B. Tech Instrumentation Engineering
Syllabi for Examinations

3rd YEAR (SEMESTER–V) (w.e.f. 2020-21)

Course no: IN-HSM-301		**Course title: Ethics and Value**			
Year and Semester		**3rd year 5th Semester**		**Contact hours per week: 2 hrs Examination Duration: 3 hrs**	
L	**T**	**P**	**C**	**Evaluation**	
2	**-**	**-**	**2**	**Minor test + Curricular activities: 40**	**Major test: 60**

Course Objectives:	
1.	To create an awareness on Engineering Ethics and Human Values.
2.	To understand social responsibility of an engineer.
3.	To appreciate ethical dilemma while discharging duties in professional life
Course Outcomes: On completion of the course, student would be able to:	
CO1	Understand the ethical theories and concepts
CO2	Understand an engineer's work in the context of its impact on society
CO3	Understand and analyze the concepts of safety and risk
CO4	Understand the professional responsibilities and rights of Engineers
CO5	Understand the concepts of ethics in the global context.

Module-I

HUMAN VALUES : Morals, Values and Ethics – Integrity – Work Ethic – Honesty – Courage –Empathy – Self-Confidence – Character .
ENGINEERING ETHICS AND THEOREMS: Senses of 'Engineering Ethics' - variety of moral issueds- types of inquiry - moral dilemmas - moral autonomy - Kohlberg's theory - Gilligan's theory - consensus and controversy – Models of Professional Roles - Professional and professionalism, moral reasoning and ethical theories, virtues, professional responsibility, integrity, self-respect, duty ethics, ethical rights, self-interest, egos, moral obligations. Theories Co-operation – Commitment.

Module-II

SOCIAL ETHICS and ENGINEERING AS SOCIAL EXPERIMENTATION: Engineering as experimentation - engineers as responsible experimenters - codes of ethics - a balanced outlook on law - Legal aspects of social ethics, the challenger case study, Engineers duty to society and environment.

Module-III

SAFETY, RESPONSIBILITIES AND RIGHTS: Safety and risk - assessment of safety and risk - risk benefit analysis and reducing risk - the Three Mile Island and Chernobyl case studies. Bhopal (MIC), Visakhapatnam (Polystyrene) case studies
RESPONSIBILITIES AND RIGHTS OF ENGINEERS: Collegiality and loyalty – respect for authority – collective bargaining – confidentiality – conflicts of interest – occupational crime – professional rights – employee rights – Intellectual Property Rights (IPR) – discrimination.

Module-IV

GLOBAL ISSUES AND ENGINEERS AS MANAGERS, CONSULTANTS AND LEADERS: Multinational corporations - Environmental ethics - computer ethics - weapons development - engineers as managers-consulting engineers-engineers as expert witnesses and advisors -moral leadership- Engineers as trend setters for global values.

Text Books:

1. Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw-Hill, New York 1996.
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi, 2004.

Reference Books:

1. Charles D. Fleddermann, "Engineering Ethics", Pearson Education / Prentice Hall, New Jersey, 2004 (Indian Reprint now available).
2. Charles E Harris, Michael S. Protchard and Michael J Rabins, "Engineering Ethics – Concepts and Cases", Wadsworth Thompson Leatning, United States, 2000 (Indian Reprint now available)
3. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 2003.
4. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, Oxford, 2001.

B. Tech Instrumentation Engineering

3rd YEAR (SEMESTER–V) (w.e.f. 2020-21)

<table>
<tr><td colspan="2">Course no: IN-PC-303</td><td colspan="4">Course title: Power Electronics-II</td></tr>
<tr><td colspan="2">Year and Semester</td><td colspan="2">3rd year
5thSemester</td><td colspan="2">Contact hours per week: 4 hrs
Examination Duration: 3 hrs</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>C</td><td colspan="2">Evaluation</td></tr>
<tr><td>3</td><td>1</td><td>-</td><td>4</td><td>Minor test + Curricular activities: 40</td><td>Major test: 60</td></tr>
<tr><td colspan="6">Course Objectives:</td></tr>
<tr><td colspan="6">1. To introduce the concept of Choppers.</td></tr>
<tr><td colspan="6">2. To introduce the concept of Inverters and types of inverters.</td></tr>
<tr><td colspan="6">3. To study the modulation & harmonics and techniques to remove harmonics.</td></tr>
<tr><td colspan="6">4. To study various types of chopper drives and its applications.</td></tr>
<tr><td colspan="6">Course Outcomes: On completion of the course, student would be able to:</td></tr>
<tr><td>CO1</td><td colspan="5">To Familiarize with control strategies of choppers, types of choppers.</td></tr>
<tr><td>CO2</td><td colspan="5">To understand the working of Inverters.</td></tr>
</table>

CO3	To Familiarize with inverters, types of choppers and their mode of angles of operations.
CO4	To understand the applications of choppers and at different stages.

Module-I

Choppers: Principle of choppers, Control strategies; Constant frequency system and Variable frequency system. Step-up choppers, Types of chopper Circuits; First Quadrant or Type-A choppers, Second-Quadrant or Type-b choppers, Two-Quadrant Type-a Chopper or Type-C chopper, Two-Quadrant Type-b Chopper or Type-D chopper, Four-Quadrant Type-a Chopper or Type-E chopper, Thyristor Chopper Circuits; Voltage commutated choppers, Current-commutated choppers and Load commutated choppers.

Module-II

Inverters: operating Principle of Single Phase Voltage source inverter; Single –Phase bridge inverter, steady state analysis of Single–Phase bridge inverter, Fourier analysis of Single–Phase inverter Output voltage, Force-commutated thyristor inverter; Modified Mcmurray Half-bridge Inverter, Modified Mcmurray Full-bridge Inverter, Modified Mcmurray-Bedford Half-bridge Inverter, Modified Mcmurray-Bedford Full-bridge Inverter, Three Phase Bridge Inverter; Three –Phase 180^0 Mode VSI and Three –Phase 120^0 Mode VSI.

Module-III

Modulation and Harmonics; Pulse Width Modulated Inverter; Single-Phase Modulation, Multiple Phase Modulation, Sinusoidal Pulse Modulation (Sin M), Reduction Of Harmonics in the inverter output Voltage; Harmonics Reduction by PWM, Harmonics Reduction by Transformer connection, Harmonics Reduction by Stepped wave Inverter, Current Source inverter; Single phase with ideal switching, Basic Series Inverter, Basic Parallel Inverter(Single Phase).

Module-IV

Electric Drives and Applications: Chopper Drives; Power Control or Motoring Control, Regenerative-Breaking control, Two Quadrant chopper control and Four Quadrant Chopper control, Speed Control of three Phase Induction Motor; Stator Voltage control, Stator Frequency control, Stator Voltage and Frequency control, Stator Current control, Static Kramer Drives, Static Scherbius Drive. (No quantitative analysis)

Text Books;

1. VendamSubramanium, ‘Power Electronics’ New Age Publishers-New Delhi
2. P.C.Sen, ’Power Electronics’ Tata McGraw-Hill Publishing Co Ltd-New Delhi
3. Mohan/Underland/Robbins, ‘Power Electronics’JohnWiley& Sons Pvt ltd-
4. Ramamurthy,’Thyristor and Its Applications’
5. Rashid ‘Power Electronics’
6. Gupta/Singh ‘Power Electronics and Introduction to Drives’DhanpatRaiPubl.Co
7. P.S.Bhimbhra ’Power Electronics’ Khanna Publishers.

3RD YEAR (SEMESTER–V) (w.e.f. 2020-21)

Course no: IN-PC-305				Course title: MICROPROCESSORS	
Year and Semester		3rd year 5thSemester		Contact hours per week: 4 hrs Examination Duration: 3 hrs	
L	T	P	C	Evaluation	
3	1	-	4	Minor test + Curricular activities: 40	Major test: 60

Course Objectives:	
1. To equip the students with architecture and working of basic microprocessors.	
2. To make the students understand the instructions sets of basic microprocessors and various assembly language programs.	
3. To impart the knowledge of various programmable interfacing chips.	
4. To design and study the various instrumentation systems with programmable chips.	
Course Outcomes: On completion of the course, student would be able to:	
CO1	Understand the basic of the internal organisation of 8086 Microprocessor.
CO2	Understand different addressing modes and instructions of 8086, design and develop assembly language programs using software interrupts, subroutines, macros.
CO3	Understand to interface memory and I/O devices with 8086 through programmable interface chips
CO4	Understand interrupt structure in 8086 and few case studies using interfacing chips useful in instrumentation systems.

Module - I

Introduction to Microprocessors, Microcomputer systems, Computer languages. Microprocessor Architecture, Microprocessor operation with memory and input / output devices. 8085 based microprocessor systems.

Module - II

Instructions: Basic Instructions, Format, classification, Status flags, Writing Assembly Language Programs. Additional Instructions and Programming techniques: Logic Operators, Data transfer and 16 bit Arithmetic Instructions.

Module - III

Looping, counting, Indexing. Stack, Subroutines, conditional call and Return. Code Conversions: BCD to binary, Binary to BCD. BCD Arithmetic's and data operations: BCD Addition and subtraction, Introduction to advanced Instructions and applications, Multiplication. Timing diagrams, machine cycle.

Module - IV

Basic interfacing concepts, Memory mapped and Peripheral mapped I/O. Interrupts and interrupts structure of 8085. Basic concepts in serial I/O's, Programmable Peripheral Interface (PPI), Direct Memory Access(DMA) and DMA controller(8257). Keyboard & display interface

(8279). Introduction to8086 Microprocessor - Architecture and signals, Pin diagram, Memory organisation,, Minimum mode and Maximum Mode 8086 system.

References:

1. Microprocessor Architecture Programming and Applications by Gaonkar, Penram International
2. Microprocessors and its Applications byTheagrajan. PHI
3. Microprocessors and interfacing by D.V.Hall.
4. Microprocessor system: The 8086/8088 family IInd ed. By Yu.Cheng& Gibson

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3RD YEAR (SEMESTER–V) (w.e.f. 2020-21)

Course no: IN-PC-307		**Course title: Analogue Communication Engineering**			
Year and Semester		**3rd year 5th Semester**		**Contact hours per week: 4 hrs Examination Duration: 3 hrs**	
L	**T**	**P**	**C**	**Evaluation**	
3	**1**	**-**	**4**	**Minor test + Curricular activities: 40**	**Major test: 60**

Module-I

Signal Analysis: Introduction, Classification of signals, Singularity or elementary functions, representation of signals, Convolution, properties of signal systems, Fourier series and applications in **LTI system**, trigonometric Fourier series, Fourier transform; its properties and applications in **LTI system**

Module-II

Noise: classification of noise, voltage-current models of a noisy resistor, noise in reactive circuits, Signal to noise ratio, Noise figure, noise temperature

Amplitude Modulation: amplitude modulation, spectrum and modulation index of AM, over modulation, power content in AM, Generation of AM, Double side band suppressed carrier modulation, Single side band modulation, AM demodulation, vestigial side band modulation systems, frequency division multiplexing.

Module-III

Frequency Modulation: angle modulation, phase and frequency modulation, FM Spectrum, effect of variation of MI on spectrum of FM, Narrow band and wide band frequency modulation, FM generation using parametric variation and Armstrong method, FM demodulation, noise in FM Systems

Module-IV

Transmitter: Classification of radio transmitters, block diagram of AM Transmitter, carrier frequency requirements of radio transmitter, privacy systems,FM transmitters

Receivers: Classification of receivers, TRF receivers, superhetrodyne receivers, frequency

mixers, IF Amplifiers, Tracking and alignment of receivers, Automatic gain control and automatic frequency control.

Reference Books:

1. Principles of Communication systems, McGraw Hill, By Taub and Schilling.
2. Electronic Communication system, PHI, By G Kennedy.
3. Electronic communications, PHI, By Roddy and Coolen.

3RD YEAR (SEMESTER–V) (w.e.f.2020-21)

Course no: IN-PE-309		**Course title: Linear Automatic Control System**			
Year and Semester		**3rd year 5th Semester**		**Contact hours per week: 4 hrs Examination Duration: 3 hrs**	
L	**T**	**P**	**C**	**Evaluation**	
3	**1**	**-**	**4**	**Minor test + Curricular activities: 40**	**Major test: 60**

Course Objectives:	
1. Study the time response of various types (0, 1, 2, 3, etc.) of system Execute time response analysis of a second order control system using MATLAB/ simulation software	
2. Study the Stability analysis of Linear system, Analyze and interpret stability of the system through Root Locus, Bode plot and Nyquist plot.	
3. Study Lag, Lead, Lead-Lag compensators and verify experimental results using MATLAB.	
4. Study the concept of state, state variables and various state models techniques and concept of controllability and observability, pole placement by state feedback	
Course Outcomes: On completion of the course, student would be able to:	
CO1	Ability to derive Mathematical Modeling various types (0, 1, 2, 3, etc.) of system and anayze their time responses
CO2	Able to Analyze the effect of P, PI, PD and PID controllers on a control system and design suitable controller for a typical process
CO3	Ability to Analyze and interpret stability of the systemthroughRoot Locus, Bode plot and Nyquist plot.
CO4	Able to design lead, lag, lead-lag compensators using time domain and frequency domain analysis techniques.
CO5	An ability to understand concept of state, state variables and the design output feedback controller in state space.

Module – I

TIME DOMAIN ANALYSIS: Standard test signal (step, ramp, impulse, parabolic) time response of various types (0, 1, 2, 3, etc.) of system. Steady state error analysis, effect of adding zero to a system. Design consideration of 2nd order system, design of higher order system, performance indices

Module - II

STABILITY OF A CONTROL SYSTEM : Concept of stability, necessary conditions of stability, Hurwitz Stability criterion, Routh stability criterion, relative stability analysis, more

on the Routh stability criterion, The Root locus technique: The root locus concept construction of root loci, root contours, system with transportation Lag, sensitivity of the roots of the characteristic equation.

Module - III

FREQUENCY DOMAIN ANALYSIS: Correlation between time and frequency response, polar plots, bode plots, all- pass and minimum- phase system experimental determination of transfer functions, log magnitude versus phase plots. Stability in frequency domain: mathematical preliminaries, Nyquist stability criterion, assessment of relative stability using Nyquist criterion, closed-loop frequency response, sensitivity analysis in frequency domain.

Module-IV

STATE VARIABLE ANALYSIS AND DESIGN: Concept of state, state variables and state models, state models for linear continuous time system, diagonization, solution of state equations, concept of controllability and observability, pole placement by state feedback, state variables and linear desecrate-time systems.

Reference Books:

1. Automatic Control System ByKuo
2. Feedback Control System ByD'Azzo and Houpis
3. Modern Control Engineering ByOagata
4. Control Systems Engineering By Nagrath&Gopal.

3RD YEAR (SEMESTER–VI) (w.e.f.2020-21)

Course no: IN-PC-302		**Course title: Instrument & System Design**			
Year and Semester		**3rd year 6h Semester**		**Contact hours per week: 3 hrs Examination Duration: 3 hrs**	
L	**T**	**P**	**C**	**Evaluation**	
2	**1**	**-**	**3**	**Minor test + Curricular activities: 40**	**Major test: 60**

Course Objectives:	
1. To provide a coherent knowledge about concepts of instrument system design	
2. to develop knowledge about system characteristics and performance attributes	
3. To elaborate relevant issues of physical, architecture design at printed circuits board level of complex electronic systems	
4. To understand the fundamentals circuit layout	
5. To develop concept of power distributions systems	
Course Outcomes: On completion of the course, student would be able to:	
CO1	Apply basic principles and guidelines of physical architecture design for complex electronic systems
CO2	Analyze the various system attributes and their impact on system performance
CO3	Analyze the influence of interconnects at different levels on electronic system performance

CO4	Develop system model on the basis of learned concepts

Module - I

Introduction - overview of system engineering, system perspective, documentation, concept development, requirements, design development, rapid pro totyping and field testing, validation, verification and integration, maintenance and life-cycle costs, failure, iteration and judgment.
Packaging and Enclosures: Packaging influence, packaging design, wiring, temperature, vibration and shock, component packaging, mechanical issues, case studies of a New Chassis and Housing Design Concept for Electronic Equipment, and Robot.

Module-II

Grounding and Shielding: Safety, Noise, principle of energy coupling, Grounding, filtering, shielding, electrostatic discharge and it protection, general rules for design; Case study-EMC design of an oscilloscope.

Module - III

Circuit Design: Fundamentals of circuit design, high speed design, low power design, noise and error limitation, standard data buses and networks, reset and power failure detection, input/output interfaces.

Module -IV

Circuit layout and Power: Circuit boards, component placement, routing of signals and traces, grounds, returns and shields, connectors and cables, design for manufacture, testing and maintenance; Power: Power requirements, sources of power, power conversion, definitions and specifications, power distribution and conditioning, electromagnetic interfaces.

Reference Books:

1. Noise reduction techniques in electronic systems, 2nd ed. New York: Wiley By H.W.Ott
2. Electronic Instrument Design, Oxford Univ. Press, By Him R. Fowler
3. Intuitive Operational Amplifiers, MeGraw-Hill, By T.M.Frederiksen
4. Printed Circuit Boards, CEDT Series TMH By Walter C. Bosshart

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3RD YEAR (SEMESTER–VI) (w.e.f. 2020-21)

Course no: IN-PC-304				**Course title: Digital Communication Engineering**	
Year and Semester		**3rd year 6h Semester**		**Contact hours per week: 3 hrs Examination Duration: 3 hrs**	
L	**T**	**P**	**C**	**Evaluation**	
2	**1**	**-**	**3**	**Minor test + Curricular activities: 40**	**Major test: 60**

Course Objectives:
1. To introduce students with the need for electronic communication.
2. To familiarize with digital modulation and its formats.
3. To have understanding of angle modulation and its types.

4. To have knowledge of pulse modulation and digital modulation.	
5. To gain analytical skills based information theory.	
6. To have basic knowledge about source coding and error controlling codes.	
Course Outcomes: On completion of the course, student would be able to:	
CO1	Acquire knowledge about the analog modulation and its different formats including power and current relations in and AM wave.
CO2	Have good understanding of angle modulation including frequency modulation and phase modulation and respective demodulation techniques.
CO3	Acquire knowledge about pulse analog modulation and digital modulation and respective demodulation techniques.
CO4	To have acquaint about the basics of information theory and associated codes.
CO5	Acquire basic knowledge about source coding and error control coding techniques together with solving simple numerical problems.

Module-I

Pulse Modulation: Sampling Theorem ,natural sampling, flat top sampling, quantization process , Pulse amplitude modulation ,TDM,PWM, PCM, DPCM,DM,ADM

Module-II

Digital modulation Techniques: Digital modulation formats, types of digital modulation: ASK, BPSK, BFSK, DPSK, QPSK and Minimum Shift Keying

Module-III

Information theory: Introduction, Information rate, source coding theorem, Huffman coding, discrete memory less channel, mutual information channel capacity, channel coding theorem, channel capacity theorem shanon's theorem and shanon-hartley theorem.

Module-IV

Coding theory: Introduction, Linear block codes, cyclic codes convolution codes, decoding of convolution codes, distance properties of convolution codes.

Data Networks: Communication Networks, Circuit Switching, Store and forward switching, layered architecture, packet networks, and multiple access communication.

Reference Books:

1. Principles of communication systems, Pub.-McGraw Hill, by Taub And Schilling
2. Digital communication, Pub.- John Willy and sons, by Simon Hykin.
3. Communication Systems – B P Lathi
4. Communication Switching Systems and Networks, Pub.-PHI, by Thiagrajan Vishwanathan.

3RD YEAR (SEMESTER–VI) (w.e.f.2020-21)

Course no: IN-PE-306	**Course title: Fuzzy Logic Control**

Year and Semester		3rd year 6h Semester		Contact hours per week: 3 hrs Examination Duration: 3 hrs	
L	**T**	**P**	**C**	**Evaluation**	
2	**1**	**-**	**3**	**Minor test + Curricular activities: 40**	**Major test: 60**

Course Objectives:	
To study and acquire the basic knowledge of fuzzy logic.	
To study the basic architecture of FKBC and its design parameters	
To study nonlinear & adaptive fuzzy controllers.	
To identify, formulate and solve the neuro fuzzy logic based problems.	
Course Outcomes: On completion of the course, student would be able to:	
CO1	To understand working of basic fuzzy system and its architecture.
CO2	Able to fuzzy techniques in different field, which involve perception, reasoning and learning.
CO3	Analyze and design a real world problem for implementation and understand the dynamic behavior of a system.
CO4	Assess the results obtained by FKBC and Neuro fuzzy systems.

Module-I

INTRODUCTION : Introduction to Fuzzy control, Fuzzy logic controller components, Construction of Fuzzy sets, Fuzzy logic controller and its applications.Fuzzy control from an industrial perspective, knowledge- based controller, knowledge representation in KBC's.

Module-II

Introduction to Fuzzy sets, Crisp sets, Basic concepts of Fuzzy sets, L-fuzzy sets, level 2-fuzzy sets, type 2-fuzzy sets. Fuzzy sets Vs. Crisp sets. Fuzzy Arithmetic, Algebraic operations, set-theoretic operations, fuzzy relation on sets & fuzzy set compositions of Fuzzy relations, properties of the minimum-maximum composition.

Module-III

FKBC DESIGN PARAMETERS: The FKBC architecture, choice of variables and contents of rules, Derivation of rules, Choice of membership functions, choice of scaling factors, Choice of fuzzification procedure, Choice of defuzzification procedure, comparison and evaluation of defuzzification methods.

Module-IV

ADAPTIVE FUZZY CONTROL**:** Design and performance evaluation, Approaches to Design such as membership function tuning using gradient descent, Membership function tuning using performance criteria, the self-organizing controller, Model based controller.

BOOKS FOR REFERENCE :

1. Fuzzy control system by Abraham Kandel and Gideon Imngholz, Narosa.
2. Fuzzy logic control system by T.Ross

3. Fuzzy Control system by D. Drainkov& M. Reienfrank.
4. Klir George J. " Fuzzy sets and Fuzzy Logic Theory and Applications", PHI

3RDYEAR (SEMESTER–VI) (w.e.f.2020-21)

Course no: IN-PC-308		**Course title: Digital Signal Processing**			
Year and Semester		**3rd year 6h Semester**		**Contact hours per week: 4 hrs Examination Duration: 3 hrs**	
L	**T**	**P**	**C**	**Evaluation**	
3	**1**	**-**	**4**	**Minor test + Curricular activities: 40**	**Major test: 60**

Course Objectives:	
1. To study the basic of Z transform and its application in LTI discrete-time systems.	
2. To study the Discrete linear Time Invariant systems in Z domain and in frequency domain.	
3. To study different structure realization of Finite Impulse Response systems and Finite Impulse Response systems.	
4. To study the basic of Discrete-Fourier Transform (DFT), Fast Fourier Transform (FFT) algorithms and its application.	
5. To study the digital filters for filtering applications.	
Course Outcomes: On completion of the course, student would be able to:	
CO1	To learn the basic of Z transform and its application in LTI discrete-time systems.
CO2	To analyze the Discrete linear Time Invariant systems in Z domain and in frequency domain.
CO3	To understand the different structure realization of Finite Impulse Response systems and Finite Impulse Response systems.
CO4	To learn the basic of Discrete-Fourier Transform (DFT), Fast Fourier Transform (FFT) algorithms and its applications.
CO5	To Design digital filters for filtering applications.

