FACULTY OF ENGINEERING

Scheme of Instructions and Examination

(AICTE Model Curriculum for the Academic Year 2020-21)

and

Syllabi

B.E. V and VI Semester

of

Four Year Degree Programme

in

Electronics and Instrumentation Engineering

(With effect from the academic year 2020 - 21)

(As approved in the faculty meeting held on XX-XX-2020)

Issued by

Dean, Faculty of Engineering

Osmania University, Hyderabad – 500 007

2020

SCHEME OF INSTRUCTION AND EXAMINATION
B.E. (ELECTRONICS AND INSTRUMENTATION ENGINEERING)
V – SEMESTER

S. No.	Course Code	Course Title	Scheme of Instruction				Scheme of Examination			Credits
			L	T	P/D	Contact Hrs/Wk	CIE	SEE	Duration in Hrs	
Theory Courses										
1	PC501EE	Instrumentation Systems	3	-	-	3	30	70	3	3
2	PC502EE	Power Plant Instrumentation	3	-	-	3	30	70	3	3
3	PC237EE	Linear Control Systems	3	-	-	3	30	70	3	3
4	PC238EE	Microprocessors and Microcontrollers	3	-	-	3	30	70	3	3
5	PC239EE	Signals and Systems	3	1	-	4	30	70	3	4
6	PE5_ _EE	Professional Elective - I	3	-	-	3	30	70	3	3
Practical/ Laboratory Courses										
7	PC263EE	Electrical Circuits Lab	-	-	2	2	25	50	3	1
8	PC264EE	Control Systems Lab	-	-	2	2	25	50	3	1
9	PC265EE	Power Electronics Lab	-	-	2	2	25	50	3	1
			18	**01**	**06**	**25**	**255**	**570**	-	**22**

Professional Elective – I		
1	PE551EE	Building Management Systems
2	PE552EE	Principles of Communication Engineering
3	PE553EE	Advanced Sensors

HS: Humanities and Social Sciences BS: Basic Science ES: Engineering Science MC: Mandatory Course PC: Professional Core PE: Professional Elective
L: Lecture T: Tutorial P: Practical D: Drawing
CIE: Continuous Internal Evaluation SEE: Semester End Evaluation (Univ. Exam) ,

Note:

1. Each contact hour is a clock hour
2. The duration of the practical class is two hours, however it can be extended wherever necessary, to enable the student to complete the experiment.

Course Code	Course Title						Core / Elective
PC501EE	**INSTRUMENTATION SYSTEMS**						**Core**
Prerequisite	Contact Hours per Week				**CIE**	**SEE**	**Credits**
	L	T	D	P			
NIL	3	1	0	0	**30**	**70**	**4**

Course Objectives

- To expose to various sensors and transducers for measuring mechanical quantities.
- To understand the specifications of sensors and transducers.
- To learn the basic conditioning circuits for various sensors and transducers.
- To introduce advances in sensor technology.

Course Outcomes

At the end of the course students will be

1. Describe the basics of measurement system and its input, output configuration of measurement system.
2. Discuss with both static and dynamic characteristics of measurement system.
3. Explain with the principle and working of various sensors and transducers.
4. Design signal conditioning circuit for various transducers.
5. Identify or choose a transducer for a specific measurement application.

UNIT -I

Measurement of Motion: Angular velocity (speed) measurement: Electrical methods like DC and AC Tacho generators, eddy current (drag cup) Tachometers and Stroboscopic method.

Acceleration measurements: Seismic displacement, velocity, acceleration pick-ups, electromagnetic and electro dynamic type of velocity transducers, piezoelectric transducers, deflection type of accelerometer, bonded strain gauge accelerometer, and piezoelectric accelerometers.

UNIT-II

Measurement of force, Torque and Temperature: Basic methods of force measurement: characteristics of elastic force transducers, load cells. Various types of Torque measurement: absorption, transmission, stress, deflection type. Measurement of Temperature: Laws of thermocouples, Thermocouple circuits, reference junction considerations ice bath reference junction special materials, configurations and techniques (cooled thermocouples, pulsed thermocouples, and multifunction thermocouples) and radiation thermometers.

UNIT - III

Measurement of flow: Classification of flow meters, head flow meters like orifice plate, venturi tube, flow nozzle and Pitot tube. Rotameter, electromagnetic flow meter, positive displacement meter, hot wire and hot film anemometer, mass flow measurements, rotor torque mass flow meter.

UNIT-IV

Measurement of liquid level: Electrical methods: Resistive, inductive and capacitive methods, capacitive variable area method, capacitive voltage divider method, capacitive variable dielectric constant method. Measurement of liquid level using gamma rays, ultrasonic method and float

Measurement of humidity: Absolute Humidity, relative humidity, hygrometers (resistive and capacitive hygrometer), Microwave refractometer, Aluminum oxide hygrometers.

Measurement of P^H Electrodes: Station Glass and Calomel Electrodes, installation of P^H meters.

UNIT V

Measurement of sound: Sound level meter microphones with their types like carbon and capacitive microphone, dynamic microphone, inductive microphone, Piezo electric microphone. Pressure response of capacitive microphone

Suggested Reading:

1. C.S.Rangan, G R Sarma & V S N Mani, Instrumentation Devices and Systems-TMH, 2nd Edition 2004
2. B.Nakra & Chowdhari, Instrumentation Measurement and Analysis, TMH, 2nd Edition 2003
   D.V.S.Murthy, Transducers and Instrumentation. PHI, 1995 4. John P. Bentley, Principles of Measurement Systems, 3rd Edition, Pearson Education, 2000.
3. Doebelin E.O, Measurement Systems - Application and Design, 4th Edition, McGraw-Hill, New
4. Patranabis D, Principles of Industrial Instrumentation, 2nd Edition, Tata McGraw Hill, New Delhi, 1997.

Course Code	Course Title						Core / Elective
PC502EE	**POWER PLANT INSTRUMENTATION**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
NIL	3	-	-	-	**30**	**70**	**3**

Course Objectives

- To acquire good knowledge of power generation using various methods.
- To acquire good knowledge of Instrumentation involved in Power generation.
- To know the basics of Turbine supervisory instrumentation and control.

Course Outcomes

At the end of the course students will be able to

1. Describe power generation using various methods and explain the working of thermal power plant in detail. Decode P & I diagrams for process control systems.
2. Explain the techniques for measurement and control of four basic parameters like level, temperature, pressure and flow for power station as well as general process control systems.
3. Describe the Instrumentation and control associated with boilers in TPP, and apply the knowledge gained for identifying and eliminating the redundancy in formulating the boiler control loops.
4. Explain the prime mover supervision and control mechanism and describe the turbine supervisory instrumentation used in TPP.
5. Explain the power generation using NPP, Hydroelectric, wind power and combined cycle power plant with its associated Instrumentation.

UNIT-I

Overview of Power Generation: Method of power generation in thermal power plants, building blocks, Boiler types, feed water systems, steam circuits, combustion process, products of combustion process, fuel systems, treatment of flue gases, condensate systems, feed water conditioning, P&I diagram of boiler, importance of instrumentation in power generation.

UNIT-II

Measurement in boiler system: Metal temperature measurement in boilers, piping system for pressure measuring devices, smoke and dust monitor, flame monitoring. Introduction to turbine supervising system, pedestal vibration, shaft vibration measurement. Non-contact type of transducers for speed measurement and LVDT for the measurement of shell expansion

UNIT-III

Control Loops in Boiler: Combustion control, air fuel ratio control, furnace draft control, boiler drum level control, three element drum level control, main and reheat steam temperature control, super-heater control, at temperature, de-aerator control, boiler following mode operation, turbine following mode operation.

UNIT-IV

Turbine, Monitoring and Control: Lubricant oil temperature control, Hydrogen generator cooling system. Condenser vacuum control and gland steam exhaust pressure control.

