1	2	3		3											
	CO2	2	3	1	1	3										
	CO3	2	1	1	3											
	CO4	2	2	1	2	3										

Content Delivery Method

- Visual presentation (D2)

Reference

- Lab Manual

8EI7A APPLIED INSTRUMENTATION LAB

8EI7A	Applied Instrumentation Lab	L	T	P	Marks
	Total Hours - 40	0	0	3	50

Contents

S.No.	Contents
1	Measurement of optical power attenuation and numerical aperture in a plastic optical fibre
2	Study and measurement of losses in optical fibre.
3	Measurements of various amplitudes and time intervals between each segment of ECG, Measurement of R-R interval and calculation of Heart Rate.
4	Determination of Heart Axis by measuring QRS amplitude in the different leads (Lead I, Lead II and Lead III) and Plotting Einthoven Triangle.
5	Measurement of Heart rate variability (HRV) and analysis using time and frequency-based approach.
6	Recording of blood pressure using sphygmomanometer & stethoscope and relate with heart rate.
7	Recording of the EMG Signal for different stress on the muscle.
8	To find out various lung capacity measurements using pneumotachograph.
9	Study of EEG Signal, to measure the amplitude, frequency & nature of EEG.
10	Design of an instrumentation amplifier for amplification of the low-level ECG signals for gain 1000 and CMRR >100 dB and flat frequency response from 4 to 40 Hz.

Course Outcomes

The students of the course should be able to

CO1: Identify practical aspects of measurement and instrumentation (K1).
CO2: Recognize the limitations of physiological measurements (K2).
CO3: Experiment and test with biomedical instrumentation equipment (K4).
CO4: Deduce measurements and interpret data from physiological systems (K4).
CO5: Develop, discuss and apply electrical engineering concepts and principles to a range of problems and medical applications (K3).

CO-PO Mapping (3-Strong, 2-Moderate and 1- Weak)

8EI7A/ Applied Instrumentation Lab		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1	3	1													

	CO2	1	3													
	CO3	1	2	1	3	2										
	CO4	2	1	1	1	3										
	CO5	2	2	3	2											

Content Delivery Method

- Visual presentation (D2)

Reference

- Lab Manual