Module-I

Z-TRANSFORM & ANALYSIS: The Z-transform, properties of Z-transform, inverse of Z-transform, region of convergence and properties, analysis of LTI system in Z-Domain and in frequency domain, transient response, steady-state response, causality and stability.

Module-II

Discrete and Fast Fourier Transform (DFT & FFT):DFT and its properties, IDFT, DFT and Z-transform relationship, linear filtering using DFT , linear and circular convolution. FFT: FFT decimation-in-time (DIT) algorithm and FFT decimation-in-frequency(DIF) algorithm (Radix-2).Effect of finite Word length in Digital filter: Coefficient Quantization, product quantization, Finite Register length effect in IIR and FIR realization.

Module-III

Reliasation of Digital Filters: FIR Filter: Direct form, cascade form, frequency selective and lattice structurerealizations.IIR Filter: Direct form-I ,Direct form-II, cascade form ,parallel and lattice structure realizations Comparison between FIR and IIR filter.

Module-IV

Digital filter Design: Advantages and disadvantages of digital filters, FIR digital filter design: Characteristics and properties of FIR digital filter, FIR digital filter design using Fourier series method, Use of window functions method, frequency sampling method. IIR filter design: Design of IIR filter from analog filter by derivative approximations method, Invariant-Impulse-response method, Bilinear - transformation method and Matched Z- transformation method.

Reference Books:

1. Digital Filter Analysis & Design by Andreas Antoniou
2. Digital Signal Processing by David J. Defalta& Joseph G. Lucas
3. Digital Signal Processing by Sanjit K Mitra .
4. Digital Signal Processing by Proakis, Masnolakis
5. Digital Signal Processing by Farooq Hussain

3RD YEAR (SEMESTER–VI) (w.e.f.2020-21)

Course no: IN-PC-310				**Course title: Microcontroller & Embedded System**	
Year and Semester		**3rd year 6h Semester**		**Contact hours per week: 4 hrs Examination Duration: 3 hrs**	
L	**T**	**P**	**C**	**Evaluation**	
3	**1**	**-**	**4**	**Minor test + Curricular activities: 40**	**Major test: 60**

Course Objectives:	
1. In depth study of 8051 Architectures and programming of microcontrollers: embedded system applications.	
2. Use of assembler directives and programming in assembly language using Assembler	
3. This course concerns with Embedded systems basic knowledge: embedded architectures:	
4. To analyze and design the RTOS and applications.	
Course Outcomes: On completion of the course, student would be able to:	
CO1	Understand the fundamental concepts of Microcontroller Organization and Architecture (Intel 8051), Data Representation and Memory Usage
CO2	Apply the basic programming skills of microcontrollers for Problem Solving and Algorithm Development, Assembling/Compiling and Execution
CO3	Understand the basic of Embedded system, Understand the Embedded Product Development Life Cycle, Design embedded system in RTOS
CO4	Illustrate and design the hardware using Embedded System.
CO5	Apply various algorithms in solving sorting problems.
CO6	After study of this course it is expected that students will be able to develop interface for real time industrial process and write programs for different applications, Further it is expected that students will be able to do of their own for higher processors and microcontrollers.

Module-I

Introduction to Embedded Systems: Definitions and Classification, Overview of Embedded Systems, Embedded Software, Embedded System on Chip (SoC), Use of VLSI Designed Circuits; Processor and Memory Organization: Structural Units in Processor, Memory Devices, Processor and Memory Selection, Memory Map and Applications, Memory Blocks for Different Structures.

Module-II

Devices and Buses for Devices Networks: I/O Devices I/O Types and Examples, Parallel Port and Serial Port Devices and Communication Buses; Device Drivers, Device Servicing by Interrupt and Service Routines Linux Internals as Device Drivers and Network Functions, Writing Physical Device Deriving ISRs in a System and Some Examples, Context Switching, Deadline, Latency Priorities Programming in Assembly Language (ALP) Vs High Level Language, Basic C Program Elements, Concept of Embedded Programming in C++, Embedded Programming in C++, C program compiler, Cross Compiler.

Module-III

Microcontrollers:- Introduction; comparison of microprocessors & microcontrollers; A survey of microcontrollers, 8051 microcontroller hardware: Input/Output Pins; Ports and Circuits; External memory; counter & timers; serial data input/output; & Interrupts. Introduction to instructions of 8051: For moving data, logical operations, arithmetic operations and jump & call.

Module-IV

8051 programming with examples of study of input/output ports of 8051, use of 8051 in closed loop system, study of Internal/External Interrupts of 8051, and study of Internal counter using Internal/External clock of 8051. Interfacing: Interfacing with display, memory, keyboard, AD/DA, generation of PWM output for proportional control using timer & counter and serial data communication.

REFERENCE BOOKS:

1. The 8051 Microcontroller Architecture Programming & Application by Kenneth J. Ayala, Penram Inter.
2. The 8051 Microcontroller and Embedded Systems- Muhammad Ali Mazidi; Pearson Education India
3. Microcontroller Architecture, Programming, Interfacing and System Design by Raj Kamal, Pearson Education India
4. Programming and Customizing the 8051 Microcontroller by Fredko Mike, TMH
5. Embedded Systems Architecture, Programming, and Design by Raj Kamal, TMH

B. Tech Instrumentation Engineering
Syllabi for Examinations
4th YEAR (SEMESTER–VII) (w.e.f. 2021-22)

Course no: IN-PE-401		**Course title:**		**OPTIONAL – I ARTIFICIAL INTELLIGENCE**	
Year and Semester		**4th year 7th Semester**		**Contact hours per week: 3 hrs Examination Duration: 3 hrs**	
L	**T**	**P**	**C**	**Evaluation**	
2	**1**	**-**	**3**	**Minor test + Curricular activities: 40**	**Major test: 60**

Course Objectives:	
1. To explore the basics of Artificial Intelligence.	
2. To introduce the concepts of a Rational Intelligent Agent and that can be designed to solve problems.	
3. To gain knowledge on blind and heuristic search in AI.	
4. To create an understanding of the basic issues of knowledge representation and Logic.	
5. To be able to design expert systems with intelligence.	
Course Outcomes: On completion of the course, student would be able to:	
CO1	Recognize the role of AI to solve real world problems
CO2	Explain and implement representation of knowledge, problem solving methods in AI.
CO3	Know how to build simple knowledge-based systems.
CO4	Solve complex engineering and real-world problems using AI.

Module - I

Introduction: History, the turning test, overview of AI application are as problem & problem spaces, problems characteristics.

Module - II

Knowledge Representation Logic: Proportional & first order prediction logic, inference rules, resolution limitation of logic. Production system: Definition & history, examples of search in production system, advantages.

Module -III

Search: Informal and informal, algorithms of depth 1st, breadth 1st, hill climbing, beat 1st, search and bound; game playing - minimax search, alpha and beta pruning. Forward and backward reasoning.

Module - IV

Expert system: Introduction & examples, architecture (rule board system), development, knowledge engineering process, limitations. Programming in PROLOG.

Reference Books:

1. Artificial Intelligence by George F.luger & William A.
2. Stubblefeild, The Benjamin/Cummings Pub. Comp., Inc.
3. Principle of A.I by Nils J. Nilsson, Narosa.
4. A.I By Elaine Tich & Kevin Knoght, TMH
5. Introduction to Artificial Intelligence & Expert systems by Dass W. Patterson, PHI
6. A.I: an engineering approach by Robert J. Schlkoff, McGraw Hill.

4th YEAR (SEMESTER–VII) (w.e.f. 2021-22)

Course no: IN-PE-403		**Course title: BIO-MEDICAL INSTRUMENTATION**			
Year and Semester		**4th year 7th Semester**		**Contact hours per week: 3 hrs Examination Duration: 3 hrs**	
L	**T**	**P**	**C**	**Evaluation**	
2	**1**	**-**	**3**	**Minor test + Curricular activities: 40**	**Major test: 60**

Course Objectives:	
1. To introduce the concept of Bio Medical Instrumentation.	
2. To introduce Bio Potential Electrodes and Biomedical Recorders.	
3. To introduce the Heart Sound and Ultrasound.	
4. To study the Imaging System.	
Course Outcomes: On completion of the course, student would be able to:	
CO1	To Familiarize with Bio Medical Instrumentation.
CO2	To understand with Bio Potential Electrodes and Biomedical Recorders.
CO3	To understand the Heart Sound and Ultrasound.
CO4	To understand the Imaging System.

Module- I

Introduction: Bio-electric potential and electrode: Instrumentation system, Living Instrumentation system, Bio-metric, the anatomy of nervous system, origin of bio-potentials, resting and action potentials, propagation of action potentials, the Bio-electric potentials, bio-potential electrode: Microelectrodes, skin surface electrode, Needle electrodes.

Module -II

Biomedical recorders: Basic functioning of heart, Electrocardiograph Block diagram of ECG, ISOLATION AMPLIFIER, the ECG leads, Microprocessor based ECG Machine, multi-channel ECG Machine, vector cardiograph, Apex cardiograph, Ballistocardio graph, PCG, Microphones for PCG, amplifier for PCG, EEG: Electrode for EEG, Block diagram of EEG Machine, EMG Recording, pre amplifier for EMG, low frequency and high frequency filters, display signal delay & Trigger unit, EMG recording method.

Module -III

Ultrasonic Imaging system: Physics of ultrasonic waves, Medical ultrasound,(Basic Pulse-Echo apparatus), A-scan, Echocardiograph (M-mode), B-scanner, Real time ultrasonic imaging systems (Requirements, Mechanical Sector scanner, Multi-Element Linear Array Scanners, Phase Array system, Duplex Scanner and Annular Array Scanner), Display devices for ultrasonic imaging system, Biological effect of ultrasound.

Module-IV

Imaging System: X-ray Machine and Computed Tomography: X-ray machine, X-ray image Intensifier T.V. system, X-ray computed Tomography (CT Scanner). NMR imaging system : Imager system. Application of NMR Imaging, Advantage & disadvantage of NMR Imaging system.

Reference Books:

1. Introduction to Biomedical Equipment Technology By Carr & Brown.
2. Biomedical Instrumentation and Measurement by Cromwell, PHI.
3. Handbook of Biomedical Instrumentation by R.S.Khandpur, TMH.

4th YEAR (SEMESTER–VII) (w.e.f.2021-22)

Course no: IN-PC-405		Course title: Computer Graphics & CAD CAM			
Year and Semester		4th year 7th Semester		Contact hours per week: 3 hrs Examination Duration: 3 hrs	
L	T	P	C	Evaluation	
2	1	-	3	Minor test + Curricular activities: 40	Major test: 60

Course Objectives:	
1. To learn and understand Graphics fundamentals.	
2. To develop the algorithm design capability for creating different 2-D and 3-D graphical objects To learn creation of animated scenes for virtual objects creations	
3. To further the acquired knowledge to utilize it in different research works on Pattern Recognition and Image Processing.	
4. To learn and understand Graphics fundamentals.	
Course Outcomes: On completion of the course, student would be able to:	
CO1	Understand how to write algorithms for generating different 2-D and 3-D graphical objects.
CO2	Apply the knowledge to create and filling polygon (solid area fill),
CO3	Implement the different techniques of 2-D
CO4	Implement different line and polygon clipping algorithms,
CO5	Draw different types of projections in 3-D vector algebra, different 3-D transformation techniques, curves and surfaces and rendering methods
CO6	Animate scenes entertainment and apply the knowledge to research work.

Module-I

Introduction of computer Graphics and its applications, Overview of Graphics systems, Video display devices, Raster scan display, Raster scan systems, video controller, Raster scan display processor, Random scan display, random scan systems, color CRT monitor, Flat panel display, Interactive input devices, Logical classification of input devices, Keyboard, mouse, Trackball and spaceball, Joysticks, Image scanner, Light pens, Graphics software, Coordinates representations, Graphics primitives and functions.

Module-II

Points and lines, Line drawing algorithms, midpoint circle and ellipse algorithms. Filled area primitives: scan line polygon fill algorithm, boundary-fill and flood fill algorithms.

Translation, scaling, rotation, reflection and shear transformations, matrix representations and homogeneous coordinates, composite transforms, transformation between coordinate systems. 2-D Viewing: The viewing pipeline, viewing coordinate reference frame, window to viewport coordinate transformation, viewing functions, Cohen-Sutherland and Cyrus beck line clipping algorithms.

Module-III

Polygon surfaces, quadric surfaces, spline representation, Hermite Curve, Bezier Curve and BSpline curves, Bezier and B-Spline surfaces, sweep representations, 3-D Geometric Transformations: Translation, Rotation, Scaling, Reflection and Shear transformations, composite transformations, 3-D viewing, viewing pipeline, viewing coordinates, view volume and general projection transforms and clipping.

Module-IV

Classification, back-face detection, depth-buffer, scan line, depth sorting, BSP- tree methods, are subdivision and octree methods Illumination models and surface rendering methods: Basic illumination models, polygon rendering methods.

Design of animation sequence general computer animation functions, raster animation, computer animation languages, key frame systems, motion specifications.

TEXT & REFERENCE BOOKS :

1. COMPUTER GRAPHICS C VERSION by Donald Hearn and M. Pauline Baker, Pearsosn Education.
2. Principles of Interactive Graphics, Neuman and Sproul, TMH
3. Computer Graphics second edition "Zhigand Xiang, Roy Plastock, Schaum's outlines Tata McGraw Hill Edition.
4. Computer Graphics Principles & Practice", Second Edition in C, Foley, VanDam, Feiner and Hughes, Pearson Education.
5. Procedural Elements for Computer Graphics, David F Rogers, Tata McGraw Hill, 2nd edition.
6. An Integrated Introduction to Computer Graphics and Geometric Modelling, R. Goldman, CRC Press, Taylor & Francis Group.

4th YEAR (SEMESTER–VII) (w.e.f. 2021-22)

Course no: IN-PC-407		**Course title: ADVANCE PROCESS DYNAMICS & CONTROL**			
Year and Semester		**4th year 7th Semester**		**Contact hours per week: 3 hrs Examination Duration: 3 hrs**	
L	**T**	**P**	**C**	**Evaluation**	
2	**1**	**-**	**3**	**Minor test + Curricular activities: 40**	**Major test: 60**

Course Objectives:	
1. Acquire knowledge Process dynamics and various forms of mathematical models to express them	
2. To understand the multiloop systems	
3. To develop knowledge about controller tuning	
4. To develop understanding about PI diagrams	
5. To analyze samples data control systems	
Course Outcomes: On completion of the course, student would be able to:	
CO1	Formulate mathematical model of various systems
CO2	Design and develop multiloop control systems
CO3	Compute the tuning parameters of controllers
CO4	Construct PI diagrams
CO5	Develop the sample data control systems

Module-1

MATHEMATICAL MODELLING: Need of mathematical modelling, lumped and distributed parameters, state variables and state equations of chemical processes, mathematical modelling of CSTR, interacting system and non-interacting system.

ANALYSIS OF COMPLEX PROCESSES: Control of jacketed kettle systems, dynamic response of gas absorber, heat conduction into solids , heat exchanger.

Module-II

ANALYSIS AND DESIGN OF ADVANCED CONTROL SYSTEMS: Review and limitation of single loop control, need of multi loops, cascade, selective override, auctioneering, split range , feed forward, feed forward feedback, adaptive, inferential, ratio control, Self adaptive control: MRAC,STR.

Module-III

Controller Tuning: Tuning of PID controller, Zeigler – Nichols methods, Process reaction curve, Ultimate gain and period method, quarter decay ratio advance method of tuning, IAE, ISE, IATE

tuning of controllers. Effect of measurement and transportation lag on process response, Effect of disturbances.

Module-IV

P-I Diagrams: Standard Instrumentation Symbols for Devices, Signal Types, Representation of a Process Control Loop using PI diagram.

Sampled data Control Systems : Sampling, open loop and closed loop response, Stability, Sampled data control of first order process with transport lag, Design of sampled data controllers.

BOOKS RECOMMENDED:

1. Kane-Handbook of Advanced Process Control System
2. Curtis Johnson-Process Control: Instrumentation Technology
3. Chemical Process Controll by George Stephanopoulos
4. Process dynamics and Control by Donald P. Eckman
5. Process systems Analysis and Control Donald R. Coughanowr

4th YEAR (SEMESTER–VIII) (w.e.f.2021-22)

Course no: IN-PE-402				**Course title: (OPTIONAL – II) ROBOTICS**	
Year and Semester		**4th year 8th Semester**		**Contact hours per week: 3 hrs Examination Duration: 3 hrs**	
L	**T**	**P**	**C**	**Evaluation**	
2	**1**	**-**	**3**	**Minor test + Curricular activities: 40**	**Major test: 60**

Course Objectives:	
1. To develop the student's knowledge in various robot structures and their workspace.	
2. To develop student's skills in performing spatial transformations associated with rigid body motions.	
3. To develop student's skills in perform kinematics analysis of robot systems.	
4. To provide the student with knowledge of the singularity issues associated with the operation of robotic systems.	
5. To provide the student with some knowledge and analysis skills associated with trajectory planning.	
6. To provide the student with some knowledge and skills associated with robot control	
Course Outcomes: On completion of the course, student would be able to:	
CO1	Outline the structure of a typical robotic system, understand its link and joint parameters, and perform robot kinematics.
CO2	Identify the geometric parameters of a robot by applying the knowledge of robot kinematics and generalized differential model of the robot.
CO3	Analyse planar and spatial parallel robots in context to its forward and inverse kinematics, and evaluate its singularity, condition number and maneuverability.
CO4	Identify the dynamic parameters of a robot by applying the knowledge of general form of dynamic equation of motion.
CO5	Identify the independent joint control and torque
CO6	Design a robotic manipulator and evaluate its primary and secondary workspace. Evaluate the performance of a robot.

Module-I

Introduction to Robotics, terminology and definitions, Classification: Cylindrical, Spherical, Revolute, Rectangular; Components of Robotic Systems: Actuators, Sensors, Controllers,

Manipulators. Position and Orientation Description & frames, Rotation, Homogeneous transform, Translations, Transformation matrix.

Module-II

Forward Kinematics: Denavit-Hartenberg (D-H) representation, Link parameters, Link frame assignment, Example of Manipulation Kinematics. Inverse Kinematics: Solvability, Solution Approaches and examples; Velocities of link motion, Jacobian transformation.

Module-III

Manipulator Dynamics: Euler-Lagrange Equation, KE and PE Expressions, Equations of motion, Newton-Euler transformation, some examples; Independent Joint control: Actuator Dynamics, set point tracking, Trajectory Interpolation

Module-IV

Robot Hardware: Robot End Effectors, Grippers, grippers selection & Design; Vision: Introduction, visual sensing, Machine vision & its applications and other optical methods and Robot Applications.

Reference Books:

1. Robot and Controls By Mittal and Nagarath, TMH
2. Introduction to Robotics: Mechanics and control By J.J.Craig, Addision Weslay Pub. Co.
3. Robot Dynamics and Control, By W.Sponge & M.Vidyasagar, John Wiley and Sons, New York, 1989.
4. Robotics: Control, Sensing, Vision and Intelligence By K.S.Fu, R.C.Gonzalez and C.S.G.Lee, McGraw Hill, 1987.

4th YEAR (SEMESTER–VIII) (w.e.f.2021-22)

Course no: IN-PE-404				**Course title: ANALYTICAL INSTRUMENTATION**	
Year and Semester		**4th year 8th Semester**		**Contact hours per week: 3 hrs Examination Duration: 3 hrs**	
L	**T**	**P**	**C**	**Evaluation**	
2	**1**	**-**	**3**	**Minor test + Curricular activities: 40**	**Major test: 60**

Course Objectives:	
1. Understand the interaction of electromagnetic radiations with matter	
2. To Understand the concepts of spectroscopy	
3. To study the various methods of instrumental analysis	
4. Select an Instrument for a particular analysis with idea of its merits, demerits and limitations	
Course Outcomes: On completion of the course, student would be able to:	
CO1	Apply analytical techniques to accurately determine the elements present in the given sample
CO2	How to decide the particular spectroscopic method
CO3	Understand the air water and soil quality monitoring instruments
CO4	Apply chromatography in real time industrial environment

Module - I

Basic Components of a Spectrophotometer, different types of excitation sources, single and double monochromator components and mounting; materials for lens, prism, sample holder, filters etc for various wavelengths, optical sensors for different wavelength ranges. UV-VIS Spectrophotometers (Optical & Electronic Instrumentation) double wavelength spectrophotometer.

Module- II

Fluorescence & Phosphorescence Spectrometry (Basic principle, optical & electronic Instrumentation) Atomic Absorption & Emission Spectroscopy (Sample preparation, photometer instrumentation). Laser Raman Spectrometer Instrumentation & application.

Module - III

Basic consideration, Instrumentation, Qualitative & Quantitative elemental data analysis, limitations and applications of i) X-Ray Fluorescence, ii) Neutron activation, iii) Auger Electron and iv) ESCA techniques.

Module - IV

Basic principle of NMR phenomenon, NMR spectrometer Instrumentation and application Electron spin resonance (ESR) Spectroscopy basic principle, spectrometer instrumentation and applications. Basic principle of chromatography - Gas & Liquid column chromatograph instrumentation and applications; water pollution monitoring instrumentation.

Reference Books:

1. Instrumental Methods Of Analysis By Williard, Merrit, Dean
2. Handbook Of Analytical Instrumentation By R.S. Khandpur
3. Instrumental Methods For Chemical Analysis By E.W.Ewing
4. Introduction To Instrumental Analysis By Robert D. Braun
5. Essentials of Instrumental analysis by Skoog, Holler & Nieman, Thomson Publ.