UNIT-V

Power generation using other methods: Layout of hydroelectric power plant, power generation in nuclear power plant, importance of control rods in nuclear power generation, power generation using solar and wind energy, and combined cycle power plant.

Suggested Reading:

1. Power plant Engineering by S.C. Aurora and Domkundwar , Dhanpat rai.
2. Power plant Engineering by Sravana Kumar, and Vijaya Ramanath, I.K.International.
   Boiler control systems by David Lindsley, Mcgraw Hill.

Course Code	Course Title						Core/Elective
PC237EE	**Linear Control Systems**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

The course will introduce the students to

- To develop basic skills of utilizing mathematical tools needed to analyze and design classical linear control systems.
- To understand and develop the state space representation of control systems.

Course Outcomes

After completing this course, the student will be able to:

1. Understand the concept of the terms control systems, feedback, Mathematical modeling of Electrical and Mechanical systems.
2. Explain the time domain and frequency response analysis of control systems.
3. Acquire the knowledge of various analytical techniques used to determine the stability of control systems.
4. Able to understand the importance of design of compensators.
5. Able to demonstrate controllability and observability of modern control systems.

UNIT-I

Introduction to Control Systems: Classification of control systems. Feed-Back Characteristics, Effects of feedback - Mathematical modeling of Electrical and Mechanical systems -Transfer function- Transfer function of Potentiometer, synchro, AC servo motor, DC servo motor - Block diagram reduction technique - Signal flow graph, Mason's gain formula

UNIT-II

Time Domain Analysis: Standard test signals - Time response of first order systems - Transient response of second order system for unit step input, Time domain specifications - Steady state response - Steady state errors and error constants - Effects of P, PD, Pl and PID controllers.

UNIT-III

Stability Analysis in S-Domain: The concept of stability - Routh's stability Criterion, Absolute stability and relative stability, Limitations of Routh's stability.

Root Locus Technique: The root locus concept, Construction of root loci, Effects of adding poles and zeros on the root loci.

UNIT-IV

Frequency Response Analysis: Introduction to frequency response - Frequency domain specifications - Bode plot - Stability analysis from Bode plots - Determination of transfer function from the Bode Diagram - Polar Plots, Nyquist Plots, Stability Analysis, Gain margin and phase margin.

Control System Design: Introduction - Lag, Lead and Lag-Lead Compensator design in frequency Domain.

UNIT-V

State Space Analysis: Concepts of state, State variables and state model, Derivation of state models of linear time invariant systems - Controllable, Observable and Diagonal state models - State transition matrix - Solution of state equation - Concepts of Controllability and Observability.

Suggested Readings:

1. Nagrath I.J. and Gopal.M, *Control System Engineering*, Wiley Eastern, 2003.
2. B.C.Kuo, *Automatic Control Systems*, Wiley India, 7th Edition, 2002.
3. K. Ogata, *Modern Control System*, Prentice Hall of India, 4th Edition, 2002.
4. N.C.Jagan, *Control Systems*, B.S Publications, 2nd Edition, 2008.

Course Code	Course Title						Core/Elective
PC238EE	**Microprocessors and Microcontrollers**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

- To understand about 8085 microprocessor architecture, Instruction set and addressing modes.
- To know the use of interfacing devices and process of interfacing.
- To understand about 8051 microcontroller architecture, and programming.

Course Outcomes

After completing this course, the student will be able to:

1. Understand 8085 microprocessor architecture and its operation.
2. Write assembly language program for a given task.
3. Interface memory and I/O devices to 8085 using peripheral devices.
4. Understand uses of microcontrollers and their applications.
5. Write microcontroller programs and interface devices.

UNIT- I

Microprocessor Architecture: Microprocessors, Microcomputers, and Assembly Language, Architecture Details and its operation, Bus organization of 8085, Registers, Memory unit of 8085, Instruction decoding & execution, 8085-Based single board Microcomputer, Pin out Diagram of 8085, Bus timings, 8085 Interrupts (Hardware and Software), 8085 Vectored Interrupts. Introduction to Advanced Controllers, ARM, MSP controllers.

UNIT-II

8085 Programming: The 8085 Programming Model, Operand Types, Instruction Format, Addressing Modes, Instruction set, Writing and debugging simple assembly Language Programs, Delays.

UNIT-III

Interfacing: Memory and I/O interfacing, Programmable Peripheral Interface 8255 (PPI), Interfacing seven segment display, Interfacing matrix keyboard, A/D and D/A interfacing, Programmable Interval Timer (8253), Programmable Interrupt Controller (8259).

UNIT- IV

Microcontroller Architecture: Types of Microcontrollers, 8051 Microcontroller – Architecture, Memory organization, special function registers, pins and signals, timing and control, Ports and circuits, Counters and timers, Serial data input / output, Interrupts & timers.

UNIT-V

8051 Programming: The 8051-programming model, Operand Types, Instruction cycle, addressing modes, 8051 instruction set, Classification of instructions. Simple programs and I/O interfacing.

Suggested Readings:

1. Ramesh S. Gaonkar, *Microprocessor Architecture, Programming and Applications with the 8085,* Penram International Publishing, 5th Edition, 2011.
2. Krishna Kant, *Microprocessors and Microcontrollers - Architecture, Programming and System Design 8085, 8086, 8051, 8096,* Prentice-Hall India - 2007.
3. Kenneth. J. Ayala, *The 8051 Microcontroller Architecture Programming and Applications,* Thomson publishers, 2nd Edition, 2007.
4. A.K. Ray and Bhurchandi, *Advanced Microprocessors and Peripherals*, Tata McGraw Hill, 2003.

Course Code	Course Title						Core/Elective
PC239EE	**Signals and Systems**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

The course is introduced

- To understand the classification of continuous-time and discrete-time signals and systems
- To develop ability to solve systems represented by differential equations and difference equations using analytical methods and Laplace and Z-transforms.
- To acquire the knowledge of representing the signals in frequency domain using Fourier series and Fourier transform.

Course Outcomes

After successful completion of the course the students will be able to

1. Classify and analyze the continuous time signals and discrete time signals and systems.
2. Generate discrete time signals through sampling process and reconstruct them.
3. Determine the responses of continuous and discrete-time systems which are represented by differential equations and difference equations.
4. Analyze continuous time systems with the help of Laplace transform and discrete time system with Z-transform.
5. Analyze the continuous and discrete-time systems in frequency domain with the help of Fourier series and Fourier Transform.

UNIT-I

Introduction to continuous time signals: Examples of signals and systems as seen in everyday life in relation to engineering and science. Signal properties: periodicity, absolute integrability, determinism and stochastic character. Some special signals of importance: the unit step, the unit impulse, the sinusoid, the complex exponential, some special time- limited signals; Introduction to discrete-time signals - Sampling and Reconstruction: The Sampling Theorem and its implications. Spectra of sampled signals. Aliasing and its effects. Reconstruction: ideal interpolator, zero-order hold and first-order hold. Classification of discrete time signals.

UNIT-II

Behavior of continuous and discrete-time LTI systems: System properties: linearity: additivity and homogeneity, shift-invariance, causality and stability. Linear time invariant system, properties convolution integral and convolution sum. System representation through differential equations and difference equations.

UNIT-III

Laplace transforms: Review of the Laplace Transform for continuous time signals and systems, system functions, poles and zeros of system functions and signals, Laplace domain analysis, solution to differential equations and system behavior. **Z-transforms:** The z-Transform for discrete time signals and systems, system functions, poles and zeros of systems and sequences, z-domain analysis and solution to difference equations.

UNIT-IV

Frequency domain representation of continuous time signals: Fourier series representation of periodic signals, Waveform Symmetries, Calculation of Fourier Coefficients. Fourier Transform, properties, convolution/multiplication and their effect in the frequency domain, magnitude and phase response, Fourier domain duality.

UNIT-V

Frequency domain representation of discrete time signals: The Discrete-Time Fourier Transform (DTFT) and the Discrete Fourier Transform (DFT). Parseval's Theorem. Introduction to the applications of signal and system theory: modulation for communication, filtering, feedback control systems.

Suggested Readings:

1. V. Oppenheim, A. S. Willsky and S. H. Nawab, Signals and systems, Prentice Hall India, 1997.
2. J. G. Proakis and D. G. Manolakis, Digital Signal Processing: Principles, Algorithms, and Applications, Pearson, 2006.
3. H. P. Hsu, Signals and systems, Schaum's series, McGraw Hill Education, 2010.
4. S. Haykin and B. V. Veen, Signals and Systems, John Wiley and Sons, 2007.
5. V. Oppenheim and R. W. Schafer, Discrete-Time Signal Processing, Prentice Hall, 2009.
6. M. J. Robert, Fundamentals of Signals and Systems, McGraw Hill Education, 2007.
7. P. Lathi, Linear Systems and Signals, Oxford University Press, 2009.

Course Code	Course Title						Core / Elective
PE551EE	BUILDING MANAGEMENT SYSTEM (Professional Elective-I)						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	
	L	T	D	P			Credits
-	3	-	0	0	30	70	3

Course Objectives

- To understand the basic blocks of Building Management System.
- To design various sub systems (or modular system) of building automation
- To integrate all the sub systems.

Course Outcomes

At the end of the course students will be able to

1. Describe the basic blocks and systems for building automation
2. Use different subsystems for building automation and integrate them.
3. Understand basic blocks and systems for building automation
4. Design different systems for building automation and integrate those systems

UNIT-I

Introduction: Concept and application of Building Management System (BMS) and Automation, requirements and design considerations and its effect on functional efficiency of building automation system, architecture and components of BMS.

UNIT-II

HVAC systems: Different components of HVAC system like heating, cooling system, chillers, AHUs, compressors and filter units and their types. Design issues in consideration with respect to efficiency and economics, concept of district cooling and heating.

UNIT-III

Access control & security system: Concept of automation in access control system for safety, physical security system with components, RFID enabled access control with components, computer system access control: DAC, MAC, and RBAC.

UNIT-IV

Fire & Alarm (FA) system: Different fire sensors, smoke detectors and their types, CO and CO_2 sensors, fire control panels, design considerations for the FA system, concept of IP enabled fire & alarm system, design aspects and components of FA system.

EPBX System & BMS subsystem integration: Design consideration of EPBX system and its components, integration of all the above systems to design BMS.

UNIT-V

CCTV & Energy Management System: Components of CCTV system like cameras, types of lenses, typical types of cables, controlling system, concept of energy management system, occupancy sensors, fans & lighting controller.

Suggested Reading:

1. Jim Sinopoli,"Smart Buildings", Butterworth-Heinemann imprint of Elsevier, 2nd ed., 2010.
2. E. Albert Ting Pat So, WaiLok Chan, Intelligent Building Systems, Kluwer Academic Published, 3rd 2012.
3. Reinhold A. Carlson, Robert A. Di Giandomenico, "Understanding Building Automation Systems", Published by R.S. Means Company, 1991.
4. Morawski, E, Fire Alarm Guide for Property Managers, Publisher: Kessinger Publishing, 2007.

Course Code	Course Title						Core / Elective
PE552EE	PRINCIPLES OF COMMUNICATION ENGINEERING (Professional Elective-I)						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	
	L	T	D	P			Credits
-	3	-	0	0	30	70	3

Course Objectives

- To the principles of analog communication systems involving different modulation and demodulation schemes
- To the principles of digital communication systems involving different modulation and demodulation schemes.

Course Outcomes

At the end of the course students will be able to

1. Develop an understanding of need for modulation and generation & detection of Analog modulation techniques
2. Explore AM and FM Super heterodyne receiver working principle
3. Discuss the techniques for generation and detection of pulse Analog modulation techniques
4. Discuss the basic operation involved in PCM like sampling, quantization & encoding and are able to calculate and derive entropy and channel capacity
5. Compare different communication system with various modulation techniques in the presence of noise by analytically.

UNIT-I

INTRODUCTION TO COMMUNICATIONS SYSTEMS: Information, Communication process, primary communication resources, communication networks & channels, modulation process, Analog and Digital types of communication, Digital communication problem, transmitter, Channel Noise, receiver modulation, description, need for modulation, bandwidth requirement, sine wave and Fourier series review, frequency spectra of non-sinusoidal waves.

UNIT-II

NOISE: Atmospheric noise, extra-terrestrial noise, industrial noise, thermal agitation noise, short noise, transit time noise, miscellaneous noise. **NOISE CALCULATIONS**: Addition of noise due to several sources, addition of noise due to several amplifiers in cascade, noise in reactive circuits, noise figure signal-to-noise ratio. Definition of noise figure, calculation of noise figure (using equivalent noise resistance, measurement, and noise temperature).

UNIT-III

AMPLITUDE MODULATION : Frequency spectrum of the AM wave, representation of AM, power relations in ·the AM wave, generation of AM , basic requirements, comparison of levels grid, modulated class C amplifier, plate modulated class C amplifier, modulated transistor amplifiers.

UNIT-IV

FREQUENCY MODULATION: Description of systems, mathematical representation of FM, frequency spectrum of the FM wave, phase modulation, intersystem comparisons, effects of noise on carrier-noise triangle, pre emphasis and de emphasis, other forms of interference, comparison of wideband and narrowband FM**,** stereophonic FM multiplex system.

UNIT-V

PULSE MODULATION: Introduction to sampling process, PAM, other forms of PM. Bandwidth, noise trade off, quantization process, PCM, TDM, digital multiplexer, delta modulation, linear prediction, differential PCM, adaptive differential PCM.

Suggested Reading:

1. Haykins. S, "Communication System**",** 4th Edition, John Wiley Inc. 2000.
2. Kennedy, G. "Electronic Communication System**"** McGraw – Hill 4th Edition, 2003.
3. Singh R.P and Spare S.D. "Analog and Digital Communication Systems**".** McGraw – Hill Publishing Company Ltd. 3rd Edition, 2003.
4. Manoj Duhan, "Communication System**",** IK International Publishing House, 2012.

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Course Code	Course Title						Core / Elective
PE 553EE	ADVANCED SENSORS (Professional Elective-I)						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	
	L	T	D	P			Credits
-	3	-	0	0	30	70	3

Course Objectives

- To introduce the principles of Advanced sensors.
- To introduce the construction and applications of Advanced sensors.

Course Outcomes

At the end of the course students will be able to

1. Develop an understanding of need multi sensor and recent trends in technology
2. Explore Smart sensors working principle
3. Discuss the techniques for MEMS, NANO and Chemical sensors techniques.

UNIT – I

Sensor Fundamentals: Basic sensor technology and sensor system.
Application Consideration: Sensor characteristics, system characteristics, instrument selection, data acquisition and readout, and installation.

UNIT –II

Biosensors: Overview, applications and of origin of biosensor, bio receptor molecules, transduction mechanisms in biosensors, application range of biosensors, and future prospects.
MEMS and NANO sensors: Micro electromechanical systems (MEMS), Micromachining, Biomedical Applications, NANO sensors and carbon NANO tubes.

UNIT – III

Smart Sensors: Technology fundamentals and applications.
Electromagnetism in sensing: Introduction to electromagnetism and inductance in sensor application, magnetic field sensors and applications.