4th YEAR (SEMESTER–VIII) (w.e.f.2021-22)

Course no: IN-PC-406				**Course title: INDUSTRIAL PROCESS CONTROL**	
Year and Semester		**4th year 8th Semester**		**Contact hours per week: 3 hrs Examination Duration: 3 hrs**	
L	**T**	**P**	**C**	**Evaluation**	
2	**1**	**-**	**3**	**Minor test + Curricular activities: 40**	**Major test: 60**

Course Objectives:

1. Basic concept and Study of FC and FO type control valve and their applications with examples, Gain of valve and concept of control valve sizing for liquid, Gas, vapour and steam. (Special reference to Masoneillian & Fisher Equation) and study control valve cavitation and flashing phenomenon
2. Study control Valve noise, its calculation & reduction techniques and Design & Construction of Globe Valve.
3. Study the characteristic function of PLC, its Architecture and various PLC programming languages and Demonstrate various PLC programming skill for industrial applications.
4. Detail study and applications of Distributed process control system and Understanding of various automotive standards and Protocols used in PLC network and DCS
5. Study DCS supervisory control techniques & considerations(Algorithms), Concept of field buses and their applications

Course Outcomes: On completion of the course, student would be able to:

CO1	Able to understand FC and FO type control valve and Able to learn and analyze the various principles & concepts involved in valve sizing for liquid, Gas, vapour and steam and control valve cavitation and flashing phenomenon
CO2	Able to understand control Valve noise, its calculation, reduction techniques and Acquire the knowledge and demonstrating the constructional details of Globe Valve.
CO3	Acquire the knowledge of performance characteristic function of PLC and its Architecture.
CO4	Able to learn the various PLC programming languages and Demonstrate various PLC

	programming skill for industrial applications.
CO5	Able to learn and analyze the various principles & concepts of Distributed process control system and Understanding of various automotive standards and Protocols used in PLC network and DCS
CO6	Acquire the knowledge of DCS supervisory control techniques, the concept of field buses and their Industrial applications.
CO7	To implement new and emerging technologies to analyze, design, maintain reliable, safe, and cost effective solution for industry problems.

Module-I

CONTROL VALVE DESIGN: Control valve flow characteristics, valve & process characteristics, effect of distortion coefficient on linear and percentage valve, range-ability of control valve, control valve sizing for liquid vapor and steam. (Special reference to Masoneillian & Fisher Equation) control valve cavitation and flashing: flow control cavitation index, vibration curve cavitation index, calculation of flash fraction. Control valve gain, sequencing of control valve and viscosity correction of control valve.

Module-II

Valve noise calculation & reduction: Sources of valve noise, noise control: path treatment source treatment valve noise calculation. Design & construction of Globe Valve: Valve trends, trim design, trim flow characteristics, flow rangeability, standard trim configuration, valve plug stems, Body form of single & double seated Globe valve, construction & flow characteristics of Butterfly valve.

Module-III

Discrete State Process Control System: Development & analysis of ladder diagram, logic diagram from ladder diagram, Functional description of PLC difference between PLC & computer. Sizing & selection, PLC peripherals, programming & documentation tools. Communication networking: Universal communications networking, Peer to Peer communications, PLC installations. Programming the Programmable controller: Programming languages, ladder diagram instructions, special functions, data transfer and data manipulation operations, arithmetic operations, flow control operations, Boolean mnemonics. Functional blocks data transfer operations arithmetic and logic operations, Programmable controller's industrial applications.

Module-IV

Distributed process control system: Functional requirement of DPCS, DCS configurations, control console equipment: Video display, keyboard, peripherals device & display. Software configuration: Operating system configuration, controller function configuration, algorithm, libraries, relay rec. mounted equipment, communication between the components. DCS data high ways, field buses, multiplexers & party line system, Multiplexing & scanning, Multiplexer design. DCS Supervisory computer and configurations: Supervisory computer functions, supervisory control techniques & considerations, DCS & Supervisory computer display, DCS. DCS system integration with PLC & computer.

References Books :

1. Microprocessor in process control: C.D.Johnson
2. Instrumentation for process measurement and control by N.A. Anderson.
3. Principles and practice of automatic process control: Carlos by A Smith.
4. Instrument Engineers' handbook - Process control by Bela G. Liptak.
5. Computer based Industrial Control by Krishan Kant

Kurukshetra University, Kurukshetra

(Established by the State Legislature Act XII of 1956)
('A+' Grade, NAAC Accredited)

।। योगस्थः कुरु कर्माणि ।।
समबुद्धि व योग युक्त होकर कर्म करो

(Perform Actions while Steadfasting in the State of Yoga)

DEPARTMENT OF INSTRUMENTATION (DOI)

LOCF/OBE/NBA CURRICULUM (2020 -2021)

Program Name: B. Tech.-Electrical and Instrumentation Engineering
(For the Batches from 2020-2021 in phased manner)

(UTD Only)

LOCF/OBE/NBA CURRICULUM (2020 -2021)

Program Name: B. Tech.-Electrical and Instrumentation Engineering
(For the Batches Admitted From 2020-2021)

VISION

Be globally acknowledged as a distinguished centre of academic excellence.

MISSION

To prepare a class of proficient scholars and professionals with ingrained human values and commitment to expand the frontiers of knowledge for the advancement of society.

DEPARTMENT VISION AND MISSION

VISION

- To become a model department as a Centre of quality education, research with innovation and recognition at National and International level for serving society.

MISSION

- **M1:** To provide quality education to aspiring young minds for improving their skills, inculcating values, creating leadership qualities and enhance research with innovative methods.
- **M2:** To produce young engineers capable to be utilized in the areas of New Technological Design, Environment, ethics and sustainable technologies.
- **M3:** To develop Teaching-Learning methods which can produce socially committed good professional human being who can contribute effectively in Nation building and represent Country Internationally.

Mapping of University Vision and Mission to Department Vision and Mission

Acclaimed as modal Centre of Learning and Research by

University Vision and Mission	Department Vision and Mission
High quality knowledge delivery through state of art infrastructure and ethical values to the students	**Yes**
Students excellence will makethem professionals and innovators emerging as global leaders	**Yes**
Research and development will help in furtherance of Faculty knowledge	**Yes**

Programme Educational Objectives (PEOs):

The Department of Instrumentation in consultation with various stakeholders have formulated the Programme Educational Objectives (PEO's) that are broad statements that describe the career and professional accomplishments that the program is preparing its graduates to achieve in few years, subsequent to receiving the degree. The PEO's of the B. Tech. programme in Electrical and Instrumentation Engineering are as follows:

- **PEO1:**The graduates will become competent by applying their technical and managerial skills.
- **PEO2:**The graduates will be able to adapt to any environment and succeed in higher positions in contemporary rapidly evolving technologies in Electrical and Instrumentation engineering field.
- **PEO3:**The graduates will engage themselves in the life-long learning by pursuing higher education and participation in research and development activitiesto meet all challengesto transform them as responsible citizens of the nation

Program Specific Outcomes (PSO's):

- **PSO1:** Clearly understand the fundamental concepts of Electrical and Instrumentation Engineering
- **PSO2:** Graduates will be able to formulate and solve real life problems in the area of Electrical and Instrumentation Engineering
- **PSO3:** Graduate will possess the skills to communicate effectively in both oral and written forms, demonstrating the practice of professional ethics, and responsive to societal and environmental needs.

PEOs to Mission statement mapping

PEO's	MISSION OF THE DEPARTMENT		
	M1	M2	M3
PEO1	3	3	1
PEO2	2	3	2
PEO3	2	2	3

Program Outcomes (PO) with Graduate Attributes

Programme Outcomes are attributes of the graduates from the programme that are indicative of the graduates' ability and competence to work as an engineering professional upon graduation. Program Outcomes are statements that describe what students are expected to know or do by the time of graduation, they must relate to knowledge and skills that the students acquire from the programme. The achievement of all outcomes indicates that the student is well prepared to achieve the program educational objectives down the road. The Department of Instrumentation engineering has following twelve PO's. The course syllabi and the overall curriculum are designed to achieve these outcomes:

S. No	Graduate Attributes	Program Outcomes (POs)
1	Engineering Knowledge	**PO1:** Able to understand the fundamentals of mathematics, science, Electrical and Instrumentation Engineering and apply them to provide solution of complex engineering problems.
2	Problem Analysis	**PO2:** Ability to analyze, identify, formulate and solve engineering problems in Electrical and Instrumentation Engineering using basic fundamental principles of mathematics and science.
3	Design and Development of Solutions	**PO3:** Design a system, component or process to meet the desired needs and standards within realistic constraints such as public health and safety, social and environmental considerations.
4	Investigation of Problem	**PO4:** Design and conduct experiments, as well as do research, analyze and interpret data and give clear solutions.
5	Modern Tool usage	**PO5:** Use and learn the recent techniques, skills and modern engineering and IT tools necessary for engineering practicewith an understanding of the limitations.
6	Engineer and society	**PO6**: To give basic knowledge of social, economic, safety and cultural issues relevant to professional engineering.
7	Environment and sustainability	**PO7:** To impart knowledge related to the design and development of modern systems which are environmentally sensitive and to understand the importance of sustainable development.
8	Ethics	**PO8:** Apply ethical principles and professional responsibilities in engineering practice.
9	Individual & team work	**PO9:** Ability to visualize and function as an individual and as a member in a team of a multi-disciplinary environment.
10	Communication	**PO10:** Ability to communicate effectively on complex engineering ideas to the engineering community & the society at large. (i.e. being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions)
11	Lifelong learning	**PO11:** To impart education to learn and to engage in independent and life – long learning in the technological change.
12	Project management and finance	**PO12:** Ability to handle administrative responsibilities, manage projects & handle finance related issues in a multidisciplinary environment.

Mapping of PEO's with PO's

S. No.	*Program Educational Objectives*	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	The graduates will become competent by applying their technical and managerial skills.	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
2	The graduates will be able to adapt to any environment and succeed in higher positions in contemporary rapidly evolving technologies in Electrical and Instrumentation engineering field.	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
3	The graduates will engage themselves in the life-long learning by pursuing higher education and participation in research and development activities to meet all challenges to transform them as responsible citizens of the nation			√	√		√	√	√	√		√	√	√	√	√

LOCF/OBE/NBA CURRICULUM (2020 -2021)

Program Name: B. Tech.-Electrical and Instrumentation Engineering
Undergraduate Degree Program

General, Course structure & Theme & Semester-wise credit distribution

A. Definition of Credit:

1 Hour Lecture (L) per week	1 credit
1 Hour Tutorial (T) per week	1 credit
1 Hour Practical (P) per week and/or 2 Hours Practical(Lab)/week	0.5 credits 1 credit

B. Total credits:

Total credits for a student to be eligible to get Under Graduate degree in Engineering are 174.0 credits. A student will be eligible to get Under Graduate degree with Honors' or additional Minor Engineering, if he/she completes an additional 20 credits. These could be acquired through MOOCs.

C. Structure of Undergraduate Engineering program:

S. No.	Category	Breakup of Credits (Total 174.0)
1	**Humanities, Social Sciences and Management Courses**	**07.0**
2	**Basic Science Courses**	**17.0**
3	**Engineering Science Courses** including workshop, drawing, basics of Electrical/ Mechanical/ Computer etc.	**17.0**
4	**Professional Core Courses**	**83.0**
5	**Program Elective Courses** relevant to the branch	**18.5**
6	**Open Elective Courses**: Electives from other technical and /or emerging subjects	**22.5**
7	**Project work**, Seminar and Internship in Industry etc.	**09.0**
8	**Mandatory Courses:** [Environmental Sciences, Induction training, Indian Constitution, Essence of Indian Traditional Knowledge].	**(non-credit)**
	Total	**174.0**

D. Course code and definition:

Category of Course/ Code	Definitions
L	Lecture
T	Tutorial
P	Practical
C	Credit
CIE	Continuous Internal Evaluation
SEE	Semester End Examination

BS	Basic Science Courses
ES	Engineering Science Courses
HSM	Humanities, Social Sciences and Management Courses
EI	Electrical and Instrumentation Engineering
PC	Professional core courses
PE	Professional Elective courses
OE	Open Elective courses
PRBS/ PRPC/ PRES/PRPE/ PROE/ PRHSM	Practical Basic Science/Professional Core/ Engineering Science/ Program Elective/ Open Elective/Humanities, Social Sciences and Management Courses
MC	Mandatory courses
PROJ	Project

E. Details of Structure and distribution of credits to various courses:

S. No	Category	Course No.	Course Title	C	Teaching Schedule			
					L	T	P	Cont. Hrs.
Humanities, Social Sciences and Management Courses								
1	**HSM**	**EI-HSM-107**	English	2.0	2	-	-	2
2	**PRHSM**	**EI-PRHSM-07**	Language Lab	1.0	-	-	2	2
3	**HSM**	**EI-HSM-211**	Basics of Industrial Sociology, Economics and Management	2.0	2	0		2
4	**HSM**	**EI-HSM-212**	Project Planning Estimation and Assessment	2.0	2	0		2
			Total	**7.0**	**6**	**0**	**2**	**8**
Basic Science Courses								
1	**BS**	**EI-BS-101**	Physics	4.0	3	1	-	4
2	**PRBS**	**EI-PRBS-01**	Physics Lab	1.5	-	-	3	3
3	**BS**	**EI-BS-103**	Mathematics-I	3.0	2	1	-	3
4	**BS**	**EI-BS-102**	Chemistry	4.0	3	1		4
5	**PRBS**	**EI-PRBS-02**	Chemistry Lab	1.5			3	3
6	**BS**	**EI-BS-104**	Mathematics-II	3.0	2	1		3
			Total	**17.0**	**10**	**4**	**6**	**20**
Engineering Science Courses								
1	**ES**	**EI-ES-105**	Basic Electrical Engineering	4.0	3	1	-	4
2	**PRES**	**EI-PRES-03**	Engineering Drawing lab	1.5	-	-	3	3
3	**PRES**	**EI-PRES-05**	Basic Electrical Lab	1.0	-	-	2	2
4	**ES**	**EI-ES-106**	Programming for Problem Solving	4.0	3	1		4
5	**ES**	**EI-ES-108**	Basic Electronics Engineering	3.0	2	1		3
6	**PRES**	**EI-PRES-04**	Computer programming Lab	1.5	-	-	3	3
7	**PRES**	**EI-PRES-06**	Basic Electronic lab	1.0	-	-	2	2
8	**PRES**	**EI-PRES-08**	Workshop Practice Lab.	1.0	-	-	2	2

			Total	**17.0**	**8**	**3**	**12**	**23**
Professional Core Courses								
1	**PC**	**EI-PC-201**	Power Systems -I	3.0	2	1	--	3
2	**PC**	**EI-PC-203**	Basic Instrumentation Engineering	3.0	2	1		3
3	**PC**	**EI-PC-205**	Network Analysis	3.0	2	1		3
4	**PC**	**EI-PC-207**	Transducers and Applications	3.0	2	1		3
5	**PRPC**	**EI-PRPC-09**	Network Analysis Lab	1.0	--	--	2	2
6	**PRPC**	**EI-PRPC-11**	Transducers lab	1.5	--	--	3	3
7	**PRPC**	**EI-PRPC-15**	Power System-I Lab	1.0			2	2
8	**PC**	**EI-PC-202**	Power Electronics-I	4.0	3	1	--	4
9	**PC**	**EI-PC-204**	Electrical Measurements & Instrumentation	4.0	3	1	--	4
10	**PC**	**EI-PC-208**	Electrical Machines-I	4.0	3	1	--	4
11	**PRPC**	**EI-PRPC-10**	Power Electronics-I Lab	1.0	--		2	2
12	**PRPC**	**EI-PRPC-12**	Electrical Measurements & Instrumentation Lab	1.0	--		2	2
13	**PRPC**	**EI-PRPC-16**	Electrical Machines –I lab	1.5	--		3	3
14	**PC**	**EI-PC-303**	Power Electronics-II	4.0	3	1	--	4
15	**PC**	**EI-PC-307**	Power System- II	4.0	3	1	--	4
16	**PC**	**EI-PC-309**	Linear Automatic Control System	4.0	3	1	--	4
17	**PRPC**	**EI-PRPC-17**	Power Electronic Lab-II	1.5	--	--	3	3
18	**PRPC**	**EI-PRPC-19**	Power System Lab- II	1.5	--	--	3	3
19	**PRPC**	**EI-PRPC-23**	Control System Lab	1.5	--	--	3	3
20	**PRPC**	**EI-PRPC-25**	Industrial Training-I	**			1[$]	1
21	**PC**	**EI-PC-304**	Electrical Machines-II	4.0	3	1	--	4
22	**PC**	**EI-PC-306**	Power Plant Engineering	3.0	2	1	--	3
23	**PC**	**EI-PC-308**	Digital Signal Processing	4.0	3	1	--	4
24	**PRPC**	**EI-PC-310**	Microcontroller & Embedded System	4.0	3	1	--	4
25	**PRPC**	**EI-PRPC-18**	Electrical Machines Lab-II	1.5	--	--	3	3
26	**PRPC**	**EI-PRPC-20**	Micro-controller Lab	1.5	--	--	3	3
27	**PRPC**	**EI-PRPC-22**	Digital Signal Processing Lab	1.5	--	--	3	3
28	**PC**	**EI -PC-405**	Electric Drives	4.0	3	1	--	4
29	**PC**	**EI-PC-407**	Advance Process Dynamics and Control	4.0	3	1	--	4
30	**PRPC**	**EI-PRPC-27**	Electric Drives Lab	1.5	--	--	3	3
31	**PRPC**	**EI-PRPC-31**	Industrial Training-II	**			1[$]	1[$]
32	**PC**	**EI-PC-406**	Industrial Process Control	4.0	3	1	--	4
33	**PRPC**	**EI-PRPC-24**	Process Control Lab	1.5	--	--	3	3
34	**PRPC**	**EI-PRPC-28**	Seminar	1.0	--	--	2	2
			Total	**83**	**46**	**17**	**42**	**105**

Program Elective Courses								
1	**PE**	**EI-PE-206**	Program Elective- I	3.0	2	1	--	3
			i. Control System Components					
			ii. Electrical Energy Conservation and Auditing					
2	**PE**	**EI-PE-305**	Program Elective- II	4.0	3	1	--	4
			i. Microprocessors					
			ii. Analog and Digital Communication					
			iii. Switch Gear and Protection					
3	**PRPE**	**EI-PRPE-21**	Program Elective- II Lab	1.5	--	--	3	3
			i. Microprocessors					
			ii. Analog and Digital Communication					
			iii. Switch Gear and Protection					
4	**PE**	**EI-PE-302**	Program Elective-III	3.0	2	1	--	3
			i. Electrical Machine Design					
			ii. Mechanical Measurements in Instrumentation					
			iii. Electrical and Hybrid Vehicles					
5	**PE**	**EI -PE-403**	Program Elective- IV	3.0	2	1	--	3
			i. Biomedical Instrumentation					
			ii. Reliability Engineering					
			iii. Wind and Solar Energy Systems					
			iv. Power Quality and FACTS					
6	**PE**	**EI-PE-404**	Program Elective- V	4.0	3	1	--	4
			i. Utilization of Electrical Energy					
			ii. Instrumentation and System Design					
			iii. Fuzzy Logic Control					
			iv. Optical Instrumentation					
			v. Remote Sensing					
			Total	**18.5**	**12**	**5**	**3**	**20**
Open Elective Courses								
1	**OE**	**EI-OE-209**	Open Elective-I	3.0	2	1		3
			i. Linear Integrated Circuits					
			ii. Computer Networks					
2	**PROE**	**EI-PROE-13**	Open Elective- I Lab	1.5	--	--	3	3
			i. Linear Integrated Circuits					
			ii. Computer Networks					
3	**OE**	**EI-OE-210**	Open Elective-II	3.0	2	1	--	3
			i. Digital Techniques					

			ii. Computer Organization					
4	**PROE**	**EI-PROE-14**	Open Elective- II Lab	1.0	--		2	2
			i. Digital Techniques					
			ii. Computer Organization					
5	**OE**	**EI-OE-301**	Open Elective- III	4.0	3	1	--	4
			i. Environment Monitoring Instrumentation					
			ii. Electromagnetic Field Theory					
			iii. Mathematics-III					
			iv. Energy Efficient Systems					
6	**OE**	**EI-OE-401**	Open Elective- IV	4.0	3	1	--	4
			i. Computer Graphics & CAD CAM					
			ii. IoT and IT'S APPLICATIONS					
			iii. Introduction to Python Programming					
7	**PROE**	**EI-PROE-29**	Open Elective- IV lab	1.5	--	--	3	3
			i. Computer Graphics & CAD CAM					
			ii. IoT and IT'S APPLICATIONS					
			iii. Introduction to Python Programming					
8	**OE**	**EI-OE-402**	Open Elective- V	3.0	2	1	--	3
			i. Artificial Intelligence					
			ii. Robotics					
			iii. High Voltage Engineering					
9	**PROE**	**EI-PROE-26**	Open Elective- V Lab	1.5	--	--	3	3
			i. Artificial Intelligence					
			ii. Robotics					
			iii. High Voltage Engineering					
			Total	**22.5**	**12**	**5**	**11**	**28**
Project Work								
1	**PROJ**	**EI-PROJ-02**	Minor Project	3.0	--	--	6	6
2	**PROJ**	**EI-PROJ-01**	Case Study (Project Work)	2.0	--	--	4	4
3	**PROJ**	**EI-PROJ-04**	Major Project	4.0	--	--	8	8
			Total	**9.0**			**18**	**18**
Mandatory Courses								
1	**MC**	**EI-MC-112**	Environmental Science	**--**	**3**	**0**		**3**

Detailed First Year Curriculum Contents

B. Tech Electrical and Instrumentation Engineering

SCHEME OF EXAMINATIONS

B. Tech. 1st YEAR (SEMESTER–I) (w.e.f. 2020-21)

Course No.	Course Title	C	Teaching Schedule				Allotment of marks			Exam Duration in Hrs.
			L	T	P	Cont. Hrs.	CIE	SEE	Total	
EI-BS-101	Physics	4	3	1	-	4	40	60	100	3 Hrs
EI-BS-103	Mathematics-I	3	2	1	-	3	40	60	100	3 Hrs
EI-ES-105	Basic Electrical Engineering	4	3	1	-	4	40	60	100	3 Hrs
EI-HSM-107	English	2	2	-	-	2	40	60	100	3 Hrs
EI-PRBS-01	Physics Lab	1.5	-	-	3	3	30	45	75	3 Hrs
EI-PRES-03	Engineering Graphics and Design lab	1.5	-	-	3	3	40	60	100	3 Hrs
EI-PRES-05	Basic Electrical Lab	1	-	-	2	2	20	30	50	3 Hrs
EI-PRHSM-07	Language Lab	1	-	-	2	2	--	--	--	--
	Total	**18**	**10**	**3**	**10**	**23**	**250**	**375**	**625**	

B.Tech. 1stYEAR (SEMESTER–II) (w.e.f.2020-21)

Course No.	Course Title	C	Teaching Schedule				Allotment of marks			Exam Duration in Hrs.
			L	T	P	Cont. Hrs.	CIE	SEE	Total	
EI-BS-102	Chemistry	4	3	1		4	40	60	100	3 Hrs
EI-BS-104	Mathematics-II	3	2	1		3	40	60	100	3 Hrs
EI-ES-106	Programming for Problem Solving	4	3	1		4	40	60	100	3 Hrs
EI-ES-108	Basic Electronics Engineering	3	2	1		3	40	60	100	3 Hrs
EI-MC-112	Environmental Science	**	3	0		3	40**	60**	100**	3 Hrs
EI-PRBS-02	Chemistry Lab	1.5			3	3	30	45	75	3 Hrs
EI-PRES-04	Computer programming Lab	1.5	-	-	3	3	30	45	75	3 Hrs
EI-PRES-06	Basic Electronic lab	1	-	-	2	2	20	30	50	3 Hrs
EI-PRES-08	Workshop Practice Lab.	1	-	-	2	2	20	30	50	3 Hrs
	Total	**19**	**13**	**4**	**10**	**27**	**260**	**390**	**650**	