UNIT – IV

Chemical Sensors: Introduction to semiconductor gas detectors, ion selective electrodes, Conduct metric sensors, and mass sensors.
Fiber optic sensors: Fiber optic sensors for the measurement of temperature, pressure, displacement, turbidity and pollution

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UNIT – V

Robotics sensors: Introduction, characteristics and types of sensors, touch or tactile sensors, binary and analog sensors, proximity sensors, types of proximity sensors, contact and non-contact proximity sensors, robotic vision.

Suggesting Reading:

1. Sensor Technology Handbook by Jon Wilson Newness Publication Elsevier
2. Pallas-Areny R and Webster JG, "Sensors and Signal Conditioning," Wiley India
3. Gardener, "Micro sensors, MEMS and Smart Devices," Wiley India
4. Khazan AD, "Transducers and their Elements – Design and Applications," Prentice Hall
5. Patranabis D, "Sensors and Transducers," Prentice Hall
6. Middlehook S and Audet SA, "Silicon Sensors," Academic Press
7. Dorf RC, "Sensors, Nanoscience, Biomedical engineering and instruments," CRC Press
8. Zanger H and Zanger C, "Fiber optics Communication and other applications," Macmillan publishing

9. Joshi RM, “Biosensors,” ISHA Books
10. Webster JG, “Medical Instrumentation, Application and Design,” Wiley India

Course Code	Course Title						Core/Elective
PC263EE	**Electrical Circuits Lab**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	**2**	**25**	**50**	**1**

Course Objectives

- To Train the Students for acquiring practical knowledge in time response and frequency response of series / parallel RC, RL and RLC Circuits.
- To prepare the students for finds out parameters of a given two port network.
- To make the students for understanding the verification of theorems.

Course Outcomes

At the end of the course students will be able to

1. Evaluate the time response and frequency response character sties of R,L, C Series and parallel circuits.
2. Able to validate the network theorems.
3. Able to find various parameters of a two-port network.
4. Able to simulate electrical circuits using spice.
5. Able to synthesize networks from a given transfer function.

List of Experiments:

1. Charging and Discharging Characteristics of RC and RL series circuits.
2. Locus diagrams of RC and RL Circuits.
3. Frequencies Response of a Series RLC Circuits.
4. Frequencies Response of a Parallel RLC Circuits.
5. Parameters of two port network.
6. Series, parallel and cascade connection of two port networks.
7. Verification of Thevenin's and Norton's theorems.
8. Verification of Superposition theorem and Maximum power transfer theorem
9. Two Wattmeter method.
10. Simulation and transient analysis of series RLC circuits using PSPICE.
11. Mesh and Nodal analysis of electrical circuit using PSPICE.
12. Network Synthesis.
13. Characteristics of Linear, Non-Linear and Bilinear Elements.

Note: At least ten experiments should be conducted in the Semester.

Suggested Readings:

1. Van Valkenburg M.E., Network Analysis, Prentice Hall of India, 3rd Edition, 2000.
2. William Hayt H, Kimmerly Jack E, Steven Durbin M, Engineering Circuit Analysis, McGraw Hill, 6th Edition, 2002.
3. Jagan N.C, Lakshrninarayana C., Network Analysis, B.S. Publications, 3rd Edition, 2014.

Course Code	Course Title						Core/Elective
PC264EE	**Control Systems Lab**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**-**	**-**	**-**	**2**	**25**	**50**	**1**

Course Objectives

- To develop transfer function of various control system plants practically by conducting the experiments.
- To understand the various controllers, basic features of PLC
- Programming and control system concepts using MATLAB.

Course Outcomes

At the end of the course students will be able to:

1. Able to understand Performance of P, PI and PID Controllers.
2. Able to develop PLC programs for certain applications.
3. Acquire the knowledge of Data acquisition system and Industrial process control.

List of Experiments:

1. Characteristics of D.C. and AC. Servomotor and their transfer function.
2. Characteristics of synchros.
3. Frequency response of second order system.
4. Operating characteristics of Stepper motor.
5. Step response of second order system.
6. D.C. Position control system.
7. A.C. Position control system.
8. Performance of P, PI and PID Controller on system response.
9. Design of lag and lead compensation.
10. ON - OFF temperature control systems.
11. Simulation of control system concepts using MATLAB.
12. PLC (Programmable Logic Controller) applications. (a) Bottle filling (b) Speed control of Stepper motor (c) Liquid level control.
13. Data acquisition system and applications.
14. Industrial process control trainer.

Note: At least ten experiments should be conducted in the Semester.

Suggested Reading:

1. Nagrath I.J. & Gopal.M., *Control System Engineering*, Wiley Eastern, 2003.
2. B.C.Kuo, *Automatic Control Systems*, Wiley India, 7th Edition, 2002.
3. K.Ogata, *Modern Control System*, Prentice Hall of India, 4th Edition, 2002.
4. N.C.Jagan, *Control Systems*, B.S Publications, 2nd Edition, 2008.

Course Code	Course Title						Core/Elective
PC265EE	**Power Electronics Lab**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**-**	**-**	**-**	**2**	**25**	**50**	**1**

Course Objectives

- To be able to understand various power switching devices, trigger circuits, characteristics and applications by conducting the experiments.
- To learn and understand the rectifiers, choppers and inverters principle operation, characteristics and applications.

Course Outcomes

At the end of the course students will be able to

1. Able to understand speed control of motors by using controlled rectifier
2. Able to understand the applications of cyclo-converters
3. Able to simulate different power electronic devices using software.

List of Experiments:

1. R, RC, UJT Trigger Circuits for SCR's.
2. Design and fabrication of trigger circuits for single phase half and fully controlled bridge rectifiers.
3. Study of SCR chopper.
4. Design and fabrication of trigger circuit for MOSFET chopper.
5. Study of forced commutation techniques of SCRs.
6. Speed control of separately excited DC motor by controlled rectifier.
7. Speed control of universal motors using choppers.
8. Study of single phase half and fully controlled rectifier.
9. Study of single phase and three phase AC voltage controller.
10. Study of single phase dual converter.
11. Study of single phase cyclo converter.
12. IGBT based PWM inverters.
13. Simulation of single phase half and fully controlled rectifier.
14. Simulation of single phase and three phase AC voltage controller.
15. Simulation of single phase inverter & three phase inverter.

Note: At least ten experiments should be conducted in the Semester.

Suggested Readings:

1. Bimbra.P.S., *Power Electronics*, Khanna Publications, 2006.
2. Rashid M.H., *Power Electronics Circuits, Devices and Applications*, PHI, 2004.
3. Singh. M.D., Khanchandani K.B., *Power Electronics*, TMH, 14th reprint, 1999.
4. Mohan, Undeland and Robbins, *Power Electronic Converters. Applications and Design*, John Wiley & Sons - 3rd Edition, 2007.

SCHEME OF INSTRUCTION AND EXAMINATION
B.E. (ELECTRONICS AND INSTRUMENTATION ENGINEERING)
VI–SEMESTER

S. No.	Course Code	Course Title	Scheme of Instruction				Scheme of Examination			Credits
			L	T	P/D	Contact Hrs/Wk	CIE	SEE	Duration in Hrs	
Theory Courses										
1	PC241EE	Electrical Measurements and Instrumentation	3	1	-	4	30	70	3	4
2	PC242EE	Digital Signal Processing and Applications	3	1	-	4	30	70	3	4
3	PC504EE	Biomedical Instrumentation	3	1	-	4	30	70	3	4
4	PC505EE	Process Control	3	-	-	3	30	70	3	3
5	OE2_ EE	Open Elective - I	3		-	3	30	70	3	3
6	OE2_ EE	Open Elective – II	3		-	3	30	70	3	3
Practical/ Laboratory Courses										
7	PC507EE	Digital Signal Processing Lab	-	-	2	2	25	50	3	1
8	PC267EE	Electrical Measurements and Instrumentation Lab	-	-	2	2	25	50	3	1
9	PC268EE	Microprocessors and Microcontrollers Lab	-	-	2	2	25	50	3	1
10	PC801EE	Summer Internship*	Six Weeks during Summer Vacation							
			18	**3**	**06**	**27**	**255**	**570**	--	**24**

Open Elective – I & II		
1.	OE201EE	Electrical Energy Conservation and Auditing
2.	OE202EE	Reliability Engineering
3.	OE203EE	Non-Conventional Energy Sources
4.	OE204EE	Illumination and Electric Traction Systems

HS: Humanities and Social Sciences BS: Basic Science ES: Engineering Science MC: Mandatory Course PC: Professional Core OE: Open Elective
L: Lecture T: Tutorial P: Practical D: Drawing
CIE: Continuous Internal Evaluation SEE: Semester End Evaluation (Univ.Exam)
EE: Electrical Engineering

Note:

1. Each contact hour is a clock hour
2. The duration of the practical class is two hours, however it can be extended wherever necessary, to enable the student to complete the experiment.
3. The students have to undergo a Summer Internship of six-week duration after VI–Semester and credits will be awarded in VII–Semester after evaluation.

Course Code	Course Title						Core/Elective
PC241EE	**Electrical Measurements and Instrumentation**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**1**	**-**	**-**	**30**	**70**	**4**

Course Objectives

The objectives of this course is to impart knowledge of

- To learn and understand the fundamental concepts, principle of operation and applications of various electrical measuring instruments.
- To understand various types of Bridges in measurement of resistance, inductance, capacitance and frequency.
- To understand the operation and applications of Ballistic Galvanometer, Flux meter and DC/AC Potentiometer.
- To understand the application of CRO for measurement of Amplitude, Phase and frequency of sinusoidal signals.

Course Outcomes

After completing this course, the student will be able to:

1. Choose the suitable instrument like Ammeter, Voltmeter for AC/DC applications.
2. Select suitable Bridge for measurement of electrical parameters and quantities.
3. Use CRO for measurement of Amplitude, Phase and frequency of sinusoidal signals.

UNIT – I

Instruments: Indicating, Recording and Integrating instruments, Ammeter, Voltmeter, Expression for torque of moving coil, moving iron, Dynamometer, induction and electrostatic instruments. Extension of range of instruments, Wattmeter Torque expression for dynamometer instruments, Reactive power measurement.

UNIT II

Meters: Energy meters, single phase and 3-phase, Driving torque and braking torque equations, Errors and testing compensation, Maximum demand indicator, Power factor meters, Frequency meters, Electrical resonance and Weston type of synchro scope.

UNIT III

Bridge Methods and transducers: Measurement of inductance, capacitance and resistance using Bridges, Maxwell's, Hay's. bridge, Anderson, Wein, Desauty's, Schering's bridges, Kelvin's double bridge, Megger, Loss of charge method, Wagners earthing device, Transducers - Analog and digital transducers, Strain gauges and Hall effect transducers.

UNIT IV

Magnetic Measurements and instrument transformers: Ballistic galvanometer, Calibration by Hibbert' s magnetic standard flux meter, Lloyd-Fischer square for measuring iron loss, Determination of B-H curve and Hysteresis loop using CRO, Instrument transformers – Current and potential transformers, ratio and phase angle errors of CT's and PT's.

UNIT V

Potentiometers: Crompton's DC and AC polar and coordinate types, Applications, Measurements of impedance, Calibration and ammeter voltmeter and wattmeters. Use of oscilloscope in frequency, phase and amplitude measurements.

Suggested Readings:

1. Shawney A.K., *Electrical and Electronics Measurements and Instruments*, Dhanpatrai & Sons, Delhi, 2000.
2. Umesh Sinha, *Electrical, Electronics Measurement and Instrumentations*, Satya Prakashan, New Delhi.
3. Golding E.W., *Electrical Measurements and Measuring Instruments*, Sir Issac & Pitman & Sons Ltd., London.
4. U.A.Bakshi, A.V.Bakshi, *Electrical and Electronic Instrumentation*, Technical publications

Course Code	Course Title						Core / Elective
PC242EE	**DIGITAL SIGNAL PROCESSING AND APPLICATIONS**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
NIL	3	1	-	-	**30**	**70**	**4**

Course Objectives

- To be able to understand and apply classification: characterization, representation and analysis of signals and systems in time and frequency domain.
- To understand the principle and design of digital filters and to introduce digital signal processor and their architecture.

Course Outcomes

At the end of the course students will be able to

- Acquire the knowledge of - Classification of discrete time signals & discrete time systems, Properties of Z-transforms, Discrete time Fourier transform.
- Analyze the Characteristics of IIR digital filters, FIR digital filters.

  Explain the Advantages of Digital signal processors over conventional Microprocessors.

UNIT- I

Introduction to Digital Signal Processing: Sampling, Quantizing and coding, Classification of discrete time signals & discrete time systems, linear shift invariant systems, Stability and causality, Solution to Linear constant coefficient difference equations.

Z-transforms: Properties Inverse z – transform, System function, Relation between s-plane and z- plane - Stability in Z-domain, Solution of difference equations using one sided z-transform.

UNIT - II

Frequency domain analysis : Discrete time Fourier transform (DTFT), Properties, Frequency domain representation of discrete time signals and systems - DFS, Properties- Frequency domain sampling OFT, Properties - circular convolution - Linear convolution using OFT - Fast Fourier transforms (FFT), Radix-2 decimation in time(DIT) and decimation in frequency(DIF) FFT Algorithms, IDFT using FFT.

UNIT-III

IIR digital filters: Analog filter approximations, Butterworth and Chebyshev filters, Design of IIR Digital filters from analog filters using bilinear transformation, Impulse invariant and step invariant methods. Realization of IIR filters - Direct form - I, Direct form - II, Cascade and parallel form realizations

UNIT- IV

FIR digital filters: Characteristics of FIR Digital Filters, frequency response. Design of FIR Digital filters using window techniques, linear phase realization, Applications of digital signal processing to speech processing.

UNIT-V

Introduction to Digital Signal Processors: Introduction to programmable DSPs -Advantages of Digital signal processors over conventional Microprocessors - Architecture of TMS 320C5X.

Introduction, Bus Structure, Central Arithmetic Logic Unit, Auxiliary Register, Index Register, Auxiliary Register Compare Register, Block Move Address Register, Parallel Logic Unit, Memory mapped registers, Program controller, Status registers, on- chip memory and On-chip peripherals

Suggested Reading:

1. Proakis & Manolakis - Digital Signal Processing, Principles, Algorithms and Applications, Prentice Hall of India - 3rd Edition-1994.
2. Opeinheim & Schaffter - Digital Signal Processing, PHI Publications, 2002.
3. Salivahanan Valluaraj & Gnanapriya - Digital Signal Processing• Tata McGraw Hill, 2001.
4. Anand Kumar.A - Digital Signal Processing - PHI learning Private Ltd. 2013.
5. B.Venkataramani and M. Bhaskar - Digital Signal Processors, Architecture programs and applications, Tata McGraw Hill, 2007.

Course Code	Course Title						Core/Elective
PC504EE	BIOMEDICAL INSTRUMENTATION						Core
Prerequisite	L	T	D	P	CIE	SEE	Credits
	3	0	0	0	30	70	3

Course Objectives

- To understand various medical instruments and latest techniques used in the hospital for diagnostic purpose.
- To learn and understand electrical hazards of medical instruments and patient's safety.

Course Outcomes

On successful completion of this course student will be able to

1. Describe different general devices used in biomedical applications.
2. Explain instruments for recording Bio-potentials.
3. Explain different techniques and related instruments for measuring blood pressure, blood flow and heart sounds.
4. Describe radiography and explain recent biomedical instruments.
5. Describe electrical hazards, safety in hospital design.