** Industrial training is noncredit, audit pass course which will not counted towards marks/grade calculations

B. Tech Electrical and Instrumentation Engineering

SCHEME OF EXAMINATIONS

B. Tech. 2nd YEAR (SEMESTER–III) (w.e.f. 2021-22)

Course No.	Course Title	C	Teaching Schedule				Allotment of marks			Exam Duration in Hrs.
			L	T	P	Cont. Hrs.	CIE	SEE	Total	
EI-PC-201	Power Systems-I	3	2	1	--	3	40	60	100	3 Hrs
EI-PC-203	Basic Instrumentation Engineering	3	2	1		3	40	60	100	3 Hrs
EI-PC-205	Network Analysis	3	2	1		3	40	60	100	3 Hrs
EI-PC-207	Transducers and Applications	3	2	1		3	40	60	100	3 Hrs
EI-OE-209	**Open Elective-I**	3	2	1		3	40	60	100	3 Hrs
EI-HSM-211	Basics of Industrial Sociology, Economics and Management	2	2	0		2	40	60	100	3 Hrs
EI-PRPC-09	Network Analysis Lab	1	--	--	2	2	20	30	50	3 Hrs
EI-PRPC-11	Transducers lab	1.5	--	--	3	3	20	30	50	3 Hrs
EI-PROE-13	**Open Elective- I Lab**	1.5	--	--	3	3	20	30	50	3 Hrs
EI-PRPC-15	Power System-I Lab	1			2	2	20	30	50	3 Hrs
	Total	**22**	**12**	**5**	**10**	**27**	**320**	**480**	**800**	

Open Elective –I
i. Linear Integrated Circuits
ii. Computer Networks

B.Tech. 2nd YEAR (SEMESTER–IV) (w.e.f. 2021-22)

Course No.	Course Title	C	Teaching Schedule				Allotment of marks			Exam Duration in Hrs.
			L	T	P	Cont. Hrs.	CIE	SEE	Total	
EI-PC-202	Power Electronics-I	4	3	1	--	4	40	60	100	3 Hrs
EI-PC-204	Electrical Measurements & Instrumentation	4	3	1	--	4	40	60	100	3 Hrs
EI-PE-206	**Program Elective- I**	3	2	1	--	3	40	60	100	3 Hrs
EI-PC-208	Electrical Machines-I	4	3	1	--	4	40	60	100	3 Hrs
EI-OE-210	**Open Elective-II**	3	2	1	--	3	40	60	100	3 Hrs
EI-HSM-212	Project Planning Estimation and Assessment	2	2	0		2	40	60	100	3Hrs
EI-PRPC-10	Power Electronics-I Lab	1	--		2	2	20	30	50	3 Hrs
EI-PRPC-12	Electrical Measurements & Instrumentation Lab	1	--		2	2	20	30	50	3 Hrs
EI-PROE-14	**Open Elective- II Lab**	1	--		2	2	20	30	50	3 Hrs
EI-PRPC-16	Electrical Machines –I lab	1.5	--		3	3	30	45	75	3 Hrs
	Total	**24.5**	**15**	**5**	**09**	**29**	**330**	**495**	**825**	

Program Elective- I	**Open Elective- II**
i. Control System Components	i. Digital Techniques
ii. Electrical Energy Conservation and Auditing	ii. Computer Organization

B. Tech Electrical and Instrumentation Engineering
SCHEME OF EXAMINATIONS

B. Tech. 3rd YEAR (SEMESTER–V) (w.e.f. 2022-23)

Course No.	Course Title	C	Teaching Schedule				Allotment of marks			Exam Duration in Hrs.
			L	T	P	Cont. Hrs.	CIE	SEE	Total	
EI-OE-301	**Open Elective- III**	4	3	1	--	4	40	60	100	3 Hrs
EI-PC-303	Power Electronics-II	4	3	1	--	4	40	60	100	3 Hrs
EI-PE-305	**Program Elective- II**	4	3	1	--	4	40	60	100	3 Hrs
EI-PC-307	Power System- II	4	3	1	--	4	40	60	100	3 Hrs
EI-PC-309	Linear Automatic Control System	4	3	1	--	4	40	60	100	3 Hrs
EI-PRPC-17	Power Electronic Lab-II	1.5	--	--	3	3	30	45	75	3 Hrs
EI-PRPC-19	Power System Lab- II	1.5	--	--	3	3	30	45	75	3 Hrs
EI-PRPE-21	**Program Elective- II Lab**	1.5	--	--	3	3	30	45	75	3 Hrs
EI-PRPC-23	Control System Lab	1.5	--	--	3	3	30	45	75	3 Hrs
EI-PRPC-25	Industrial Training-I	**			1$	1	40**	60**	100**	
	Total	**26**	**15**	**5**	**13**	**33**	**320**	**480**	**800**	

$ Evaluation seminar for Industrial Training-I

** Industrial training is noncredit, audit pass course which will not counted towards marks/grade calculations

Open Elective- III	**Program Elective- II**
i. Environment Monitoring Instrumentation	i. Microprocessors
ii. Electromagnetic Field Theory	ii. Analog and Digital Communication
iii. Mathematics-III	iii. Switch Gear and Protection
iv. Energy Efficient Systems	

B. Tech. 3rd YEAR (SEMESTER–VI) (w.e.f. 2022-23)

Course No.	Course Title	C	Teaching Schedule				Allotment of marks			Exam Duration in Hrs.
			L	T	P	Cont. Hrs.	CIE	SEE	Total	
EI-PE-302	**Program Elective-III**	3	2	1	--	3	40	60	100	3 Hrs
EI-PC-304	Electrical Machines-II	4	3	1	--	4	40	60	100	3 Hrs
EI-PC-306	Power Plant Engineering	3	2	1	--	3	40	60	100	3 Hrs
EI-PC-308	Digital Signal Processing	4	3	1	--	4	40	60	100	3 Hrs
EI-PC-310	Microcontroller & Embedded System	4	3	1	--	4	40	60	100	3 Hrs
EI-PRPC-18	Electrical Machines Lab-II	1.5	--	--	3	3	30	45	75	3 Hrs
EI-PRPC-20	Micro-controller Lab	1.5	--	--	3	3	30	45	75	3 Hrs
EI-PRPC-22	Digital Signal Processing Lab	1.5	--	--	3	3	30	45	75	3 Hrs
EI-PROJ-02	Minor Project	3	--	--	6	6	50	100	150	3 Hrs
	Total	**25.5**	**13**	**5**	**15**	**33**	**340**	**535**	**875**	

Program Elective- III
i. Electrical Machine Design
ii. Mechanical Measurements in Instrumentation
iii. Electrical and Hybrid Vehicles

B. Tech Electrical and Instrumentation Engineering
SCHEME OF EXAMINATIONS

B. Tech. 4thYEAR (SEMESTER–VII) (w.e.f. 2023-24)

Course No.	Course Title	C	Teaching Schedule				Allotment of marks			Exam Duration in Hrs.
			L	T	P	Cont. Hrs.	CIE	SEE	Total	
EI-OE-401	**Open Elective- IV**	4	3	1	--	4	40	60	100	3 Hrs
EI -PE-403	**Program Elective- IV**	3	2	1	--	3	40	60	100	3 Hrs
EI -PC-405	Electric Drives	4	3	1	--	4	40	60	100	3 Hrs
EI-PC-407	Advance Process Dynamics and Control	4	3	1	--	4	40	60	100	3 Hrs
EI-PRPC-27	Electric Drives Lab	1.5	--	--	3	3	30	45	75	3 Hrs
EI-PROE-29	**Open Elective- IV lab**	1.5	--	--	3	3	30	45	75	3 Hrs
EI-PROJ-01	Case Study (Project Work)	2	--	--	4	4	40	60	100	3 Hrs
EI-PRPC-31	Industrial Training-II	**			1$	1$	40**	60**	100**	3 Hrs
	Total	**20**	**11**	**4**	**11**	**26**	**260**	**390**	**650**	

$ Evaluation seminar for Industrial Training-I

** Industrial training is noncredit, audit pass course which will not counted towards marks/grade calculations

Open Elective- IV	**Program Elective- IV**
i. Computer Graphics & CAD CAM	i. Biomedical Instrumentation
ii. IoT and IT'S APPLICATIONS	ii. Reliability Engineering
iii. Introduction to Python Programming	iii. Wind and Solar Energy Systems
	iv. Power Quality and FACTS

B. Tech. 4th YEAR (SEMESTER–VIII) (w.e.f. 2023-24)

Course No.	Course Title	C	Teaching Schedule				Allotment of marks			Exam Duration in Hrs.
			L	T	P	Cont. Hrs.	CIE	SEE	Total	
EI-OE-402	**Open Elective- V**	3	2	1	--	3	40	60	100	3 Hrs
EI-PE-404	**Program Elective- V**	4	3	1	--	4	40	60	100	3 Hrs
EI-PC-406	Industrial Process Control	4	3	1	--	4	40	60	100	3 Hrs
EI-PRPC-24	Process Control Lab	1.5	--	--	3	3	30	45	75	3 Hrs
EI-PROE-26	**Open Elective- V Lab**	1.5	--	--	3	3	30	45	75	3 Hrs
EI-PRPC-28	Seminar	1.0	--	--	2	2	20	30	50	3 Hrs
EI-PROJ-04	Major Project	4	--	--	8	8	40	60	100	3 Hrs
	Total	**19**	**8**	**3**	**16**	**27**	**240**	**360**	**600**	

Open Elective V	**Program Elective V**
i. Artificial Intelligence	i. Utilization of Electrical Energy
ii. Robotics	ii. Instrumentation and System Design
iii. High Voltage Engineering	iii. Fuzzy Logic Control
	iv. Optical Instrumentation
	v. Remote Sensing

APPENDIX A

Outcome Based Education

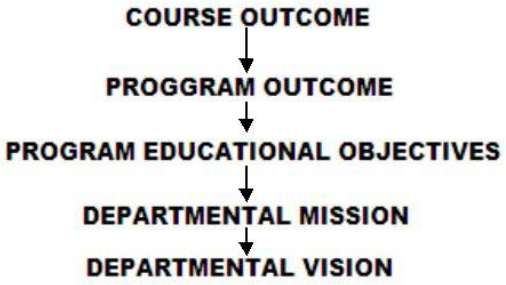
Outcome-based education (OBE) is an educational theory that bases each part of an educational system around goals (outcomes). By the end of the educational experience each student should have achieved the goal. There is no specified style of teaching or assessment in OBE; instead classes, opportunities, and assessments should all help students achieve the specified outcomes.

There are three educational Outcomes as defined by the National Board of Accreditation:
Program Educational Objectives: The Educational objectives of an engineering degree program are the statements that describe the expected achievements of graduate in their career and also in particular what the graduates are expected to perform and achieve during the first few years after graduation. [nbaindia.org]

Program Outcomes: What the student would demonstrate upon graduation. Graduate attributes are separately listed in Appendix C

Course Outcome: The specific outcome/s of each course/subject that is a part of the program curriculum. Each subject/course is expected to have a set of Course Outcomes

Mapping of Outcomes



APPENDIX B

The Graduate Attributes of NBA

Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

Problem analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

Conduct investigations of complex problems: The problems that cannot be solved by straightforward application of knowledge, theories and techniques applicable to the engineering discipline.
* That may not have a unique solution. For example, a design problem can be solved in many ways and lead to multiple possible solutions. Hat require consideration of appropriate constraints/requirements not explicitly given in the problem statement (like: cost, power requirement, durability, product life, etc.) which need to be defined (modeled) within appropriate mathematical framework that often require use of modern computational concepts and tools.#

Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

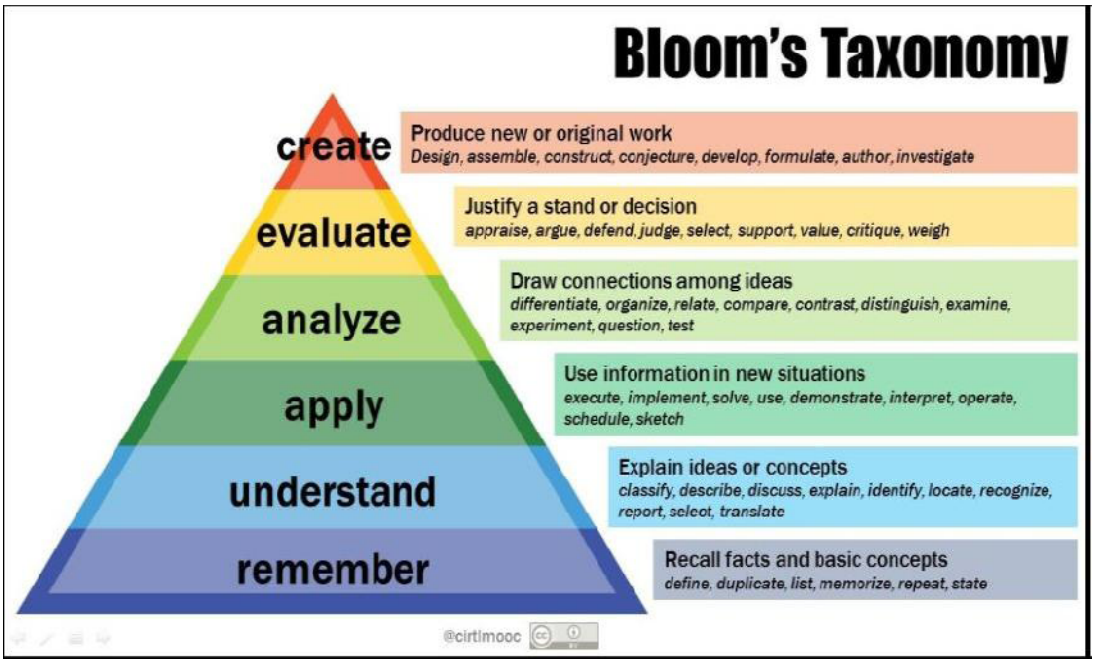
Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

APPENDIX C

BLOOM'S TAXONOMY

Bloom's taxonomy is a classification system used to define and distinguish different levels of human cognition—i.e., thinking, learning, and understanding. Educators have typically used Bloom's taxonomy to inform or guide the development of **assessments** (tests and other evaluations of student learning), **curriculum** (units, lessons, projects, and other learning activities), and instructional methods such as questioning strategies. **[eduglosarry.org]**



B. Tech Electrical and Instrumentation Engineering
SYLLABI OF EXAMINATIONS
B. Tech 1st Year (2020-21)

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-BS-101	**Course Name:** Physics	**L**	**T**	**P**	**C**
		3	**1**	**-**	**4**
Year and Semester	**1st Yr. 1st Semester**	**Contact hours per week:** (4Hrs) Exam: (3 Hrs)			
Pre-requisite of course	**NIL**	**Evaluation**			
		CIE: 40	**SEE: 60**		

Course Objectives:

1. It aims to equip the students with basic concepts of physics principles.
2. To provide adequate knowledge about tools at an intermediate to advanced level.
3. To provide students to serve them well towards tackling more advanced level of physical problems.
4. To provide knowledge and applications that they would find useful in their core subjects
5. To provide knowledge about different applications of optics, EM-theory, solid state electronics etc.

Course Outcomes: On completion of the course, student would be able to:

CO1	Understand the applications of Optics
CO2	Understand components of a laser system and their applications
CO3	Understand significance and normalization of wavefunction, Schrodinger wave equation
CO4	Understand Classification of solids on the basis of band theory and how to measure conductivity by Hall measurements
CO5	Understand Electro and magneto statics, Maxwell's equations
CO6	Apply LASER and Optical fiber for various physical parameter measurements.

Module No	**COURSE SYLLABUS CONTENTS OF MODULE**	**Hrs**	**CO'S**
1	**Electrostatics and Magnetostatics:** Divergence and curl of electrostatic field; Laplace's and Poisson's equations for electrostatic potential, Electrostatic field and charge density. electrostatics problems in presence of dielectrics. Differential and integral calculus: Concept of gradient, operator, divergence and curl Line, surface and volume integrals, Gauss –Divergence theorem, Stokes theorem, Equation of continuity, Divergence of magnetic induction, Biot savarts law. Magnetic vector potential, Amperes circuital law, Faraday's law of electromagnetic induction, the basic equations of electromagnetism, generalization of amperes law, Maxwell's equations. Energy in an electromagnetic field; Flow of energy and Poynting vector with examples.	**8**	**CO5**
2	**PHYSICAL OPTICS:** Interference: Division of wave front-Fresnel's biprism, Division of amplitude–Newton's rings, Michelson interferometer, applications. Diffraction: Difference between Fraunhofer and Fresnel diffraction. Fraunhofer diffraction through a slit. Plane transmission diffraction grating, its dispersive and resolving powers. Polarization, quarter wave plate, half wave plate, Nicol prism, Polarimeter	**8**	**CO1**
3	**Wave nature of particles, Solid state electronics and Semiconductor conductivity:** Wave nature of Particles, Time-dependent and time-independent Schrodinger equation for wavefunction, Expectation	**9**	**CO3 CO4**

	values, Free-particle wavefunction and wave-packets, Uncertainty principle. Free electron theory, Band theory of solids, Classification of solids on the basis of band theory, Fermi-Dirac probability function, Position of Fermi level in intrinsic Temperature variation of carrier concentration in extrinsic semiconductors. Electron and hole concentrations in intrinsic semiconductors, Intrinsic density, Intrinsic conductivity, Extrinsic conductivity, Law of mass action, Fermi level in extrinsic semiconductors, Electrical conduction in Extrinsic semiconductors, Diffusion length and mean life time, Hall Effect.		
4	**Dielectric and Magnetic materials:** Introduction, Nonpolar molecules, Polar molecules, Polar and nonpolar molecules in an electric field, Electric polarization of matter, Electric polarization vector, Electric field in dielectrics, Gauss's law in dielectrics, Relation between three electric vectors D, E and P, Effect of dielectric on capacitance. Magnetisation of matter (Origin of Magnetic Moment, Diamagnetism, Paramagnetism, Ferromagnetism, B, H, M), B-H curve.	**4**	**CO5**
5	**LASER:** Spontaneous and stimulated emissions, Laser action, characteristics of laser beam-concepts of coherence, He-Ne and semiconductor lasers (simple ideas), applications. **FIBRE OPTICS:** Propagation of light in fibres, numerical aperture, single mode and multi-mode fibres, dispersion, applications.	**7**	**CO1** **CO2** **CO6**

Text Books:

1. Perspectives of Modern Physics - Arthur Beiser (TMH), 2001
2. A Text Book of Optics – Brij Lal & Subramanyam, Chand & Co.1981
3. David Griffiths, Introduction to Electrodynamics, PHI 2004
4. Eisberg and Resnick, Introduction to Quantum Physics, AP, 1985
5. Ghatak, Optics, PHI, 1995
6. Introduction to Solid State Physics (VII Ed.) - Charles Kittel (John Wiley)., 2007

Suggested Reference Books:

1. Halliday and Resnick,Physics, 1981
2. W. Saslow, Electricity, magnetism andlight
3. O. Svelto, Principles of Lasers
4. Introduction to Solid State Physics (VII Ed.) - Charles Kittel (John Wiley)., 2007
5. Quantum Mechanics – Powell and Crasemann (Oxford & IBH)

Reference Books:

1. Classical Electrodynamics, By J D Jacson, Wiley Publishers, 1970
2. Solid State Physics – A. J. Dekkar. ; Mac Millan India Limited, 1981
3. Fundamentals of Magnetism- B. Cullity – Addison-Wiley Publishing, 2008
4. Semiconductor devices, physics and technology, S. M. Sze Wiley, 1981
5. Introduction to solid state physics C. Kittel, Wiley, 20011

Note for Examiner(s): Question paper will comprise three sections,

1. Section-A will be compulsory and comprise 4-short answer type questions uniformly spread to the entire syllabus.

2. Section-B will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on concepts, definitions, derivations, principles, construction and working etc.
3. Section-C will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on derivations, numerical and applications of the various topics covered therein.

Note for Students:

1. Section – A is compulsory and attempt/answer all the four questions carrying 12 marks in total.
2. Attempt/answer two questions each out of the Section – B and Section – C. All questions will carry 12 marks each.

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-BS-103	**Course Name: Mathematics-I**	**L**	**T**	**P**	**C**
		2	**1**	**0**	**3**
Year and Semester	**1st Year** **I st Semester**	**Contact hours per week:** (3 Hrs) Exam: (3 Hrs)			
Pre-requisite of course	The course requires prior knowledge of Differentiation, Integration and vector algebra.	**Evaluation**			
		CIE: 40	**SEE: 60**		

Course Objectives:	
1. To apply Differentiation to geometric principles and expand functions into series.	
2. To understand Partial differentiation and apply to various mathematical situations.	
3. To gain knowledge on fundamentals of Multiple Integrals and their Applications.	
4. To explore how to differentiate and integrate Vectors. To provide good understanding of interrelation between vector differentiation and Integration through Basic Theorems.	
Course Outcomes: On completion of the course, student would be able to:	
CO1	Understand the Differentiation and Integration applications.
CO2	Understand and solve Partial differentiation and Multiple integrals for various problems.
CO3	Apply the knowledge of Differentiation to geometric principles and expand functions into series.
CO4	Students should be able to use his knowledge of Vector analysis and relate it to fluid flows.

Module No	**COURSE SYLLABUS** **CONTENTS OF MODULE**	**Hrs**	**COs**
1	**Applications of Differentiation:** Taylor's & Maclaurin's series, Expansion by use of known series, Expansion by forming a differential equation, Asymptotes, Curvature, Tracing of Cartesian curves.	**6**	**CO1, CO2, CO3**
2	**Partial Differentiation & its Applications:** Euler's theorem, Jacobian, Errors and approximations, Maxima-minima	**6**	**CO1, CO2,**

	of functions of two variables, Lagrange's method of undetermined multipliers.		**CO3**
3	**Double Integral:** Change of order of integration Double integral in polar coordinates, Applications of double integral to find area enclosed by plane curves volume of solids of revolution. **Triple integral:** Volume of solids,	**6**	**CO1, CO2, CO3**
4	**Vector Calculus**: Differentiation of vectors: Gradient of a scalar field and directional derivative, divergence, and curl of a vector field, Del applied twice to point functions, Del applied to product of point functions. **Integration of vectors:** line integral, surface integral, volume integral, Green's, Stoke's and Gauss divergence theorems (without proof).	**6**	**CO1, CO2, CO3, CO4**

TEXT BOOKS:

1. Advanced Engineering Mathematics: E. Kreyszig. 10th Edition, John Wiley & sons,
2. Higher Engineering Mathematics: B.S. Grewal. 43rd Edition, Khanna Publications

REFERENCE BOOKS:

1. Engineering Mathematics Part-I: S.S. Sastry, 4th Edition, PHI.
2. Advanced Engineering Mathematics: R.K. Jain, S.R.K. Iyengar, 3rd Edition, Narosa Publications
3. Advanced Engineering Mathematics: Michael D. Greenberg, 2nd Edition, Pearson Publications.