UNIT-I

Introduction to Bio medical Instrumentation: General characteristics of medical instrumentation like linearity, range, frequency response, signal to noise ratio and stability. Amplifiers for Bio medical Applications: Differential, Carrier amplifiers. Recorders and display devices for Bio medical applications. General features of ink jet, thermo sensitive and optical recorders. General features of display devices for bio signals. Data acquisition and display using microcomputers.

UNIT-II

Electro Cardiography (ECG) recording system: Block Schematic diagram of ECG machine, Amplifiers and circuits for ECG, ECG Leads, Noise problems and their elimination.

Electro Encephalography (EEG): Block schematic diagram of EEG recording system, General features of different blocks, Specification of EEG amplifiers, Qualitative requirements. 10 -20 electrode placement system, resting rhythms and sleep stages.

Electro Myography (EMG): Block schematic diagram of EMG recording system. EMG amplifiers. Design considerations of EMG amplifiers. Data display for EMG.

UNIT-III

Blood pressure and Blood Flows: Electronic Techniques for indirect and direct measurement of blood pressure. Measurement of blood flow by Electromagnetic, Doppler and Plethysmo graphic methods.

Phonocardiography: Origin of heart sounds, Phonocardiography instrumentation consisting of microphone, filters and signal conditioners.

UNIT-IV

Introduction to Radiography: Physical properties of X-Rays, principles of generation of X-Rays. Radiation energy distribution, collimators and grids, fluoroscopy, and image intensifiers.

Recent Trends: Medical imaging, X-rays, laser applications, ultrasound scanner, echo cardiography, CT scan MRI/NMR, Cine angiogram, color Doppler systems, Holter monitoring, endoscopy.

UNIT-V

Electrical hazards during Bio electric monitoring: Safety codes and Standards, Micro and Macro shock and their physiological effects. Leakage currents and protection by the use of isolation transformers, Equipotential grounding and earth free monitoring.

Electrical factors in Hospital Design: Electrical power supply systems in a Hospital building. Proper installation and grounding for providing safe patient electrical environment.

Suggested Reading:

1. Leslie Cromwell, Fred J. Weibell and Erich A. Pfeiffer, *"Biomedical Instrumentation and Measurements",* 2nd Edition, Prentice Hall, New Delhi, 1998.
2. John G. Webstar, *Medical instrumentation -Application & Design,* John Wiley & Sons Inc., 3rd Edition, 2003.
3. R.S. Khandpur, *Hand Book of Biomedical Instrumentation,* Tata McGraw Hill Publishing Company Ltd., 2nd Edition, New Delhi, 2003
4. Joseph J.Carr and John M.Brown, *Introduction to Biomedical Equipment Technology,* Pearson Education, 2001.
5. L. A. Geddes, *Principles of Applied Bio-Medical Instrumentation,* John Wiley and Sons, New York, USA, 1975.
6. Geddes L. A. and Baker L. E., *"Principles of Applied Biomedical Instrumentation",* 3rd Edition, John Wiley, New York, 1989.
7. Richard Aston, *"Principles of Bio-medical Instrumentation and Measurement",* Merril Publishing Company, New York, 1990.

Course Code	Course Title						Core / Elective
PC505EE	Process Control						Core
Prerequisite	Contact Hours per Week				CIE	SEE	
	L	T	D	P			Credits
NIL	3	-	0	0	30	70	3

Course Objectives

- To dynamics of various processes.
- To impart knowledge on basic control actions, the effect of various control actions and tuning techniques of controllers.
- To impart knowledge on the final control elements.
- To give an introductory knowledge on Programmable Logic Controller (PLC) and their Programming language.

Course Outcomes

At the end of the course, students will be able to

1. Describe elements in process control loop and write a mathematical model for processes.
2. Explain various control modes and realize different electronic controllers.
3. Discuss effects of the closing of the loop with different controllers and estimate controller parameters by using various tuning methods.
4. Explain different final control elements in the process control systems.
5. Describe the nature of programmable logic controller (PLC) and develop PLC programs by using ladder diagram logic for process control applications.

UNIT-I

Process characteristics: Process variables, process degrees of freedom, characteristics of physical systems, elements of process dynamics, liquid processes, gas processes, flow processes, thermal processes, dead time, thermal element lag, pressure element lag.

UNIT-II

Controller characteristics: Automatic controller, proportional control, integral control, proportional integral control, proportional derivative control, PID control action, two position control, single speed floating control, electronic controllers, two position floating controller.

UNIT-III

Closed loop in Automatic control: Effect of closing loop, proportional control, integral control, PI control, derivative control, static error offset, velocity error, Ziegler Nichols methods, two position control, single speed floating control.

UNIT-IV

Final control elements: Electrical actuators, Pneumatic actuators, Hydraulic actuators.

Valve accessories: Pneumatic valve positioner, valve limit switches, solenoid valves, valves selection, performance, sizing and characteristics.

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UNIT-V

Discrete state process control: Introduction, relay controllers and Ladder diagrams, with elements and examples.

Programmable Logic Controllers (PLCs): Introduction to PLC design, PLC operation, and programming PLC using software functions with examples.

Suggested Reading:

1. Eckman D. P, Automatic Process Control, Wiley Eastern, 1975.
2. Majumdar S.R, Pneumatic System, Tata McGraw, 1995.
3. Curtis D.Johnson, Process Control & Instrumentation Technology, 7th Edition, Pearson Education.
4. Bela G.Liptak, Instrument Engineer's Handbook -Process Control, 3rd Edition, Gulf publications

Course Code	Course Title						Core/Elective
OE201EE	**Electrical Energy Conservation and Auditing (Open Elective)**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

- To understand the concepts of basic energy and various forms of energy.
- To understand the energy management and need of energy audit.
- To understand the energy efficiency technologies.

Course Outcomes

At the end of the course students will be able to

1. Understand the current energy scenario and importance of energy conservation.
2. Understand the concepts of energy management.
3. Understand the methods of improving energy efficiency in different electrical systems.
4. Understand the concepts of different energy efficient devices.

UNIT-I

Energy Scenario: Commercial and Non-commercial energy, primary energy resources, commercial energy production, final energy consumption, energy needs of growing economy, long term energy scenario, energy pricing, energy sector reforms, energy and environment, energy security, energy conservation and its importance, restructuring of the energy supply sector, energy strategy for the future, air pollution, climate change. Energy Conservation Act-2001 and its features.

UNIT-II

Basics of Energy and its various forms: Electricity tariff, load management and maximum demand control, power factor improvement, selection & location of capacitors, Thermal Basics-fuels, thermal energy contents of fuel, temperature & pressure, heat capacity, sensible and latent heat, evaporation, condensation, steam, moist air and humidity & heat transfer, units and conversion.

UNIT-III

Energy Efficiency in Electrical Systems: Electrical system: Electricity billing, electrical load management and maximum demand control, power factor improvement and its benefit, selection and location of capacitors, performance assessment of PF capacitors, distribution and transformer losses. Electric motors: Types, losses in induction motors, motor efficiency, factors affecting motor performance, rewinding and motor replacement issues, energy saving opportunities with energy efficient motors.

UNIT-IV

Energy Efficient Technologies in Electrical Systems: Maximum demand controllers, automatic power factor controllers, energy efficient motors, soft starters with energy saver, variable speed drives, energy efficient transformers, electronic ballast, occupancy sensors, energy efficient lighting controls, energy saving potential of each technology.

UNIT-V

Energy Management and Audit: Definition, energy audit, need, types of energy audit. Energy management (audit) approach understanding energy costs, bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel & energy substitution, energy audit instruments. Material and Energy balance: Facility as an energy system, methods for

preparing process flow, material and energy balance diagrams.

Suggested Readings:

1. Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-1, General Aspects (available online).
2. Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-3, Electrical Utilities (available online).
3. S. C. Tripathy, *Utilization of Electrical Energy and Conservation*, McGraw Hill, 1991.
4. Success stories of Energy Conservation by BEE, New Delhi (www.bee-india.org).

Course Code	Course Title						Core/Elective
OE202EE	**Reliability Engineering (Open Elective)**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

- To understand the concepts of different types of probability distributions. importance of reliability evaluation of networks.
- To make the students understand about Reliability, availability model of Power Systems and markov modeling of Power Plants. with identical and nonidentical units.

Course Outcomes

At the end of the course students will be able to

1. Understand the meaning of discrete and continuous random variables and their significance, causes of failures of a system.
2. Acquire the knowledge of different distribution functions and their applications.
3. Able to develop reliability block diagrams and evaluation of reliability of different systems..

UNIT-I

Discrete and continuous random variables. Probability density function and Cumulative distribution function. Mean and variance. Binomial, Poisson, Exponential and WeibulI distributions.

UNIT-II

Failure and causes of failure. Failure rate and failure density. Reliability function and MTTF. Bath tub curve for different systems. Parametric methods for above distributions. Non - Parametric methods from field data.

UNIT-III

Reliability block diagram. Series and parallel systems. Network reduction technique, Examples. Evaluation of failure rate, MTTF and reliability, Active and Standby Redundancy, r out of n configuration. Non-series - parallel systems. Path based and cut set methods.

UNIT - IV

Availability, MTTR and MTBF, Markov models and State transition matrices. Reliability models for single component. two components, Load sharing and standby systems. Reliability and availability models of two unit parallel systern with repair and standby systems with repair.

UNIT – V

Repairable Systems. maintainability. Preventive maintenance, Evaluation of reliability and J1TTF. Overhauling and replacement. Optimum maintenance policy. Markov model of a power plant with identical units and non-identical units. Capacity outage probability table. Frequency of failures and Cumulative frequency.

Suggested Readings:

1. Charles E. Ebeling. Reliability and Maintainability Engineering, McGraw Hill International Edition, 1997.
2. Balaguruswamy, Reliability Engineering, Tata McGraw Hill Publishing Company Ltd, 1984.
3. R.N. Allan. Reliability Evaluation of Engineering Systems, Pitman Publishing, 1996.
4. Endrenyi. Reliability Modeling in Electric Power Systems. John Wiley & Sons, 1978.

Course Code	Course Title						Core/Elective
OE203EE	**Non-Conventional Energy Sources (Open Elective)**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

- To understand basics and types of Non-conventional energy sources.
- To understand the working and operation of Solar and wind energy systems.
- To understand the working and operation of Ocean, Geo-thermal and biomass energy systems.

Course Outcomes

At the end of the course students will be able to

1. Understand the applications of non-conventional energy sources and fuel cells.
2. Acquire the knowledge of Solar energy storage systems, wind generation and control.
3. Acquire the knowledge of Geothermal, Biomass and ocean energy conversion systems.

UNIT-I

Review of Conventional and Non-Conventional energy sources - Need for non-conventional energy sources Types of Non- conventional energy sources - Fuel Cells - Principle of operation with special reference to H2 °2 Cell - Classification and Block diagram of fuel cell systems - Ion exchange membrane cell - Molten carbonate cells - Solid oxide electrolyte cells - Regenerative system- Regenerative Fuel Cell - Advantages and disadvantages of Fuel Cells- Polarization - Conversion efficiency and Applications of Fuel Cells.

UNIT-II

Solar energy - Solar radiation and its measurements - Solar Energy collectors -Solar Energy storage systems - Solar Pond - Application of Solar Pond - Applications of solar energy.

UNIT-III

Wind energy- Principles of wind energy conversion systems - Nature of wind - Power in the Wind-Basic components of WECS -Classification of WECS -Site selection considerations - Advantages and disadvantages of WECS -Wind energy collectors -Wind electric generating and control systems - Applications of Wind energy -Environmental aspects.

UNIT-IV

Energy from the Oceans - Ocean Thermal Electric Conversion (OTEC) methods - Principles of tidal power generation -Advantages and limitations of tidal power generation -Ocean waves - Wave energy conversion devices -Advantages and disadvantages of wave energy - Geo-thermal Energy - Types of Geo-thermal Energy Systems - Applications of Geo-thermal Energy.

UNIT-V

Energy from Biomass - Biomass conversion technologies / processes - Photosynthesis - Photosynthetic efficiency - Biogas generation - Selection of site for Biogas plant - Classification of Biogas plants - Details of commonly used Biogas plants in India - Advantages and disadvantages of Biogas generation -Thermal gasification of biomass - Biomass gasifies

Suggested Readings:

1. Rai G.D, Non-Conventional Sources of Energy, Khandala Publishers, New Delhi, 1999.
2. M.M.El-Wakil, Power Plant Technology. McGraw Hill, 1984.

Course Code	Course Title						Core/Elective
OE204EE	**Illumination and Electric Traction Systems (Open Elective)**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

- To introduce the students and understand Utilization of electrical energy for various applications like industrial heating, welding etc.,
- To understand the concept of illumination, and know the applications of various lamps to factory lighting, street lighting etc.
- To understand the concept of electrification of traction system.

Course Outcomes

At the end of the course students will be able to

1. Students will be able to design and use op-amps for various linear and non-linear applications.
2. Ability to design and use voltage regulators and active filters.

UNIT-I

Industrial Heating: Advantages and methods of electric heating. Description, operation and performance of resistance ovens — Design of elements. Core type, Coreless type furnaces, High frequency eddy current heating, Dielectric heating. Arc furnace. Electric welding, Resistance welding, welding transformer and its rating, various types of Electric arc welding and electric resistance welding.

UNIT–II

Schematic Utilization and Connection Diagrams for Motor Control: Two supply sources for 3 phase Induction motors. Direct reversing, remote control operation, and jogging operating of Induction motor. Contactor control circuit. Push button control stations. Over load relays, limit switches, float switches. Interlocking methods for reversing control.

UNIT – III

Illumination: Introduction, nature and production of light, Sensitivity of the eye, Units of light. The inverse square law and cosine law, Solid angle, Lighting calculations — Determination of M.S.C.P, Rousseau's construction, Discharge lamps, Sodium vapour lamps, Mercury vapour lamps — Fluorescent lamp, Starting and power factor corrections, Stroboscopic effects — Neon signs, Application to factory lighting, Street lighting and Flood lighting.

UNIT – IV

Electric Traction: System of Electric Traction — Transmission of drive — Systems of track electrification — Traction mechanics — Speed time curves — Tractive effort — Power of Traction motor — Specific energy consumption — Mechanics of train movement— Coefficient of adhesion. Traction Motors: Desirable characteristics, d.c series motors, a.c series motors 3-phase induction motors, d.c motor series & parallel control, Energy saving.

UNIT – V

Train Lighting: Systems of train lighting — Special requirements of train lighting — Methods of obtaining unidirectional polarity — Methods of obtaining constant output — Single battery system — Double battery parallel block system — Principal equipment of double battery system — Coach wiring — Dynamo.

Batteries: Lead acid batteries, SMF batteries, Construction and maintenance, Charging and rating of batteries.

Suggested Readings:

1. Partab H, Art and Science of Utilization of Electric Power, Dhanpat Rai & Sons, 1997.
2. K.B. Raina & S.K. Bhattacharya, Electrical Design, Estimating
3. and Costing, Wiley Eastern Ltd., 1991.
4. Partab H, Modern Electric Traction, Dhanpat Rai & Sons, 2000.
5. B.L.Theraja, A Text Book of Electrical Technology, S.Chand & Company Ltd, Vol —I.