Note for Examiner(s): Question paper will comprise three sections,

1. Section-A will be compulsory and comprise 4-short answer type questions uniformly spread to the entire syllabus.
2. Section-B will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on concepts, definitions, derivations, principles, construction and working etc.
3. Section-C will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on derivations, numerical and applications of the various topics covered therein.

Note for Students:

1. Section – A is compulsory and attempt/answer all the four questions carrying 12 marks in total.
2. Attempt/answer two questions each out of the Section – B and Section – C. All questions will carry 12 marks.

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-ES-105	**Course Name:** Basic Electrical Engineering	**L**	**T**	**P**	**C**
		3	**1**	**-**	**4**
Year and Semester	**1st year** **1st Semester**	**Contact hours per week:** (4Hrs) **Exam:** (3hrs.)			
Pre-requisite of	**NIL**	**Evaluation**			

course		CIE: 40	SEE: 60
Course Objectives:			
1. To study basics theory, laws and theorem of DC electrical networks.			
2. To study working of various electrical AC circuits, magnetic circuits and its parameters.			
3. To study the working theory of AC and DC electrical machines.			
4. To introduce the domestic wiring and earthing in electrical system.			
Course Outcomes: On completion of the course, student would be able to:			
CO1	To understand the basic concept of electrical circuits, electrical laws and network theorems.		
CO2	To understand the basic components and working theory of DC and AC network.		
CO3	To understand the parameters of electrical networks and equipments.		
CO4	To understand the circuits and working of various electrical machines.		
CO5	To impart basic technical knowledge of electrical wiring system and apply it to technological fields.		

Module No	COURSE SYLLABUS CONTENTS OF MODULE	Hrs	COs
1	**DC Circuits:** Electrical circuit elements (Resistance, inductance and Capacitance), voltage and current sources, Kirchoff current and voltage laws, analysis of simple circuits with dc excitation. Superposition, Thevenin and Norton Theorems. Time-domain analysis of first-order RL and RC circuits.	**7**	**CO1, CO2**
2	**AC Circuits:** Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor, power factor improvement and its significance. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Three-phase balanced circuits, voltage and current relations in star and delta connections.3-phase power equation, measurement of three phase power by two wattmeter method.	**7**	**CO1, CO2, CO3**
3	**Transformers:** Magnetic materials, BH characteristics, working of ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections**.**	**7**	**CO3, CO4**
4	**Electrical Rotating Machines:** Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Loss components and efficiency, starting and speed control of induction motor. Construction and working of Single-phase induction motor and torque-speed characteristic. Construction and working of DC machine and speed control of separately dc motor. Construction and working of synchronous generators.	**8**	**CO3, CO4**
5	**Electrical Installations:** Components of domestic wiring system, earthing system and its significance. Elementary calculations for energy consumption.	**4**	**CO3, CO5**

Suggested Text / Reference Books:

1. D. P. Kothari and I. J. Nagrath, “Basic Electrical Engineering”, Tata McGraw Hill, 2010.
2. D. C. Kulshreshtha, “Basic Electrical Engineering”, McGraw Hill, 2009.
3. L. S. Bobrow, “Fundamentals of Electrical Engineering”, Oxford University Press, 2011.
4. E. Hughes, “Electrical and Electronics Technology”, Pearson, 2010.
5. V. D. Toro, “Electrical Engineering Fundamentals”, Prentice Hall India,1989.
6. B.L. Theraja and A. K. Theraja,“Electrical Technology”,Vol-I, S.Chand.

Note for Examiner(s): Question paper will comprise three sections,

1. Section-A will be compulsory and comprise 4-short answer type questions uniformly spread to the entire syllabus.
2. Section-B will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on concepts, definitions, derivations, principles, construction and working etc.
3. Section-C will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on derivations, numerical and applications of the various topics covered therein.

Note for Students:

1. Section – A is compulsory and attempt/answer all the four questions carrying 12 marks in total.
2. Attempt/answer two questions each out of the Section – B and Section – C. All questions will carry 12 marks.

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-HSM-107	**Course Name:** English	**L**	**T**	**P**	**C**
		2	**-**	**-**	**2**
Year and Semester	**1st Yr.** **1st Semester**	**Contact hours per week:** (2Hrs) Exam: (3 Hrs)			
Pre-requisite of course	**NIL**	**Evaluation**			
		CIE: 40	**SEE: 60**		
Course Objectives:					
To make student understand the details of functional English.					
To make student learn the effective communication skills					
Course Outcomes: On completion of the course, student would be able to:					
CO1	The student will acquire basic proficiency in English				
CO2	Writing and speaking skills				
CO3	Reading and listening skills				
CO4	Vocabulary enrichment				

Module No	**COURSE SYLLABUS CONTENTS OF MODULE**	**Hrs**	**COs**
1	**Vocabulary Building:** The concept of Word Formation Root words from foreign languages and their use in English Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives.	**3**	**CO1, CO2, CO3, CO4**

	Synonyms, antonyms, and standard abbreviations.		
2	**Basic Writing Skills:** Sentence Structures, Use of phrases and clauses in sentences, Importance of proper punctuation, Creating coherence, Organizing principles of paragraphs in documents, Techniques for writing precisely	**5**	**CO2**
3	**Identifying Common Errors in Writing:** Subject-verb agreement, Noun-pronoun agreement, Misplaced modifiers, Articles, Prepositions, Redundancies, Clichés	**4**	**CO1**
4	**Nature and Style of sensible Writing:** Describing, Defining, Classifying, Providing examples or evidence, writing introduction and conclusion	**5**	**CO1, CO2**
5	**Writing Practices:** Comprehension, Précis Writing, Essay Writing	**3**	**CO1, CO2**
6	**Oral Communication** (This unit involves interactive practice sessions in Language Lab): Listening Comprehension, Pronunciation, Intonation, Stress and Rhythm, Common Everyday Situations: Conversations and Dialogues, Communication at Workplace, Interviews, Formal Presentations	**4**	**CO1, CO3**

Text Books:

1. Practical English Usage. Michael Swan. OUP.1995.
2. Remedial English Grammar. F.T. Wood. Macmillan.2007
3. On Writing Well. William Zinsser. Harper Resource Book.2001
4. Study Writing. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press.2006.
5. Communication Skills. Sanjay Kumar and Pushp Lata. Oxford University Press.2011.
6. ExercisesinSpokenEnglish.Parts.I-III.CIEFL,Hyderabad.OxfordUniversityPress

Note for Examiner(s): Question paper will comprise three sections,

1. Section-A will be compulsory and comprise 4-short answer type questions uniformly spread to the entire syllabus.
2. Section-B will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on concepts, definitions, derivations, principles, construction and working etc.
3. Section-C will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on derivations, numerical and applications of the various topics covered therein.

Note for Students:

1. Section – A is compulsory and attempt/answer all the four questions carrying 12 marks in total.
2. Attempt/answer two questions each out of the Section – B and Section – C. All questions will carry 12 marks.

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-PRBS-01	**Course Name: Physics Lab**	**L**	**T**	**P**	**C**
		-	**-**	**3**	**1.5**
Year and Semester	**1st Yr.** **1st Semester**	**Contact hours per week:** (3Hrs) Exam: (3 Hrs)			
Pre-requisite of course	**NIL**	**Evaluation**			
		CIE: 30	**SEE: 45**		

Course Objectives:	
1. Understand the applications of Optics	
2. Understand components of a laser system and their applications	
3. Understand to measure conductivity in semiconductors	
4. Understand basics of quantum principles	
Course Outcomes: On completion of the course, student would be able to:	
CO1	Experiments in Optics/ principles
CO2	Experiments in acoustics/ applications
CO3	Experiments in Lasers/ optical principles
CO4	Experiments in Magnetism/ applications
CO5	Experiments in Semiconductor conductivity/ properties

Expt. No	**COURSE SYLLABUS** **CONTENTS OF MODULE**	**COs**
1	Magnetic field from Helmholtz coil; To study the variation of magnetic field with distance and to find the radius of coil by Stewart and Gee's apparatus	**CO1** **CO2** **CO3** **CO4**
2	To find the wavelength of sodium light by Newton's rings experiment.	
3	To find the wavelength of sodium light by Fresnel's biprism experiment.	
4	To find the wavelength of various colours of white light with the help of a plane transmission diffraction grating.	
5	To find the wavelength of sodium light by Michelson interferometer.	
6	To find the resolving power of a telescope.	
7	To find the specific rotation of sugar solution by using a polarimeter.	
8	To compare the capacitances of two capacitors by Density bridge and hence to find the dielectric constant of a medium.	
9	To find the frequency of A.C. mains by using sonometer.	
10	To Find Value of high Resistance by substitution method	
11	To Find the value of high resistance by leakage method	
12	To Convert a galvanometer in to an Ammeter of given range.	
13	To study laser beam characteristics, diffraction.	
14	To find the value of e/m for electrons by Helical method, Measurement of Lorentz force in a vacuum tube.	
15	To find the ionization potential of Mercury using a thyratron tube...	
16	To find the value of Planck's constant by using a photo electric cell.	
17	To find the value of Hall Co-efficient of semi-conductor.	
18	To find the band gap of intrinsic semi-conductor using four probe method.	
19	To calculate the hysteresis loss by tracing a B-H curve.	

Text Books:

1. Advanced Practical Physics – B.L. Worshnop and H.T. Flint (KPH)
2. Practical Physics – S.L.Gupta &V.Kumar (Pragati Prakashan).
3. Advanced Practical Physics Vol.I& II – Chauhan &Singh (Pragati Prakashan).

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-PRES-03	**Course Name:** Engineering Graphics and Design lab	**L**	**T**	**P**	**C**
		-	**-**	**3**	**1.5**
Year and Semester	**1st Yr.** **1st Semester**	**Contact hours per week:** (3Hrs) Exam: (3 Hrs)			
Pre-requisite of course	**NIL**	**Evaluation**			
		CIE: 40	**SEE: 60**		

Course Objectives:	
1. To make students understand about construction of various types of Curves and scales.	
2. To make students understand about orthographic projections of Point, Line, Plane and regular solids.	
3. To make students understand about sectional views and development of right regular solids	
Course Outcomes: On completion of the course, student would be able to:	
CO1	To learn about construction of various types of Curves and scales.
CO2	To learn about orthographic projections of Point, Line and Plane
CO3	To learn about orthographic projections of regular solids.
CO4	To learn about sectional views and development of right regular solids

Module No	**COURSE SYLLABUS CONTENTS OF MODULE**	**COs**
1	**Introduction to Engineering Drawing covering:** Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid and Involute; Scales – Plain, Diagonal and Vernier Scales;	**CO1, CO2, CO3, CO4**
2	**Orthographic Projections covering:** Principles of Orthographic Projections-Conventions - Projections of Points and Projection of lines inclined to both planes; Projections of planes inclined Planes - Auxiliary Planes;	
3	**Projections of Regular Solids: t**hose inclined to both the Planes- (Pyramid, Prism, Cone and Cylinder) Auxiliary Views. Floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc.	
4	**Section of Solids:** Sectional View of simple right regular solids, Development of Surfaces of right regular solids (Pyramid, Prism, Cone and Cylinder)	

Suggested Text/Reference Books:

1. Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing House

2. Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education
3. Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMHPublication
4. Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-PRES-05	**Course Name:** Basic Electrical Lab.	**L**	**T**	**P**	**C**
		0	**0**	**2**	**1**
Year and Semester	**1st Year** **1st Semester**	**Contact hours per week:** (2Hrs) **Exam:** (3hrs.)			
Pre-requisite of course	**Basic Science**	**Evaluation**			
		CIE: 20	**SEE: 30**		

Course Objectives:

1. To study the different laws and theorems of electric networks.
2. To familiarize with different DC and AC electric networks
3. To study different electric equipments and their application.
4. Familiarize with the safety rules for electrical laboratory.

Course Outcomes: On completion of the course, student would be able to:

CO1	Impart the conceptual knowledge of electric circuit laws and network theorems and apply these to laboratory work.
CO2	Ability to analyze the performance of an electric circuits as well as handling of electric equipments.
CO3	Acknowledge the principles of operation and the main features of electric network and their applications.
CO4	Get an exposure to common electrical components and their ratings. Develop skills to use in different technological field.

Expt. No	**COURSE SYLLABUS** **CONTENTS OF MODULE**	**COs**
1	To study and verify Kirchhoff's current law and Kirchhoff's voltage law.	**CO1 CO2 CO3 CO4**
2	To study and verify Thevenin's theorem.	
3	To study and verify Norton's theorem.	
4	To study and verify Superposition theorem.	
5	To study and verify Maximum power transfer theorem.	
6	To study the operation of series RLC network and determine its parameters.	
7	To study the operation of parallel RLC network and determine its parameters.	
8	To study the characteristics of series RLC network under resonance condition and determine its resonance frequency from resonance curve.	
9	To study the characteristics of parallel RLC network under resonance condition and determine its resonance frequency from resonance curve.	
10	Perform three phase power measurement by using two wattmeter's method for balanced three phase load.	
11	To study the basic operation and equivalent circuit of a single-phase transformer.	
12	Perform Open Circuit & Short Circuit tests on single phase transformer.	
13	Perform Load test on single phase transformer.	
14	To study the characteristics of fluorescent lamps.	
15	To study the characteristics of tungsten filament lamps.	

Text/Reference Books:

1. D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 2010.
2. D. C. Kulshreshtha, "Basic Electrical Engineering", McGraw Hill, 2009.
3. L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press, 2011.

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-PRHSM-07	**Course Name: Language Lab.**	**L**	**T**	**P**	**C**
		-	**-**	**2**	**1**
Year and Semester	**1st Yr. 1st Semester**	**Contact hours per week:** (2Hrs)			
Pre-requisite of course	Functional English	**Evaluation**			
		CIE: 00		**SEE: 00**	

Course Objectives:

1. Graduates will attain skills to conduct experiments/investigations and interpret data with reference to systems and standards
2. Graduates will have ability to communicate effectively in written, oral and instrumentation formats to put forth solutions and prepare detailed engineering report in the process and automation industries.
3. Graduates will be able to apply the knowledge, skill and attitude as a team player in initiating, executing and managing projects in the areas of design, manufacture, marketing and entrepreneurship in multi-disciplinary environments.

Course Outcomes: On completion of the course, student would be able to:

CO1	Imparting the role of communicative ability as one of the soft skills needed for placement
CO2	Developing communicative ability and soft skills needed for placement
CO3	Making students Industry-Ready through inculcating team-playing capacity

Expt. No	**COURSE SYLLABUS CONTENTS OF MODULE**	**COs**
1	**GRAMMAR IN COMMUNICATION:** Grammar and Usage – Building Blocks, Homonyms, Subject and Verb Agreement, Error Correction - Grammar Application, Framing Questions – Question words, Verbal Questions, Tags, Giving Replies –Types of Sentences, Listening Comprehension –Listening and Ear training.	**CO1, CO2, CO3**
2	**ASSERTIVE COMMUNICATION:** Listening Comprehension in Cross–Cultural Ambience, Telephonic Conversations/Etiquette, Role Play Activities, Dramatizing Situations- Extempore – Idioms and Phrases	
3	**CORPORATE COMMUNICATION:** Video Sensitizing, Communicative Courtesy – Interactions – Situational Conversations, Time Management, Stress Management Techniques, Verbal Reasoning, Current Affairs – E Mail Communication / Etiquette	
4	**PUBLIC SPEAKING:** Giving Seminars and Presentations, Nuances of Addressing a Gathering - one to one/ one to a few/ one to many, Communication Process, Visual Aids & their Preparation, Accent Neutralization, Analyzing the Audience, Nonverbal Communication.	
5	**INTERVIEW & GD TECHNIQUES:** Importance of Body Language –Gestures & Postures and Proxemics, Extempore, Facing the Interview Panel, Interview FAQs, Psychometric Tests and Stress Interviews, Introduction to GD, Mock GD Practices.	

Text Books:

1. Bhatnagar R.P. & Rahul Bhargava, “English for Competitive Examinations”, Macmillian Publishers, India, 1989, ISBN: 9780333925591
2. Devadoss K. & Malathy P., “Career Skills for Engineers”, National Book Publishers, Chennai, 2013.
3. Aggarwal R.S., “A Modern Approach to Verbal & Non–Verbal Reasoning”, S.Chand Publishers, India, 2012, ISBN : 8121905516

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-BS-102	**Course Name:** Chemistry	**L**	**T**	**P**	**C**
		3	**1**	**-**	**4**
Year and Semester	**1st Yr.** **2nd Semester**	**Contact hours per week:** (4Hrs) Exam: (3 Hrs)			
Pre-requisite of course	**NIL**	**Evaluation**			
		CIE: 40	**SEE: 60**		

Course Objectives:	
The concepts developed in this course will aid in quantification of several concepts in chemistry that have been introduced at the 10+2 levels in schools.	
Technology is being increasingly based on the electronic, atomic and molecular level modifications.	
Quantum theory is more than 100 years old and to understand phenomena at nanometer levels, one has to base the description of all chemical processes at molecular levels.	
Course Outcomes: On completion of the course, student would be able to:	
CO1	Analyze microscopic chemistry in terms of atomic and molecular orbitals and inter molecular forces.
CO2	Apply the knowledge of conductance to explain various electrochemical phenomenon.
CO3	Distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques
CO4	Rationalize bulk properties and processes using thermodynamic considerations.
CO5	Rationalize periodic properties such as ionization potential, electronegativity, oxidation states and electronegativity.
CO6	Distinguish between various stereoisomers.

Module No	**COURSE SYLLABUS CONTENTS OF MODULE**	**Hrs**	**COs**
1	**Atomic and molecular structure:** Schrodinger equation. Particle in a one-dimensional box solution and its applications for molecules. Molecular orbital theory and its applications to the formation of homonuclear (H_2, N_2) and heteronuclear diatomic molecules (NO, CO, CN) Energy level diagrams of diatomics. Pi (p)-molecular orbitals of butadiene and benzene and aromaticity. Crystal field theory and the energy level diagrams for $[Ni(CO)_4]$, $[Co(NH_3)_6]$, $[PtCl_2(NH_3)_2]$ and magnetic properties of transition metal complexes and their magnetic properties.	**10**	**CO1, CO2**

2	**Spectroscopic techniques and applications:** Principles of spectroscopy and selection rules. Electronic spectroscopy. Fluorescence spectroscopy and its applications in medicine. Vibrational and rotational spectroscopy of diatomic molecules. Applications. Nuclear magnetic resonance (NMR) and magnetic resonance imaging (MRI), surface characterization with Auger electron spectroscopy (AES), X-ray Photoelectron Spectroscopy (XPS) and Secondary Ion Mass Spectrometry (SIMS).	**10**	**CO3**
3	**Electrochemistry:** Conductance of electrolytic solutions, Transference number and its determination by Hittorf method and Moving boundary method, Kohlrausch's law of independent migration of ions, Interionic attraction theory, activity and activity coefficients of strong electrolytes. **Use of free energy in chemical equilibria:** Thermodynamic functions: Internal energy, enthalpy, entropy and free energy. Estimations of entropy and free energies. Free energy and EMF. Cell potentials, the Nernst equation and applications. pH, Acid-base, oxidation-reduction and solubility equilibria.	**10**	**CO4**
4	**Periodic properties:** Effective nuclear charge, penetration of orbitals, variations of *s, p, d* and *f* orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries of molecules: H_2O, NH_3, CCl_4, PCl_5, SF_6 and $Pt(NH_3)_2Cl_2$. **Stereochemistry:** Representations of 3-dimensional structures, structural isomers and stereoisomers, configurations and symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis.	**8**	**CO4, CO5**

Text Books:

1. University chemistry, by B. H.Mahan
2. Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane
3. Fundamentals of Molecular Spectroscopy, by C. N.Banwell
4. Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M.S. Krishnan
5. Physical Chemistry, by P. W. Atkins
6. Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore, 5th Edition http://bcs.whfreeman.com/vollhardtschore5e/default.asp

Note for Examiner(s): Question paper will comprise three sections,

1. Section-A will be compulsory and comprise 4-short answer type questions uniformly spread to the entire syllabus.
2. Section-B will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on concepts, definitions, derivations, principles, construction and working etc.
3. Section-C will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on derivations, numerical and applications of the various topics covered therein.

Note for Students:

1. Section – A is compulsory and attempt/answer all the four questions carrying 12 marks in total.
2. Attempt/answer two questions each out of the Section – B and Section – C. All questions will carry 12 marks.

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-BS-104	**Course Name:** Mathematics-II	**L**	**T**	**P**	**C**
		2	**1**	**0**	**3**
Year and Semester	**Ist Year** **IInd Semester**	**Contact hours per week:** (3Hrs) Exam: (3 Hrs)			
Pre-requisite of course	The course assumes prior knowledge of topics in Matrices, Differentiation, Partial Fractions, Partial Differentiation.	**Evaluation**			
		CIE: 40	**SEE: 60**		

Course Objectives:	
1.	To explore the Properties of Matrices.
2.	To know various basic Differential equations and solve them.
3.	To gain knowledge on Laplace transformations and ability to apply them in various problems
4.	To provide good understanding of Linear and non-linear Partial Differential equations.

Course Outcomes: On completion of the course, student would be able to:	
CO1	Understand significance and Solve for different Matrix properties
CO2	Differentiate between linear and non-linear differential equations and solve them.
CO3	Understand and apply Laplace Transformations and use them to solve Differential equations.
CO4	Differentiate between linear and non-linear partial differential equations, form them related to in hand problems and solve them.

Module No	**COURSE SYLLABUS** **CONTENTS OF MODULE**	**Hrs**	**COs**
1	**Matrices & its Applications:**, inverse using elementary transformations, consistency of linear system of equations, linear and orthogonal transformations, Eigen values and Eigen vectors, properties of Eigen values.	**6**	**CO1**
2	**Ordinary Differential Equations & its Applications:** Exact differential equations. Equations reducible to exact differential equations. **Linear differential equations of second and higher order**: complementary function and particular integral, method of variation of parameters to find particular Integral, Cauchy and Legendre linear differential equations, Simultaneous linear Differential equation with constant co-efficients.	**6**	**CO2**
3	**Laplace Transforms and its Applications:**Transforms of derivatives, transforms of integrals, multiplication by t^n, division by t. Evaluation of integrals by Laplace transforms. Laplace transform	**6**	**CO3**

	of Unit step function, unit impulse function and periodic function. **Inverse Laplace transforms**, convolution theorem, application to linear differential equations		
4	**Partial Differential Equations and Its Applications:**Formation of partial differential equations, Lagrange's linear partial differential equation, First order non-linear partial differential equation, Method of separation of variables and its applications.	**6**	**CO4**

TEXT BOOKS:

1. Advanced Engineering Mathematics: E. Kreyszig, 10th Edition, John Wiley & son
2. Higher Engineering Mathematics: B.S. Grewal. 43rd Edition, Khanna Publication

REFERENCE BOOKS:

1. Engineering Mathematics Part-I : S.S. Sastry, 4th Edition, PHI.
2. Advanced Engineering Mathematics: R.K. Jain, S.R.K. Iyengar, 3rd Edition, Narosa Publications
3. Advanced Engg. Mathematics: Michael D. Greenberg, 2nd Edition, Pearson Publications.