Course Code	Course Title						Core/Elective
PC507EE	**DIGITAL SIGNAL PROCESSING LAB (Common to EEE and EIE)**						**Core**
	L	**T**	**D**	**P**	**CIE**	**SEE**	**Credits**
PC242EE	**0**	**0**	**0**	**2**	**25**	**50**	**1**

Course Objectives

To prepare the students

- To develop MATLAB code to generate different discrete signals and perform basic operations.
- To develop MATLAB code to convert continuous to discrete by DFT and FFT computations.
- To obtain Convolution of sequences and sampling theorem.
- To develop MATLAB code to design FIR and IIR filters.
- To use DSP kit and CCS, write code to obtain convolution of sequences, design of FIR and IIR filters, compute DFT and FFT algorithms, Impulse response and generate basic waves

Course Outcomes

On successful completion of this course student will be able to

1. Compute and write MATLAB code to generate basic waves and perform basic operations on them.
2. Compute and write MATLAB code to apply sampling theorem,
3. Do convolution and compute DFT and FFT.
4. Compute and write MATLAB code to design FIR and IIR filters.
5. Compute and write MATLAB code to obtain convolution of sequences,
6. Design FIR and IIR filters,
7. Conduct impulse response experiment and generate basic waves using DSP kit.

List of Experiments

1. Generation of different discrete signal sequences and Waveforms.
2. Basic Operations On Discrete Time Signals
3. DFT Computation and FFT Algorithms.
4. Verification of Convolution Theorem.
5. Verification of sampling theorem.
6. Design of Butterworth and Chebyshev LP and HP filters.
7. Design of LPF using Rectangular, Hamming and Kaiser Windows.
8. To perform linear and circular convolution for the given sequences.
9. Design and implementation of FIR and IIR filter.
10. Computation of DFT using DIT and DIF algorithm.
11. Generation of basic waves.
12. Impulse response.

Note: At least ten experiments should be conducted in the Semester

Suggested Reading:

1. Proakis & Manolakis - Digital Signal Processing, Principles, Algorithms and Applications, Prentice Hall of India - 3rd Edition-1994.
2. Opeinheim & Schaffter - Digital Signal Processing, PHI Publications, 2002.

Course Code	Course Title						Core/Elective
PC267EE	**Electrical Measurements and Instrumentation Lab**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**-**	**-**	**-**	**2**	**25**	**50**	**1**

Course Objectives

- To train the students for acquiring practical knowledge for measuring resistance, inductance and capacitance using various bridges.
- To train the student for the usage of A.C. and D.C. potentiometers.
- To make the student understand the operation of CRO and its usefulness in finding the amplitude, phase and frequency of waveforms.

Course Outcomes

At the end of the course students will be able to:

1. Measure the inductance, capacitance and resistance using various bridges.
2. Measure resistance and calibrate ammeter, voltmeters and wattmeter using A.C. and D.C. potentiometers.
3. Have hands on experience on the operation of CRO.

List of Experiments:

1. Measurement of low resistance by Kelvin's Double Bridge.
2. Calibration of single phase energy meter.
3. Measurement of inductance by Maxwell's and Anderson's bridges.
4. Measurement of capacitance by Desauty's and Schering's bridges.
5. Measurement of Iron losses by Lloyd, Fishers magnetic square.
6. Measurement of Resistance and calibration of Ammeter using D.C. potentiometer.
7. Calibration of voltmeter and wattmeter using D.C. potentiometer.
8. Measurement of unknown voltage and impedance using A.C. potentiometer.
9. Calculation of iron losses using B-H curve with oscilloscope.
10. Localizing Ground and short circuit faults using Murray loop test and Varley loop test.
11. Measurement of relative permittivity (Ɛr) of a dielectric medium using Schering bridge.
12. Measurement of frequency of unknown sinusoidal signal with CRO.
13. Measurement of phase and amplitude using CRO.
14. Calibration of given power factor meter using calibrated voltmeter, ammeter and wattmeter.

Note: At least ten experiments should be conducted in the Semester.

Suggested Reading:

1. Shawney A.K., *Electrical and Electronics Measurements and Instruments*, Dhanpatrai & Sons, Delhi, 2000.
2. Umesh Sinha, *Electrical, Electronics Measurement and Instrumentations*, Satya Prakashan, New Delhi.
3. Golding E.W., *Electrical Measurements and Measuring Instruments*, Sir Issac and Pitman & Sons Ltd., London.

Course Code	Course Title						Core/Elective
PC268EE	**Microprocessor and Microcontrollers Lab**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**-**	**-**	**-**	**2**	**25**	**50**	**1**

Course Objectives

- Developing of assembly level programs and providing the basics of the processors
- To provide solid foundation on interfacing the external devices to the processor according to the user requirements to create novel products and solutions for the real time problems
- To assist the students with an academic environment needed for a successful professional career.

Course Outcomes

At the end of the course students will be able to

1. Familiarize with the assembly language programming.
2. Write programs for given task using different addressing modes.
3. Interface various IO devices using 8255 PPI
4. Write programs using various interrupts.
5. Interface the microcontroller for some real life applications.

List of Experiments:

8085 based:

1. Signed/unsigned multiplication and division.
2. Finding average, largest, square root, etc.
3. Sorting set of numbers.
4. Code conversion like BCD numbers into binary.
5. 8255 PPI for interfacing LEDs.
6. 8255 PPI for interfacing to generate triangular wave using DAC.
7. Using interrupts.
8. Interfacing seven segment display.
9. Interfacing matrix keyboard.

8051 based:

1. Data transfer – block move, exchange, sorting, finding largest element in array.
2. Arithmetic instructions: multi byte operations.
3. Boolean & logical instructions (Bit manipulations).
4. Programs to generate delay, programs using serial port and on chip timer/counter.
5. Use of JUMP and CALL instructions.
6. Square wave generation using timers.
7. Interfacing of keyboard and 7-segment display module.
8. DAC interfacing for generation of sinusoidal wave.

Note: At least five experiments for 8085 and at least five experiments for 8051.

Course Code	Course Title					Core/Elective
PC801EE	**Summer Internship**					**Core**
Prerequisite	Contact Hours			CIE	SEE	Credits
	L/T	D	P			
-	**-**	**-**	**Six Weeks**	**50**	**-**	**2**

Course Objectives

- To give an experience to the students in solving real life practical problems with all its constraints.
- To give an opportunity to integrate different aspects of learning with reference to real life problems.
- To enhance the confidence of the students while communicating with industry engineers and give an opportunity for useful interaction with them and familiarize with work culture and ethics of the industry.

Course Outcomes

At the end of the course students will be able to:

1. Design/develop a small and simple product in hardware or software.
2. Complete the task or realize a pre-specified target, with limited scope, rather than taking up a complex task and leave it.
3. Learn to find alternate viable solutions for a given problem and evaluate these alternatives with reference to pre-specified criteria.
4. Implement the selected solution and document the same.
5. Able to write a technical report and present it to appropriate audience.

Summer Internship is introduced as part of the curriculum for encouraging students to work on problems of interest to industries. A batch of two or three students will be attached to a person from an Electronics Industry / R & D Organization / National Laboratory for a period of six weeks. This will be during the summer vacation following the completion of the VI Semester course. One faculty member will act as an internal guide for each batch to monitor the progress and interacts with the Industry guide.

After the completion of the summer internship, students will submit a brief technical report on the internship executed and present the work through a seminar talk to be organized by the department. Award of sessional are to be based on the performance of the student at the work place to be judged by industry guide and internal guide (25 Marks) followed by presentation before the committee constituted by the department (25 Marks). One faculty member will co-ordinate the overall activity of Summer Internship.

***Students have to undergo summer internship of six Weeks duration at the end of VI semester and two credits will be awarded in the VII Semester after evaluation.**