Note for Examiner(s): Question paper will comprise three sections,

1. Section-A will be compulsory and comprise 4-short answer type questions uniformly spread to the entire syllabus.
2. Section-B will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on concepts, definitions, derivations, principles, construction and working etc.
3. Section-C will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on derivations, numerical and applications of the various topics covered therein.

Note for Students:

1. Section – A is compulsory and attempt/answer all the four questions carrying 12 marks in total.
2. Attempt/answer two questions each out of the Section – B and Section – C. All questions will carry 12 marks.

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-ES-106	**Course Name:** Programming for Problem Solving	**L**	**T**	**P**	**C**
		3	**1**	**0**	**4**
Year and Semester	**1st Year IInd Semester**	**Contact hours per week:** (4Hrs) Exam: (3 Hrs)			
Pre-requisite of course	**NIL**	**Evaluation**			
		CIE: 40		**SEE: 60**	
Course Objectives:					
1. To explain the problem solving concepts using a computer.					
2. To develop problem solutions for the computer by using problem solving tools.					

3. To describe the Programming structure of C language.	
4. To convert an Algorithm, Pseudo code and Flowchart into a C program	
5. To find errors and execute a C program	
Course Outcomes: On completion of the course, student would be able to:	
CO1	Understand the fundamental concepts of computerhardware and number systems.
CO2	Apply the basic programming skills of C Language in problem solving.
CO3	Use different data types, decision structures, loops, arrays, strings and functions of C-programming to design a computer program.
CO4	Apply dynamic memory concepts with pointers.
CO5	Apply various algorithms in solving sorting problems.
CO6	Apply linear data structures like Stack, Queues and Trees in organizing and traversing data.

Module No	COURSE SYLLABUS CONTENTS OF MODULE	Hrs	COs
1	**Generations and Classification of Computers** - Applications of Computers - Basic Organization of a Computer - Number system - Binary, Decimal, Octal and Hexadecimal – Problems **Introduction to C Language**: Algorithm, Flowchart, Pseudo-code solution to problem, Basic concepts of a C program, Declaration, Assignment & Print statement, Types of operators and expressions, Programming examples and exercise. **Branching and Looping:** Two-way selection (if, if- else, nested if-else, cascaded if-else), switch statement, ternary operator? Goto, Loops (For, do- while, while) in C, break and continue, programming examples and exercises.	**9**	**CO1, CO2, CO3**
2	**Functions:** User defined functions-function definition, function declaration,function call, Formal and actual parameters, Categories of functions, Passing parameters to functions- Pass by value, Pass by reference, Recursion- types of recursion, programming example s and exercises. **Arrays and Strings:** Arrays: Classification of arrays, Storing value in arrays, Using arrays with Functions- passing individual elements of array, passing the whole array, Multidimensional arrays-addition and multiplication of matrices, **Searching and Sorting**-Linear search, Binary search, Bubble sort, String: Declaring, Initializing, Printing and reading strings, String input and output functions, String handling functions, Arrays of strings, programming examples and Exercises.	**9**	**CO2, CO3, CO5**
3	**Structures and File Management**: Basics of structures-structure data types, type definition, accessing structures, Structure operations, Complex structures-nested structures, structures containing arrays, Array of structures, Structures and Functions, **File Management:** Creating a file, Declaring file pointer variable, Modes of a file, Opening and closing the files, Input and output operations, Programming examples and exercises.	**9**	**CO3, CO4**
4	**Pointers:** Pointers concepts, Pointers and functions, Arrays and	**9**	**CO4,**

	pointers, address arithmetic, Character pointer and functions, Pointers to pointer, Dynamic allocations methods- malloc(), calloc(), realloc(),free(), Array of pointers, **Introduction to Data Structures:** Primitive and non-primitive data types, Definition and applications of Stacks, Queues, Linked Lists and Trees		**CO6**

Text Books:

1. "The C ProgrammingLanguage", BrianW. Kernighan and Dennis M. Ritchie, 2nd Edition, PHI, 2012.
2. "Problem Solving with C ", Jacqueline Jones &Keith Harrow, 1stEdition, Pearson2011.
3. "Let Us C" , by Yashavant Kanetkar, 5th Edition, BPB

Reference Books:

1. "Computer Concepts and C Programming", Vikas Gupta, Dreamtech Press2013.
2. "Programming with C ", R. S. Bichkar, University Press,2012.
3. "Computer Programming in C ", V. Rajaraman, PHI, 2013.

Note for Examiner(s): Question paper will comprise three sections,

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3. Section-C will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on derivations, numerical and applications of the various topics covered therein.

Note for Students:

1. Section – A is compulsory and attempt/answer all the four questions carrying 12 marks in total.
2. Attempt/answer two questions each out of the Section – B and Section – C. All questions will carry 12 marks.

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-ES-108	**Course Name:** Basic Electronics Engineering	**L**	**T**	**P**	**C**
		2	**1**	**-**	**3**
Year and Semester	**1st Yr.** **2nd Semester**	**Contact hours per week:** (3Hrs) Exam: (3 Hrs)			
Pre-requisite of course	EI-BS-101, Physics-I First Semester, Introduction to Solid State Physics	**Evaluation**			
		CIE: 40		**SEE: 60**	
Course Objectives:					
1. To impart the basic concepts of Semi-Conductor Electronics.					
2. To lay the foundation to understand the various semi-conductor devices.					

3. To impart the basic concept of design and study of various circuits in Electronics.	
4. To lay the foundation for the advance courses in electronics.	
Course Outcomes: On completion of the course, student would be able to:	
CO1	Understand the principles of semiconductor Physics and foundation of various semi-conductor devices.
CO2	Understand transistors as an amplifier and as a switch and various design parameter of an amplifier.
CO3	Know the concept of feedback in amplifier and oscillator and design of different oscillator.
CO4	Understand the constructional geometry of FET family and FET amplifier circuit with a view towards reduced power consumption.

Module No	COURSE SYLLABUS CONTENTS OF MODULE	Hrs	COs
1	Semiconductors p-type and n-type, pn junction diodes and energy band structure, pn junction as a circuit element and its characteristics, half wave and full wave rectifier circuits, basic filter circuits, clipper & clamper circuit. Zener diode and its applications as a voltage regulator. LED its characteristics construction & applications.	**6**	**CO1**
2	Transistor PNP and NPN- its fabrication and Characteristics in different configurations. Biasing in transistors, Concept of d.c. and a.c. load line and operating point selection. Transistor action as an amplifier and as a switch, Various amplifiers configurations, Design of amplifier and determination of parameters voltage gain current gain input resistance and output resistance & power gain.	**6**	**CO2**
3	Concept and need of feedback in amplifiers, Types of feedback in amplifiers, their effect on the amplifier parameters with their advantages and disadvantages, Cascading in amplifiers, Frequency response of RC Coupled amplifiers with explanation, Oscillators circuits and their types with explanation on their design difference, Multivibrators and their types, design and their applications.	**6**	**CO2** **CO3**
4	Field Effect Transistors, Constructions and their types, Characteristics of JFET, MOSFET their types and Various amplifier configurations using FET. Characteristics and Construction of SCR, TRIAC, UJT and their basic areas applications.	**6**	**CO4**

Reference Books:

1. Electronic Devices & Circuits - Boylstad & Nashelsky.
2. Integrated Electronics By Millman & Halkias.
3. Electronic Principles – Malvino
4. Principles of Electronics – V.K. Mehta, Shalu Melta.
5. Electronic Circuits – Donald L. Shilling & Charles Belowl

Note for Examiner(s): Question paper will comprise three sections,

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3. Section-C will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on derivations, numerical and applications of the various topics covered therein.

Note for Students:

1. Section – A is compulsory and attempt/answer all the four questions carrying 12 marks in total.
2. Attempt/answer two questions each out of the Section – B and Section – C. All questions will carry 12 marks.

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-MC-112	**Course Name:** Environmental Science	**L**	**T**	**P**	**C**
		3	**0**	**-**	**-**
Year and Semester	**1st Yr.** **2nd Semester**	**Contact hours per week:** (3Hrs) Exam: (3 Hrs)			
Pre-requisite of course	**NIL**	**Evaluation**			
		CIE: 40**	**SEE: 60****		

Course Objectives:
To study concepts from economic, political, and social analysis as they pertain to the design and evaluation of environmental policies and institutions.
Study concepts and methods from ecological and physical sciences and their application in environmental problem solving.
To study the ethical, cross-cultural, and historical context of environmental issues and the links between human and natural systems.
To introduce roles and identities of citizens in a complex and interconnected world.

Course Outcomes: On completion of the course, student would be able to:	
CO1	Understand key concepts from economic, political, and social analysis as they pertain to the design and evaluation of environmental policies and institutions.
CO2	Appreciate concepts and methods from ecological and physical sciences and their application in environmental problem solving.
CO3	Appreciate the ethical, cross-cultural, and historical context of environmental issues and the links between human and natural systems.
CO4	Reflect critically about their roles and identities as citizens, consumers and environmental actors in a complex, interconnected world.

Module No	**COURSE SYLLABUS CONTENTS OF MODULE**	**Hrs**	**Cos**
1	**The Multidisciplinary nature of environmental studies** Definition, scope and importance, Need for public awareness.	**3**	**CO1**
2	**Natural Renewable and non-renewable resources:** Natural resources and associated problems. a) Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on	**6**	**CO1 CO2 CO3 CO4**

	forests and tribal people. b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. c) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. d) Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies. e) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification. • Role of an individual in conservation of natural resources.		
3	**Ecosystems:** Concept of an ecosystem, Structure and function of an ecosystem, Producers, consumers and decomposers, Energy flow in the ecosystem, Ecological succession, Food chains, food webs and ecological pyramids,	**3**	**CO3**
4	**Biodiversity and its conservation:** • Introduction – Definition: genetic, species and ecosystem diversity. • Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values. • Hot-spots of biodiversity. • Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. • Endangered and endemic species of India. • Conservation of biodiversity: in-situ and ex-situ conservation of biodiversity.	**4**	**CO4** **CO2**
5	**Environmental Pollution** Definition • Causes, effects and control measures of: Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards • Solid waste Management: Causes, effects and control measures of urban and industrial wastes. • Role of an individual in prevention of pollution. • Disaster management	**5**	**CO1** **CO2** **CO3** **CO4**
6	**Social Issues and the Environment** • From Unsustainable to Sustainable development • Urban problems related to energy • Water conservation, rain water harvesting, watershed management • Resettlement and rehabilitation of people; its problems and concerns. Case studies. • Environmental ethics: Issues and possible solutions. • Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case studies. • Wasteland reclamation. • Consumerism and waste products. • Environment Protection Act.	**5**	**CO1** **CO2** **CO3** **CO4**

	• Air (Prevention and Control of Pollution) Act. • Water (Prevention and Control of Pollution) Act • Wildlife Protection Act • Forest Conservation Act • Issues involved in enforcement of environmental legislation • Public awareness.		
7	**Human Population and the Environment** • Population growth, variation among nations • Population explosion – Family Welfare Programme • Environment and human health. • Human Rights. • Value Education. • HIV/AIDS • Women and Child Welfare.		
8	**Field Work:** • Visit to a local area to document environmental assets-river / forest / grassland / hill / mountain. • Visit to a local polluted site–Urban/Rural / Industrial / Agricultural. • Study of common plants, insects, birds. • Study of simple ecosystems – pond, river, hill slopes, etc.		

Note for Examiner(s): Question paper will comprise three sections,

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3. Section-C will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on derivations, numerical and applications of the various topics covered therein.

Note for Students:

1. Section – A is compulsory and attempt/answer all the four questions carrying 12 marks in total.
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Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-PRBS-02	**Course Name:** Chemistry Lab	**L**	**T**	**P**	**C**
		-	**-**	**3**	**1.5**
Year and Semester	**1st Yr.** **2nd Semester**	**Contact hours per week:** (3Hrs) Exam: (3 Hrs)			
Pre-requisite of course	**NIL**	**Evaluation**			
		CIE: 30	**SEE: 45**		
Course Objectives:					

To teach the fundamentals of basic chemical sciences with hand on experience essential for the development of new technologies to Electrical and Instrumentation engineering.	
Course Outcomes: On completion of the course, student would be able to:	
CO1	Measuremolecular/system properties such as surfacetension,viscosity, conductance and pH of solutions, alkalinity, chloride content, dissolved oxygen, hardness of water,etc.
CO2	Identify the number of compounds in a mixture using TLC.
CO3	Synthesize a small drug molecule and polymer resin.
CO4	Determine the amount of solute in a solution using spectrophotometers.
CO5	Measure the kinematic viscosity, pour and cloud point of oil.

Expt. No	COURSE SYLLABUS CONTENTS OF MODULE	COs
1	To determine the relative viscosity of a given liquid using Ostwald viscometer.	**CO1, CO2, CO3, CO4, CO5**
2	Using Redwood viscometer determine the viscosity of an oil sample.	
3	To determine the surface tension of a giving liquid using stalagmometer.	
4	To determine the alkalinity of a given water sample.	
5	To identify the number of components, present in a given organic mixture by Thin Layer Chromatography (TLC).	
6	Determination of strength of a given HCl solution by titrating it with a standardized NaOH solution using conductivity meter.	
7	To determine the strength of a given acid solution by titrating it with a base using pH meter.	
8	Synthesis of a drug (Aspirin/Paracetamol).	
9	To prepare Phenol-formaldehyde and Urea formaldehyde resin.	
10	Determination of chloride content of a given water sample.	
11	To determine temporary and permanent hardness of a given water sample by EDTA method.	
12	Determination of the partition coefficient of a substance for its distribution between two immiscible solvents.	
13	To find out the content of sodium and potassium in a given salt solution by Flame Photometer.	
14	To verify Beer-Lambert law and determine the □max and concentration of unknown solution of KMnO4 using a spectrophotometer.	
15	To determine the amount of dissolved oxygen present in a given water sample.	
16	To find out the pour point and cloud point of a lubricating oil.	

SUGGESTED BOOKS:

1. A Text Book on Experimental and Calculation – Engineering Chemistry, S.S. Dara, S. Chand & Company (Ltd.)
2. Essential of Experimental Engineering Chemistry, Shashi Chawla, Dhanpat Rai Publishing Company.
3. Theory & Practice Applied Chemistry – O.P. Virmani, A.K. Narula (New Age)

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-PRES-04	**Course Name:** Computer Programming Lab	**L**	**T**	**P**	**C**
		0	**0**	**3**	**1.5**
Year and Semester	**1st Year** **IInd Semester**	**Contact hours per week:** (3Hrs) **Exam:** (3hrs.)			
Pre-requisite of course	**NIL**	**Evaluation**			
		CIE: 30		**SEE: 45**	

Course Objectives:
1. To write C programs to solve the problems
2. To compile and execute programs in C
3. To identify the syntax errors and semantic errors
4. To debug the program in C
5. To write C programs to solve the problems

Course Outcomes: On completion of the course, student would be able to:	
CO1	Use flowcharts to solve computational problems.
CO2	Create and develop algorithms with arithmetic and logical operators.
CO3	Analyse and implement an algorithm with data types, decision structures, loops, arrays, strings and functions.
CO4	Design and develop algorithms using predefined or user-defined functions to solve problems on sorting, searching and file processing.

Expt. No	**COURSE SYLLABUS** **CONTENTS OF MODULE**	**COs**
1	Write a C program to compute roots of quadratic equation $ax^2+bx+c=0$, where *a, b,* and *c* are three coefficients of a quadratic equation are inputs.	**CO1, CO2, CO3, CO4**
2	Design and develop an algorithm to find the *reverse* of an integer number.	
3	Design and develop an algorithm to check whether given number is PALINDROME or NOT, Implement a C program for the developed algorithm that takes an integer number as input and output the reverse of the same with suitable messages. Ex: Num: 2019, Reverse: 9102, Not a Palindrome.	
4	Design and develop a c program to implement simple calculator using switch case statement.	
5	Draw the flowchart and Write a C Program to compute Sin(x) using Taylor series approximation given by Sin(x) = x - (x^3/3!) + (x^5/5!) - (x^7/7!) + …….	
6	Develop, implement and execute a C program to search a Number in a list using *linear searching* Technique.	
7	Develop an algorithm, implement and execute a C program that reads *N* integer numbers and arrange them in ascending order using *Bubble Sort*.	
8	Design and develop a C program to read and print a matrix and check whether a given Matrix is a sparse Matrix or not.	
9	Write and execute a C program to display Pascal Triangle using for loop.	
10	Write a C program to implements the following string manipulation functions till the use wishes to continue (infinite loop): (i) *strcpy*() (ii) srrlen() (iii) strrev () (iv) strcmp() (v) strcat(). Read a sentence and print frequency of vowels and total count of consonants.	
11	Design and develop a C function *RightRotate (x, n)* that takes two integers *x*	

	and *n* as input and returns value of the integer *x* rotated to the right by *n* positions. Assume the integers are unsigned.	
12	Draw the flowchart and write a *recursive* C function to find the factorial of a number, *n*!, define by *fact*(*n*)=1, if *n*=0. Otherwise *fact* (*n*) =*n***fact* (*n*-1). Using this function, write a C program to compute the binomial coefficient ${}^{n}C_{r}$. Tabulate the results for different values of *n* and *r* with suitable messages	
13	Given two university information files such as "studentname.txt" and "usn.txt" that contains students Name and USN respectively. Write a C program to create a new file called "output.txt" and copy the content of files "studentname.txt" and "usn.txt" into output file in the sequence shown below. Display the contents of output file "output.txt" on to the screen. Student Name USN Name 1 USN1 Name 2 USN2…. ….	
14	**a.** Write a C program to maintain a record of n student details using an array of structures with four fields (Roll number, Name, Marks, and Grade). Assume appropriate data type for each field. Input & Print the members of the structure **b.** Write a C program to take 2 structures HH:MM: SS as T1 & T2 & display the time difference as structure as T3.	
15	Write a C program using pointers to compute the sum, mean and standard deviation of all elements stored in an array of n real numbers.	

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-PRES-06	**Course Name:** Basic Electronic Lab.	**L**	**T**	**P**	**C**
		-	**-**	**2**	**1**
Year and Semester	**1st Yr.** **2nd Semester**	**Contact hours per week:** (2Hrs) Exam: (3 Hrs)			
Pre-requisite of course	**NIL**	**Evaluation**			
		CIE: 20		**SEE: 30**	

Course Objectives:	
1. Ability to identify the basic electronic components.	
2. Ability to work on the basic electronic equipments.	
3. Ability to get the electronic circuit concepts.	
4. Ability to design the basic circuit in electronics.	
Course Outcomes: On completion of the course, student would be able to:	
CO1	Well verse with the use of the electronic components and equipments.
CO2	Well verse with the fundamentals and the parameters of components related to their fabrication and construction.
CO3	Able to start with the basic design concepts circuits operations.

Expt. No	**COURSE SYLLABUS** **CONTENTS OF MODULE**	**COs**
1	Familiarization of the basic electronic components and electronic lab equipment's like Functional Generators, CRO, Power supplies, multimeters etc.	

2	Draw and study the forward and reverse characteristics of the PN Diode.	**CO1, CO2, CO3**
3	To draw and study the clipping circuits in various modes.	
4	To draw and study the clamping circuits in positive and negative mode.	
5	To draw and study the differentiating and integrating circuits.	
6	To draw and study the low pass and high pass filters.	
7	To design and study the half and full wave rectifier	
8	To design and study the effect of various filter circuits on rectifiers performance.	
9	To study the characteristics of pnp and npn transistors in CE mode and determine h parameters from characteristics.	
10	To study the characteristics of pnp and npn transistors in CB mode and determine h parameters from characteristics.	
11	To design and study the RC coupled CE amplifier and measure its voltage and current gain.	
12	To design and study Hartley oscillator.	
13	To design and study Phase shift oscillator.	
14	To measure the effect of negative feedback on amplifier in RC coupled current series mode.	

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-PRES-08	**Course Name:** Workshop Practice Lab	**L**	**T**	**P**	**C**
		-	**-**	**2**	**1**
Year and Semester	**1st Yr.** **2nd Semester**	**Contact hours per week:** (2Hrs) Exam: (3 Hrs)			
Pre-requisite of course	**NIL**	**Evaluation**			
		CIE: 20	**SEE: 30**		

Course Objectives:

1. Upon completion of this course, the students will gain knowledge of the different manufacturing processes which are commonly employed in the industry, to fabricate components using different materials.
2. Upon completion of this laboratory course, students will be able to fabricate components with their own hands.
3. They will also get practical knowledge of the dimensional accuracies and dimensional tolerances possible with different manufacturing processes.
4. By assembling different components, they will be able to produce small devices of their interest.

Course Outcomes: On completion of the course, student would be able to:

CO1	To provide the basics of manufacturing processes
CO2	To provide working knowledge of lathe machines
CO3	To provide the study of measuring tools
CO4	To study the machine tools

Expt. No	COURSE SYLLABUS CONTENTS OF MODULE	COs
1	**Lectures & videos: Detailed contents** **(i.)** Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods **(2 lectures)** **(ii.)** CNC machining, Additive manufacturing **(1lecture)** **(iii.)** Fitting operations & power tools **(1lecture)** **(iv.)** Plastic molding, glass cutting **(1lecture)** **(v.)** Metal casting **(1lecture)** **(vi.)** Welding (arc welding & gas welding), brazing **(1 lecture)**	**CO1, CO2, CO3, CO4**
2	To study different types of measuring tools used in metrology and determine least counts of Vernier calipers, micrometers and Vernier height gauges.	
3	To study different types of machine tools (lathe, shape or planer or slotter, milling, drilling machines)	
4	To prepare a job on a lathe involving facing, outside turning, taper turning, step turning, radius making and parting-off.	
5	To study different types of fitting tools and marking tools used in fitting practice.	
6	To prepare lay out on a metal sheet by making and prepare rectangular tray, pipe shaped components e.g. funnel.	
7	To prepare joints for welding suitable for butt welding and lap welding.	
8	To perform pipe welding.	
9	To study various types of carpentry tools and prepare simple types of at least two wooden joints.	
10	To prepare simple engineering components/ shapes by forging.	
11	To prepare mold and core assembly, to put metal in the mold and fettle the casting.	
12	To prepare horizontal surface/ vertical surface/ curved surface/ slots or V-grooves on a shaper/ planner.	
13	To prepare a job involving side and face milling on a milling machine.	

Text Books:

1. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements of Workshop Technology", Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited,Mumbai.
2. Kalpakjian S. And Steven S. Schmid, "Manufacturing Engineering and Technology", 4th edition, Pearson Education India Edition,2002.
3. Gowri P. Hariharan and A. Suresh Babu," Manufacturing Technology – I" Pearson Education,2008.
4. Roy A. Lindberg, "Processes and Materials of Manufacture", 4thedition, Prentice Hall India,1998.
5. Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata McGrawHill House, 2017.

Appendix –I

Detailed first year curriculum contents

Guide to Induction Program

1. Introduction

(Induction Program was discussed and approved for all colleges by AICTE in March 2017. It was discussed and accepted by the Council of IITs for all IITs in August 2016. It was originally proposed by a Committee of IIT Directors and accepted at the meeting of all IIT Directors in March 2016.[1]This guide has been prepared based on the Report of the Committee of IIT Directors and the experience gained through its pilot implementation in July 2016 as accepted by the Council of IITs. Purpose of this document is to help institutions in understanding the spirit of the accepted Induction Program and implementing it.)

Engineering colleges were established to train graduates well in the branch/department of admission, have a holistic outlook, and have a desire to work formational needs and beyond.

The graduating student must have knowledge and skills in the area of his study. However, he must also have broad understanding of society and relationships. Character needs to be nurtured as an essential quality by which he would understand and fulfill his responsibility as an engineer, a citizen and a human being. Besides the above, several meta-skills and underlying values are needed.

There is a mad rush for engineering today, without the student determining for himself his interests and his goals. This is a major factor in the current state of demotivation towards studies that exists among UG students.

The success of gaining admission into a desired institution but failure in getting the desired branch, with peer pressure generating its own problems, leads to a peer environment that is demotivating and corrosive. Start of hostel life without close parental supervision at the same time, further worsens it with also a poor daily routine.

To come out of this situation, a multi-pronged approach is needed. One will have to work closely with the newly joined students in making them feel comfortable, allow them to explore their academic interests and activities, reduce competition and make them work for excellence, promote bonding within them, build relations between teachers and students, give a broader view of life, and build character.

2. Induction Program

When new students enter an institution, they come with diverse thoughts, backgrounds and preparations. It is important to help them adjust to the new environment and inculcate in them the ethos of the institution with a sense of larger purpose. Precious little is done by most of the institutions, except for an orientation program lasting a couple of days.

[1]A Committee of IIT Directors was setup in the 152nd Meeting of IIT Directors on 6th September 2015 at IIT Patna, on how to motivate undergraduate students at IITs towards studies, and to develop verbal ability. The Committee submitted its report on 19th January 2016. It was considered at the 153rd Meeting of all IIT Directors at IIT Mandi on 26 March 2016, and the accepted report came out on 31 March 2016. The Induction Program was an important recommendation, and its pilot was implemented by three IITs, namely, IIT(BHU), IIT Mandi and IIT Patna in July 2016. At the 50th meeting of the Council of IITs on 23 August 2016, recommendation on the Induction Program and the report of its pilot implementation were discussed and the program was accepted for all IITs.

We propose a 3-week long induction program for the UG students entering the institution, right at the start. Normal classes start only after the induction program is over. Its purpose is to make the students feel comfortable in the in new environment, open them up, set a healthy daily routine, create bonding in the batch as well as between faculty and students, develop awareness, sensitivity and understanding of the self, people around them, society at large, and nature.[2]

The time during the Induction Program is also used to rectify some critical lacunas, for example, English background, for those students who have deficiency in it. The following are the activities under the induction program in which the student would be fully engaged throughout the day for the entire duration of the program.

(i) IIT Gandhinagar was the first IIT to recognize and implement a special 5-week Foundation Program for the incoming 1st year UG students. It took a bold step that the normal classes would start only after the five week period. It involved activities such as games, art, etc., and also science and other creative workshops and lectures by resource persons from outside.

(ii) IIIT Hyderabad was the first one to implement a compulsory course on Human Values. Under it, classes were held by faculty through discussions in small groups of students, rather than in lecture mode. Moreover, faculty from all departments got involved in conducting the group discussions under the course. The content is non-sectarian, and the mode is dialogical rather than sermonizing or lecturing. Faculty were trained beforehand, to conduct these discussions and to guide students on issues of life.

(iii) Counselling at some of the IITs involves setting up mentor-mentee network under which 1st year students would be divided into small groups, each assigned a senior student as a student guide, and a faculty member as a mentor. Thus, a new student gets connected to a faculty member as well as a senior student, to whom he/she could go to incase of any difficulty whether psychological, financial, academic, or otherwise.

The Induction Program defined here amalgamates all the three into an integrated whole, which leads to its high effectiveness in terms of building physical activity, creativity, bonding, and character. It develops sensitivity towards self and one's relationships, builds awareness about others and society beyond the individual, and also in bonding with their own batch-mates and a senior student besides a faculty member. Scaling up the above amalgamation to an intake batch of 1000 plus students was done at IIT(BHU), Varanasi starting from July 2016.

Physical Activity

This would involve a daily routine of physical activity with games and sports. It would start with all students coming to the field at 6 am for light physical exercise or yoga. There would also be games in the evening or at other suitable times according to the local climate. These would help develop teamwork. Each student should pick one game and learn it for three weeks. There could also be gardening or other suitably designed activity where labour yields fruits from nature.

Creative Arts

Every student would choose one skill related to the arts whether visual arts or performing arts.

[2]Induction Program as described here borrows from three programs running earlier at different institutions: (1) Foundation Program running at IIT Gadhinagar since July 2011, (2) Human Values course running at IIIT Hyderabad since July 2005, and (3) Counselling Service or mentorship running at several IITs for many decades. Contribution of each one is described next.

Examples are painting, sculpture, pottery, music, dance etc. The student would pursue it every day for the duration of the program. These would allow for creative expression. It would develop a sense of aesthetics and also enhance creativity which would, hopefully, flow into engineering design later.

Universal Human Values

It gets the student to explore oneself and allows one to experience the joy of learning, stand up to peer pressure, take decisions with courage, be aware of relationships with colleagues and supporting staff in the hostel and department, be sensitive to others, etc. Need for character building has been underlined earlier. A module in Universal Human Values provides the base.

Methodology of teaching this content is extremely important. It must not be through do's and dont's, but get students to explore and think by engaging the mini dialogue. It is best taught through group discussions and real life activities rather than lecturing. The role of group discussions, however, with clarity of thought of the teachers cannot be over emphasized. It is essential for giving exposure, guiding thoughts, and realizing values.

The teachers must come from all the departments rather than only one department like HSS or from outside of the Institute. Experiments in this direction at IIT (BHU) are noteworthy and one can learn from them.[3]

Discussions would be conducted in small groups of about 20 students with a faculty men to reach. It is too pen thinking towards these. If, Universal Human Values discussions could even continue for rest of the semester as a normal course, and not stop with the induction program.

Besides drawing the attention of the student to larger issues of life, it would build relationships between teachers and students which last for their entire4-year stay and possibly beyond.

Literary

Literary activity would encompass reading, writing and possibly, debating, enacting a play etc.

Proficiency Modules

This period can be used to overcome some critical lacunas that students might have, for example, English, computer familiarity etc. These should run like crash courses, so that when normal courses start after the induction program, the student has overcome the lacunas substantially. We hope that problems arising due to lack of English skills, wherein students start lagging behind or failing in several subjects, for no fault of theirs, would, hopefully, become a thing of the past.

Lectures by Eminent People

This period can be utilized for lectures by eminent people, say, once a week. It would give the students exposure to people who are socially active or in public life.

Visits to Local Area

A couple of visits to the landmarks of the city, or a hospital or orphanage could be organized.

[3]The Universal Human Values Course is a result of along series of experiments at educational institutes starting from IIT-Delhi and IIT Kanpur in the 1980s and 1990s as an elective course, NIT Raipur in late 1990s as a compulsory one-week off campus program. The courses at IIT (BHU) which started from July 2014, are taken and developed from two compulsory courses at IIIT Hyderabad first introduced in July 2005.

This would familiarize them with the area as well as expose them to the under privileged.

Familiarization to Dept./Branch &Innovations

The students should be told about different method of study compared to coaching that is needed at IITs. They should be told about what getting into a branch or department means what role it plays in society, through its technology. They should also be shown the laboratories, workshops & other facilities.

3. Schedule

The activities during the Induction Program would have an Initial Phase, a Regular Phase and a Closing Phase. The Initial and Closing Phases would be two days each.

3.1 Initial Phase

Time	Activity
Day 0 Whole day	Students arrive - Hostel allotment. (Preferably do pre-allotment)
Day 1 *09:00am-03:00pm*	*Academic registration*
04:30 pm -06:00pm	Orientation
Day 2 09:00 am - 10:00 am	Diagnostic test (for English etc.)
10:15 am - 12:25 pm	Visit to respective depts.
12:30 pm - 01:55 pm	Lunch
02:00 pm - 02:55 pm	Director's address
03:00 pm - 03:30 pm	Interaction with parents
03:30 pm - 05:00 pm	Mentor-mentee groups - Introduction within group. (Same as Universal Human Values groups)

3.2 Regular Phase

After two days is the start of the Regular Phase of induction. With this phase there would be regular program to be followed everyday.

3.2.1 Daily Schedule

Some of the activities are on a daily basis, while some others are at specified periods within the Induction Program. We first show a typical daily timetable.

	Sessn. Time	***Activity***	***Remarks***
	Day 3 onwards		
	06:00am	Wake up call	
I	06:30 am -07:10am	Physical activity (mild exercise/yoga)	
	07:15am-08:55am	***Bath, Breakfast, etc.***	
II	09:00 am -10:55am	Creative Arts /Universal Human Value	Half the groups do Creative Arts
III	11:00 am -12:55pm	Universal Human Values /Creative Arts	Complementary alternate
	01:00pm-02:25pm	***Lunch***	
IV	02:30 pm - 03:55 pm	Afternoon Session	See below.

V	04:00 pm - 05:00 pm	Afternoon Session	See below.
	05:00 pm - 05:25 pm	***Break / light tea***	
VI	05:30 pm - 06:45 pm	Games / Special Lectures	
	06:50 pm - 08:25 pm	*Rest and Dinner*	
VII	08:30 pm - 09:25 pm	Informal interactions (in hostels)	

Sundays are off. Saturdays have the same schedule as above or have outings.

3.2.2 Afternoon Activities(Non-Daily)

The following five activities are scheduled at different times of the Induction Program, and are not held daily for everyone:

1. Familiarization to Dept./Branch & Innovations
2. Visits to Local Area
3. Lectures by Eminent People
4. Literary
5. Proficiency Modules

Here is the approximate activity schedule for the afternoons (may be changed to suit local needs):

Activity	***Session***	***Remarks***
Familiarization with Dept./Branch & Innovations	**IV**	For 3 days (Day 3 to 5)
Visits to Local Area	**IV, V and VI**	For 3 days - interspersed (e.g. 3 Saturdays)
Lectures by Eminent People	**IV**	As scheduled - 3-5 lectures
Literary (Play/Book Reading / Lecture)	**IV**	For 3-5days
Proficiency Modules	**V**	Daily, but only for those who need it

3.3 Closing Phase

Time	***Activity***
Last But One Day	
08:30 am -12noon	Discussions and finalization of presentation within each group
02:00 am -05:00pm	Presentation by each group in front of 4 other groups besides their own (about 100 students)
Last Day	
Whole day	Examinations (if any). May be expanded to last 2 days, in case needed.

3.4 Follow Up after Closure

A question comes up as to what would be the follow up program after the formal 3-week Induction Program is over? The groups which are formed should function as mentor- mentee network. A student should feel free to approach his faculty mentor or the student guide, when facing any kind of problem, whether academic or financial or psychological etc.(For every 10 undergraduate first year students, there would be a senior student as a *student guide*, and for every 20 students, there would be a *faculty mentor*.) Such a group should remain for the entire 4-5

year duration of the stay of the student. Therefore, it would be good to have groups with the students as well as teachers from the same department/discipline[4].

Here we list some important suggestions which have come up and which have been experimented with.

3.4.1 Follow Up after Closure – Same Semester

It is suggested that the groups meet with their faculty mentors once a month, within the semester after the 3-week Induction Program is over. This should be a scheduled meeting shown in the timetable. (The groups are of course free to meet together on their own more often, for the student groups to be invited to their faculty mentor's home for dinner or tea, nature walk, etc.)

3.4.2 Follow Up – Subsequent Semesters

It is extremely important that continuity be maintained in subsequent semesters. It is suggested that at the start of the subsequent semesters (upto fourth semester), three days be set aside for three full days of activities related to follow up to Induction Program. The students be shown inspiring films, do collective artwork, and group discussions be conducted. Subsequently, the groups should meet at least once a month.

4. Summary

Engineering institutions were setup to generate well trained man power in engineering with a feeling of responsibility towards oneself, one's family, and society. The incoming undergraduate students are driven by their parents and society to join engineering without understanding their own interests and talents. As a result, most students fail to link up with the goals of their own institution.

The graduating student must have values as a human being, and knowledge and meta-skills related to his/her profession as an engineer and as a citizen. Most students who get demotivated to study engineering or their branch, also lose interest in learning.

The *Induction Program* is designed to make the newly joined students feel comfortable, sensitize them towards exploring their academic interests and activities, reducing competition and making them work for excellence, promote bonding within them, build relations between teachers and students, give a broader view of life, and building of character.

The *Universal Human Values* component, which acts as an anchor, develops awareness and sensitivity, feeling of equality, compassion and oneness, draw attention to society and nature, and character to follow through. It also makes them reflect on their relationship with their families and extended family in the college (with hostel staff and others).It also connects students with each other and with teachers so that they can share any difficulty they might be facing and seek help.

[4]We are aware that there are advantages in mixing the students from different depts. However, in mixing, it is our experience that the continuity of the group together with the faculty mentor breaks down soon after. Therefore, the groups be from the same dept. but hostel wings have the mixed students from different depts. For example, the hostel room allotment should be in alphabetical order irrespective of dept.

References:

1. *Motivating UG Students Towards Studies*, Rajeev Sangal, IITBHU Varanasi, Gautam Biswas, IIT Guwahati, Timothy Gonsalves, IIT Mandi, Pushpak Bhattacharya, IIT Patna, (Committee of IIT Directors), 31 March 2016, IIT Directors' Secretariat, IIT Delhi.

Contact: *Prof. Rajeev Sangal,* Director, IIT(BHU), Varanasi (director@iitbhu.ac.in)

B. Tech Electrical and Instrumentation Engineering
SYLLABI for EXAMINATIONS

B. Tech. 2nd YEAR

Course Code: EI-PC-201	**Course Name:** Power Systems-I	**L**	**T**	**P**	**C**
		2	**1**	**-**	**3**
Year and Semester	**2nd year** **IIIrd Semester**	**Contact hours per week:** (3Hrs) **Exam:** (3hrs.)			
Pre-requisite of course	**Basic Electrical Engineering**	**Evaluation**			
		CIE: 40	**SEE: 60**		

Course Objectives:	
1.To introduce and study the basic concept, layout and structure of power system.	
2.To study types of transmission line and type of line conductors.	
3.To study the role of insulators and towers in transmission lines.	
4.To study the various parameters of transmission lines and its performance.	
Course Outcomes: On completion of the course, student would be able to:	
CO1	To Familiarize with the basic concept, layout and structure of power system.
CO2	To understand basics of transmission line and transmission line conductors.
CO3	To understand the significance of insulators and towers in power system.
CO4	To understand the models of transmission line and analyze the various parameters of transmission lines and its performance.
CO5	To impart basic technical knowledge of power system and apply it to technological fields. To engage in independent and life – long learning in the technological change.

Module No	**COURSE SYLLABUS CONTENTS OF MODULE**	**Hrs**	**COs**
1	**GENERAL SUPPLY SYSTEMS:** Introduction to Power System, Per unit system, Layout of power supply network, System interconnection, Importance of electric power, Power system components, power supply network, effect of voltage on conductor size, comparison of conductor volume in typical supply systems, elementary high voltage DC transmission and its advantages & disadvantages. **Types of conductors:** Hard drawn copper conductors, AAC, AAAC, ACSR and bundled conductors, Resistance, Skin effect, Proximity Effect.	**7**	**CO1, CO2**
2	**INSULATORS**: Types of insulators, voltage distribution across suspension insulators, string efficiency, methods of improving string efficiency. **MECHANICAL DESIGN:** Line supports- Towers and Poles, Vibration of conductors, Effect of vibration on transmission lines, Prevention of vibration, Sag and tension–Various methods of sag and tension calculations, Loading on conductors and it affects, Span of equal and unequal lengths, Effect of ice and wind, dampers.	**7**	**CO1, CO3**
3	**TRANSMISSION-LINE PARAMETERS** Conductance and Inductance: Solid Cylindrical Conductor, Inductance: Single-Phase Two-Wire Line and Three-Phase Three-Wire Line with Equal Phase Spacing, Composite Conductors, Unequal Phase Spacing, Bundled Conductors, Series Impedances: Three-Phase Line with	**7**	**CO2, CO4, CO5**

	Neutral Conductors and Earth Return, Electric Field and Voltage: Solid Cylindrical Conductor Capacitance: Single-Phase Two-Wire Line and Three-Phase Three-Wire Line with Equal Phase Spacing, Stranded Conductors, Unequal Phase Spacing, Bundled Conductors		
4	**PERFORMANCE OF TRANSMISSION LINES:** models of short, medium and long transmission lines, Transmission-Line Differential Equations and detailed performance analysis of these lines including A B C D parameters, Ferranti effect, capacity of synchronous condenser, voltage control, Reactive Compensation Techniques.	**7**	**CO4, CO5**

Text/Refrence Books:

1. J. Grainger and W. D. Stevenson, "Power System Analysis", McGraw Hill Education, 1994.
2. O. I. Elgerd, "Electric Energy Systems Theory", McGraw Hill Education, 1995.
3. D. P. Kothari and I. J. Nagrath, "Modern Power System Analysis", McGraw Hill Education, 2003.
4. A. R. Bergen and V. Vittal, "Power System Analysis", Pearson Education Inc., 1999.
5. B. M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G. Strbac, "Electric Power Systems", Wiley, 2012.
6. W.D.Stevenson, "Elements of power system analysis", MGH.
7. B.M.Weedy , "Electric Power System", John Wiley & Sons.
8. Transmission & Distribution of Electrical Engineering: Westing House & Oxford Univ. Press, New Delhi.

Note for Examiner(s): Question paper will comprise three sections,

1. Section-A will be compulsory and comprise 4-short answer type questions uniformly spread to the entire syllabus.
2. Section-B will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on concepts, definitions, derivations, principles, construction and working etc.
3. Section-C will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on derivations, numerical and applications of the various topics covered therein.

Note for Students:

1. Section – A is compulsory and attempt/answer all the four questions carrying 12 marks in total.
2. Attempt/answer two questions each out of the Section – B and Section – C. All questions will carry 12 marks.

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-PC-203	**Course Name:** Basic Instrumentation Engineering	**L**	**T**	**P**	**C**
		2	**1**	**0**	**3**
Year and Semester	**2nd year** **3rd Semester**	**Contact hours per week:** (3Hrs) **Exam:** (3hrs.)			
Pre-requisite of course	**Physics, Mathematics**	**Evaluation**			
		CIE: 40	**SEE: 60**		
Course Objectives:					
1. Gaining factual knowledge that includes terminology, classifications and methods					
2. Learning fundamental principles, generalizations, or theories					

3. To introduce to the students the operation of various electronic Instruments which are used to measure the electronic parameters	
Course Outcomes: On completion of the course, student would be able to:	
CO1	Analyze the characteristics of each instrument
CO2	Define terms associated with instrumentation
CO3	Categorize various types of instruments
CO4	Explain various types of indicating and recording instruments
CO5	Apply the knowledge of various transducers to measure the physical quantities of shaft speed and acceleration
CO6	Apply the knowledge of to identify instrument for measuring quantities like Power, field strength, phase, Q factor

Module No	COURSE SYLLABUS CONTENTS OF MODULE	Hrs	COs
1	**Introduction:** Block diagram of measuring instruments, characteristics of instruments, classification of instruments, classification of standards, error in measurement, relative, systematic, random error, parabolic errors. Standards, True Value, Errors (Gross, Systematic, Random); Static Characteristic of Instruments (Accuracy, Precision, Sensitivity, Resolution & threshold).**Classification of Instruments**(Absolute & Secondary Instruments; Indicating, Recording & Integrating instruments; Based upon Principle of operation), Generalized Instrument (Block diagram, description of blocks).	**8**	**CO1, CO2, CO3**
2	**Indicating Instruments:**Three forces in Electromechanical indicating instrument, Comparison between gravity & spring controls; Comparison of damping methods & their suitability, bearing supports, pivot-less supports (Simple & taut-band), Scale information. **Recorders:** Strip chart recorders, galvanometric recorders, null type recorders, potentiometric recorders, X-Y recorders, ultraviolet recorders, magnetic tape recorders, FM recorders and their merits and demerits, pulse duration modulation (PDM) recorders & digital tape recorders (RB, RZ, NRZ-M and NRZ-C).	**6**	**CO1, CO4**
3	**Tachometers:** DC tachometers, AC tachometers, Bearing tachometers, magnetic speed sensors, impulse tachometers, stroboscopic tachometers, variable-reluctance tachometers, photoelectric tachometers, eddy current tachometers, hydraulic tachometers, vibration measurement. Accelerometers: Bonded strain gauge accelerometer, Piezoelectric accelerometer, seismic mass accelerometer, servo accelerometer and digital accelerometer.	**6**	**CO1, CO5**
4	**Potentiometers:** DC potentiometers, Basic potentiometer circuit, Compton type & multiple range potentiometer, constructional details & precision type potentiometers & their applications, AC potentiometer, Power meter, field strength meter, phase meter, vector impedance meter, Q meter, LCR bridge.	**6**	**CO1, CO6**

Reference Books:

1. Electronic Instrumentation ByH.S.Kalsi, TMH

2. Electronic Instrumentation Techniques By Cooper Halfrick, PHI

3. Electronic Instrumentation & Measurement By A. K.Sawhney, Dhanpat Rai& Sons
4. Electronic Instruments and Measurement By Jones & Chin
5. Principles of measurement &Instrumentation by Alan S. Morris
6. Electrical, Electronics measurement & Instrumentation, by JB Gupta

Note for Examiner(s): Question paper will comprise three sections,

1. Section-A will be compulsory and comprise 4-short answer type questions uniformly spread to the entire syllabus.
2. Section-B will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on concepts, definitions, derivations, principles, construction and working etc.
3. Section-C will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on derivations, numerical and applications of the various topics covered therein.

Note for Students:

1. Section – A is compulsory and attempt/answer all the four questions carrying 12 marks in total.
2. Attempt/answer two questions each out of the Section – B and Section – C. All questions will carry 12 marks.

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-PC-205	**Course Name:** Network Analysis	**L**	**T**	**P**	**C**
		2	**1**	**-**	**3**
Year and Semester	**2nd year 3rd Semester**	**Contact hours per week:** (3Hrs) **Exam:** (3hrs.)			
Pre-requisite of course	Basic Electrical Engineering	**Evaluation**			
		CIE: 40	**SEE: 60**		

Course Objectives:	
1. To introduce students with the fundamental concepts in graph theory	
2. To familiarize about transient response of different type of circuits.	
3. To explain concepts of network functions.	
4. To introduce open circuit, short circuit, transmission, hybrid parameters and their interrelationship.	
5. To understand and learn network filters	
6. To learn the synthesize of network using passive elements.	
Course Outcomes: On completion of the course, student would be able to:	
CO1	Understand the fundamental concepts of graph theory.
CO2	Understand and analyze the transient response of various type of circuits under different excitations.
CO3	Understand poles and zeroes of network functions and interpretations in terms of their stability.
CO4	Learn the various parameters and their interrelationship, able to solve numerical with series, cascade, and parallel connection using two port parameters.
CO5	Able to understand and solve problems related to low-pass, high–pass and band reject, constant K pass filters, m-derived
CO6	Understand and problem solving related to synthesization one port and two port networks.

Module No	COURSE SYLLABUS CONTENTS OF MODULE	Hrs	COs
1	**Topology:** Principles of network topology, Graph matrices, network analysis using graph theory. **Transient Response**: Transient response of RC, RLC, RL circuits to various excitation signals such as step, ramp, impulse and sinusoidal excitations using Laplace transform.	**6**	**CO1, CO2**
2	**Network Functions:** Terminal pairs or ports, network functions for one port and two port networks, pole and zeros of network functions, restrictions on pole and zero locations for driving point functions and transfer functions, time domain behaviour from pole – zero plots, stability criteria of active networks.	**6**	**CO3,**
3	**Two Port Networks:** Characteristics and parameters of two port networks, short circuit admittance parameters, open circuit impedance parameters, transmission parameters, hybrid parameters, relationship between parameter sets, interconnection of two port networks, T and π networks.	**5**	**CO4**
4	**Filter Networks:** Fundamentals of filters, network equations, and characteristic impedance of low-pass, high–pass and band reject, constant K pass filters, m-derived.	**5**	**CO5**
5	**Network Synthesis**: Herwitz polynomial, positive real functions, elementary idea of active networks and frequency	**4**	**CO6**

Text Books:

1. Networks and Systems, D. Roy Choudhary, Wiley Eastern Ltd.
2. Network Analysis: A Sudhakar and S P Shyammohan, TMH.
3. Network Analysis and Synthesis, CL Wadhwa, New Age International Publishers.
4. Circuit Theory, A. Chakrabarti, Dhanpat Rai& Co.

Reference Books:

1. An Introduction to Modern Network Synthesis, M E Van Valkenburg, Wiley Eastern Ltd.
2. Circuit Theory, T.S.K.V. Iyer, Tata McGraw Hill

Note for Examiner(s): Question paper will comprise three sections,

1. Section-A will be compulsory and comprise 4-short answer type questions uniformly spread to the entire syllabus.

2. Section-B will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on concepts, definitions, derivations, principles, construction and working etc.

3. Section-C will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on derivations, numerical and applications of the various topics covered therein.

Note for Students:

1. Section – A is compulsory and attempt/answer all the four questions carrying 12 marks in total.

2. Attempt/answer two questions each out of the Section – B and Section – C. All questions will carry 12 marks.

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-PC-207	**Course Name:** Transducers and Applications	**L**	**T**	**P**	**C**
		2	**1**	**-**	**3**
Year and Semester	**2nd year** **IIIrd Semester**	**Contact hours per week:** (3Hrs) **Exam:** (3hrs.)			
Pre-requisite of course	**Knowledge of Basic science, Basic Electrical Engineering**	**Evaluation**			
		CIE: 40	**SEE: 60**		

Course Objectives:

1. To study the basic concept and fundamental of sensors and transducers.
2. To study Basic principle of operation of strain gauge, piezoelectric sensors and its circuits.
3. To study the different types of transducers/sensors for the measurement of non-electrical quantities.

Course Outcomes: On completion of the course, student would be able to:

CO1	Able to understand the fundamental concepts of sensors and transducers.
CO2	Ability to analyze various electrical and non-electrical Sensors and Transducers by using their basic fundamental principles of mathematics and science.
CO3	Familiarize to use sensors and transducers for the measurements of various electrical and non-electrical parameters.
CO4	To impart technical knowledge of sensors and apply it to technological fields. To engage in independent and life – long learning in the technological change.

Module No	**COURSE SYLLABUS CONTENTS OF MODULE**	**Hrs**	**COs**
1	**Transducers:** Basic concepts of sensors and transducers and their classification, characteristics and choice of transducers, factors influencing the choice of transducers. Basic operating principle of resistance strain gauge, type of electrical strain gauges and their theories: wire gauges, unbounded strain gauges, foil gauges, semiconductor strain gauges and thin film gauges, Materials for strain gauges, strain gauge circuits.	**7**	**CO1, CO2**
2	**Displacement Transducers:**Resistive transducers, potentiometers, loading effect, construction of potentiometers. Variable inductance transducers, Linear Variable Differential Transformer (LVDT), Rotary Variable Differential Transformer (RVDT), Variable Reluctance, Variable Capacitive displacement Transducers and Hall Effect Transducers. Piezoelectric transducers: modes of operation of piezoelectric crystals, properties of piezoelectric crystals, equivalent circuit of piezoelectric transducers, loading effects and frequency response, impulse response of piezoelectric crystals.	**7**	**CO2, CO3, CO4**
3	**Force Transducers:** load Cell, Hydraulic Load Cell. **Pressure transducers:** Manometers, Elastic transducers, Mcloed Gauge, Pirani-gauge, Ionization gauge, **Temperature Transducers:** Resistance Temperature Detector, Thermistor, Thermocouple,Thermoelectric sensors, Pyrometers.	**7**	**CO2, CO3, CO4**
4	**Flow Transducers:** Classification of flow meter, Volume flow Sensors,Turbine type, Rotameters, Anemometers, Ultrasonic, Mass flow meters, Positive displacement type flow-meter, Open channel flow measurement, E.M. Flow-meter. **Level Transducers**: Thermal effect type, Electric methods, Ultrasonic	**7**	**CO2, CO3, CO4**

	method. **Acoustics sensors:** Ceramic microphones, capacitor microphones, electric microphones, magnetic microphone. **Humidity sensors**: Hair hygrometer, electrode hygrometer, moisture sensors.		

Text/References Books:

1. A. K.Sawhney, "A Course in Electrical and Electronics Measurement and Instrumentation,DhanpatRai & Co.
2. D.Patranabis, " Principles of Electronic Instrumentation,", PHI
3. D. Patranabis, "Sensors and Transducers", PHI.
4. D.A.Bell, "Electronic Instrumentation and Measurements", PHI.
5. Rangan, Sharma and Mani, "Instrumentation Devices and Systems", TMH.
6. Raman Pallas-Arency and J.G. Webster,"Sensors and Signal Conditioning", John Wiley & Sons.
7. Considine DM (ed),"Process Instruments and Controls Handbook", McGraw-Hill.
8. Jones B.E "Instrument Science & Technology", Adam Hilger.
9. Neubert H.K.P, "Instrument Transducers: An introduction to their performance and design", Oxford.
10. Norton H.N,"Sensors and Analyzer Handbook",Prentice Hall.
11. Usher M.J,"Sensors and Transducers", Macmillan.

Note for Examiner(s): Question paper will comprise three sections,

1. Section-A will be compulsory and comprise 4-short answer type questions uniformly spread to the entire syllabus.
2. Section-B will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on concepts, definitions, derivations, principles, construction and working etc.
3. Section-C will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on derivations, numerical and applications of the various topics covered therein.

Note for Students:

1. Section – A is compulsory and attempt/answer all the four questions carrying 12 marks in total.
2. Attempt/answer two questions each out of the Section – B and Section – C. All questions will carry 12 marks.

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code:	**Course Name: Open Elective-I**	**L**	**T**	**P**	**C**
EI-OE-209	(i) Linear Integrated Circuits	**2**	**1**	**0**	**3**
Year and Semester	**2nd year** **IIIrd Semester**	**Contact hours per week:** (3Hrs) Exam: (3 Hrs)			
Pre-requisite of course	EI-ES-108 Basic Electronics Engineering	**Evaluation**			
		CIE: 40	**SEE: 60**		

Course Objectives:
1. To impart the basic concepts of Analog Electronics.
2. To impart the basic concepts of one of the most widely used active components of analog electronics Operational Amplifier.
3. To design and study various circuits using active components mainly OpAmp.
4. To lay the foundation for the courses in electronics related to instrumentation.

Course Outcomes: On completion of the course, student would be able to:	
CO1	Understand the basic design of Operational amplifier and its parameters.
CO2	Understand the frequency response of Op-amp and various inverting and non-inverting Op amp based applications.
CO3	Understand the uses of opamp in Instrumentation.

Module No	**COURSE SYLLABUS** **CONTENTS OF MODULE**	**Hrs**	**COs**
1	Basics of Operational Amplifier (Op-Amp)--emitter coupled differential amplifier, transfer characteristics of differential amplifier, Block Diagram of Op-amp, Op- amp parameters : offset voltages and currents, input bias current, CMRR and measurement of Op-Amp parameters	**6**	**CO1**
2	Frequency and Phase Response in Opamp, Op-Amp Circuit Bandwidth. OpAmp applications: Inverting, Concept of virtual ground, Non-inverting, adder, analog integration and differentiation, wave form generators (square wave, pulse and triangle wave generator)	**6**	**CO2**
3	Op-Amp Applications II: Instrumentation Amplifier, Precision Half Wave Rectifier, Precision Full Wave Rectifier, limiting Circuits, Clamping Circuits, Peak Detectors, Sample & Hold Circuits, logarithmic Amplifier, Phase Shift Oscillator, Oscillator Amplitude Stabilization, Wien-Bridge Oscillator.	**6**	**CO2 CO3**
4	Regulated Power Supplies: Regulator Action, Regulator Performance, Voltage follower Regulator (Design & performance), Adjustable Voltage Regulator (Design & performance),Stabilization, Output Current limiting (Short circuit Protection) (Fold-back Current limiting), I.C. Regulators (Basic Idea). The 555 I.C. Timer, and its applications.	**6**	**CO2 CO3**

Reference Books:

1. Integrated Electronics by MillmanHalkias, McGraw Hill
2. Op-Amps & Linear Integrated Circuits by R.A.Gayakwad
3. Op-Amps & Linear Integrated Circuits by David A.Bell

Note for Examiner(s): Question paper will comprise three sections,

1. Section-A will be compulsory and comprise 4-short answer type questions uniformly spread to the entire syllabus.
2. Section-B will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on concepts, definitions, derivations, principles, construction and working etc.
3. Section-C will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on derivations, numerical and applications of the various topics covered therein.

Note for Students:

1. Section – A is compulsory and attempt/answer all the four questions carrying 12 marks in total.
2. Attempt/answer two questions each out of the Section – B and Section – C. All questions will carry 12 marks.

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-OE-209	**Course Name: Open Elective-I** **(ii)** Computer Networks	**L**	**T**	**P**	**C**
		2	**1**	**0**	**3**
Year and Semester	**2nd Year** **III rd Semester**	**Contact hours per week:** (3Hrs) Exam: (3 Hrs)			
Pre-requisite of course	The course does not assume prior knowledge of networking. However, Basic Computer Knowledge is desirable	**Evaluation**			
		CIE: 40	**SEE: 60**		

Course Objectives:

5. To explore the basics of computer networks
6. To know various computer network protocols.
7. To gain knowledge on fundamentals of network administration.
8. To explore how tomanage the flow of information. To provide good understanding of Internet and networking design aspects

Course Outcomes: On completion of the course, student would be able to:

CO1	To understand the fundamental of computer networks
CO2	To understand the models of UDP and TCP models.
CO3	To apply the TCP/IP and OSI models with merits and demerits.
CO4	Students should be able to use his knowledge to develop/design at LAN

Module No	**COURSE SYLLABUS** **CONTENTS OF MODULE**	**Hrs**	**COs**
1	**INTRODUCTION TO COMPUTER NETWORKS:** Components, Direction of Data flow Types of connections, topologies, protocols and standards of ISO/OSI model, TCP/IP Model. **PHYSICAL LAYER:**Transmission modes, Multiplexing, Transmission media, Switching, Circuit Switched Networks, Datagram Networks, Virtual Circuit Networks.	**7**	**CO1, CO2**
2	**DATA LINK LAYER:** Introduction, Framing, Error Detection and Correction-Parity-LRC-CRC Hamming code, flow and error control, Noiseless channels, Noisy Channels, HDLC, Point to Point Protocols. Medium Access Sub Layer: ALOHA, CSMA/CD, LAN-Ethernet IEEE802.5, IEEE 802.11, Random Access, Controlled Access, Channelization.	**5**	**CO2, CO3**
3	**NETWORK LAYER:** Logical Addressing, Internetworking, Tunneling, Address mapping, ICMP, IGMP, Forwarding, Unit-Cast Routing Protocols, Multicast Routing Protocols.	**5**	**CO2, CO3, CO5**
4	**TRANSPORT LAYER:** Process to Process Delivery, UDP and TCP protocols, Data traffic, congestion, congestion control, QoS in switched networks.	**5**	**CO3, CO4**
5	**APPLICATION LAYER:**Domain name space, DNS in Internet, Electronic Mail, SMPT, FTP, WWW, HTTP, SNMP	**5**	**CO4, CO6**

TEXT BOOKS

1. Computer Networking: A. Top-Down Approach Featuring the Internet, James F Kurose & Keith W. Ross. 3rd Edition Pearson Education.
2. Data Communications and Networking, Behrouz. A. Forouzan, Fourth Edition TMH, 2006.
3. Computer Networks, Andrew S Tanenbaum 4th Edition Pearson Education, PHI

REFERENCE BOOKS

1. Data Communication and Computer Networks, P.C. Gupta, PHI
2. An Engineering approach to Computer Networks, S. Keshav, 2nd Edition Pearson Education.
3. Understanding communications and Networks, 3rd edition, W.A. Shay, Cengage Learning.
4. Data and Computer Communication, William Stallings, 6th Edition, Pearson Education, 2000.

Note for Examiner(s): Question paper will comprise three sections,

4. Section-A will be compulsory and comprise 4-short answer type questions uniformly spread to the entire syllabus.
5. Section-B will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on concepts, definitions, derivations, principles, construction and working etc.
6. Section-C will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on derivations, numerical and applications of the various topics covered therein.

Note for Students:

3. Section – A is compulsory and attempt/answer all the four questions carrying 12 marks in total.
4. Attempt/answer two questions each out of the Section – B and Section – C. All questions will carry 12 marks.

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-HSM-211	**Course Name:** Basics of Industrial Sociology, Economics and Management	**L**	**T**	**P**	**C**
		2	**0**	**0**	**2**
Year and Semester	**2nd year III rd Semester**	**Contact hours per week:** (2Hrs) Exam: (3 Hrs)			
Pre-requisite of course	NIL	**Evaluation**			
		CIE: 40	**SEE: 60**		

Course Objectives:	
1. Acquire basic knowledge of social processes of society, social institutions and patterns of social behavior	
2. Acquire knowledge of economics to facilitate the process of economic decision making	
3. Acquire knowledge of basic management aspects	
4. Develop cognizance of the importance of management principles	
Course Outcomes: On completion of the course, student would be able to:	
CO1	Demonstrate knowledge of core sociological concepts
CO2	Evaluate the economic theories, cost concepts and pricing policies
CO3	Describe the role of economics in the decision making process
CO4	Demonstrate the roles, skills and functions of management

Module No	**COURSE SYLLABUS CONTENTS OF MODULE**	**Hrs**	**COs**
1	Meaning of social change, nature of social change, theories of social change. The causes of social change, the process of social change. Factors of social change - the technological factors, the cultural factors, the effect of technology on major social institutions, social relations in industry.	**6**	**CO1**
2	Introduction to Industrial Economic, production function and its type;	**10**	**CO2**

	least cost combination, law of variable proportion, law of return increasing, constant and diminishing. Fixed and variable costs in short run and long run, opportunity costs. Perfect competition – meaning and characteristics, Monopoly – meaning and characteristics, concept of equilibrium of a firm.		
3	Meaning of management, characteristics of management, Fayol's principles of management. Personnel management - meaning and functions, manpower – process of manpower planning, recruitment and selection – selection procedure. Training – Objectives and types of training, various methods of training. Marketing research – meaning, objectives. Purchasing management – meaning and objectives, purchase procedure, inventory control techniques. Financial management- Introduction, objectives of financial decision.	**10**	**CO3, CO4**

TEXT BOOKS

1. An introduction to Sociology by D.R.Sachdeva and VidyaBhusan,
2. Society- An introductory Analysis by R.N.MaclverCharls H. Page
3. Microeconomics- Theory and Applications by D. N. Dwivedi, Vikas Publishing House
4. Modern Economics Theory by K.K.Dewett, S.Chand and Co.
5. Economic Analysis by K.P.Sundharam and E.N.Sundharam, Sultan Chand & Sons
6. Micro Economic Theory by M.L.Jhingam, Konark Publishers Pvt. Ltd.
7. Principle of Economics by M.L. Seth, LakshamiNarain Aggarwal Educ. Pub.- Agra
8. Principle & Practices of Management by R.S.Gupta, B.D.Sharma, N.S.Bhalla, Kalyani Pub.
9. Organization and Management by R.D.Aggarwal TMH
10. Business Organization and Management by N.C.Shukla.

Note for Examiner(s): Question paper will comprise three sections,

1. Section-A will be compulsory and comprise 4-short answer type questions uniformly spread to the entire syllabus.
2. Section-B will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on concepts, definitions, derivations, principles, construction and working etc.
3. Section-C will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on derivations, numerical and applications of the various topics covered therein.

Note for Students:

1. Section – A is compulsory and attempt/answer all the four questions carrying 12 marks in total.
2. Attempt/answer two questions each out of the Section – B and Section – C. All questions will carry 12 marks.

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-PRPC-09	**Course Name:** Network Analysis Lab	**L**	**T**	**P**	**C**
		0	**0**	**2**	**1**
Year and Semester	**2nd Year III rd Semester**	**Contact hours per week:** (2 Hrs) **Exam:** (3hrs.)			
Pre-requisite of course	**Basic Electrical Engg**	**Evaluation**			
		CIE: 20	**SEE: 30**		

Course Objectives:	
1. To familiarize with different components and equipments used in the laboratory.	
2. To study RLC combination circuits practically.	
3. To familiarize and practical understanding of two port network.	
4. To understand various filter circuits practically.	
Course Outcomes: On completion of the course, student would be able to	
CO1	Analyse circuit combinations of R, L and C for transient behaviors.
CO2	Work with two port networks for practical understanding of Y, Z , and ABCD parameters.
CO3	Analyse low pass, high pass filters based on their characteristics.

Expt. No	**COURSE SYLLABUS** **CONTENTS OF MODULE**	**COs**
1	To find resonance frequency, Bandwidth, Q factor of RLC series circuit.	**CO1, CO2, CO3,**
2	To study and plot the transient response of RL circuit	
3	To study and plot the transient response of RC circuit	
4	Determination of driving point and transfer functions of a two port ladder network and verify with theoretical values.	
5	To calculate and verify 'Z' parameters of two-port network	
6	To calculate and verify 'Y' parameters of two-port network.	
7	To calculate and verify 'ABCD' parameters of two-port network.	
8	To determine equivalent parameters of parallel connection of two-port network	
9	To plot the frequency response of High pass filter and determine the half-power frequency	
10	To plot the frequency response of Low pass filter and determine the half- power frequency.	
11	To plot the frequency response of High pass filter and determine the half-power frequency	

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-PRPC-11	**Course Name:** Transducers Lab	**L**	**T**	**P**	**C**
		0	**0**	**3**	**1.5**
Year and Semester	**2nd Year** **IIIrd Semester**	**Contact hours per week:** (3Hrs) **Exam:** (3hrs.)			
Pre-requisite of course	**Basic Science, Basic Electrical Engineering Lab**	**Evaluation**			
		CIE: 20	**SEE: 30**		

Course Objectives:	
1. To study the basic operation of different type of sensors/transducers.	
2. To familiarize with transducers circuits and their application.	
3. Familiarize with the safety rules for transducers laboratory.	
Course Outcomes: On completion of the course, student would be able to:	
CO1	Impart the conceptual knowledge of transducers /sensors and apply these to laboratory work.
CO2	Ability to analyze the performance as well as handling of transducer equipments.
CO3	Acknowledge the principles of operation and the main features of sensors/transducers.
CO4	Develop skills to use these measuring devices in different technological field.

Expt. No	COURSE SYLLABUS CONTENTS OF MODULE	COs
1	To study the characteristics of strain gauge for pressure measurement.	CO1 CO2 CO3 CO4
2	To study the characteristics of Load cell for force measurement.	
3	To study the characteristics of Thermistor for temperature measurement.	
4	To study the characteristics of Resistance temperature detector (RTD) for temperature measurement.	
5	To study the characteristics of Thermocouple for temperature measurement.	
6	To study the characteristics and loading effect of Potentiometer.	
7	To study the characteristics of Elastic transducers.	
8	To study the characteristics and calibration of linear variable differential transformer (LVDT) transducer for displacement measurement.	
9	To study the characteristics of Piezo-electric Transducer.	
10	To study the characteristics of Hall-effect Transducer.	
11	To Study and calibration of a flow sensors for flow measurement.	
12	To Study the characteristics and calibration of electrical transducers for level measurement.	
13	To Study the characteristics and calibration of acoustics sensors for sound measurement.	
14	To Study the characteristics of light sensors for light measurement.	
15	To Study the characteristics of hygrometer transducers for moisture measurement.	

Reference Books:

1. Sawhney. A.K, "A Course in Electrical and Electronics Measurements and Instrumentation", 18th Edition, DhanpatRai& Company Private Limited, 2007.
2. Renganathan. S,"Transducer Engineering", 4th edition Allied Publishers, Chennai, 2003.

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-PROE-13	**Course Name: Open Elective- I Lab** (i) Linear Integrated Circuits Lab	**L**	**T**	**P**	**C**
		0	**0**	**3**	**1.5**
Year and Semester	**2nd Year** **IIIrd Semester**	**Contact hours per week:** (3Hrs) **Exam:** (3hrs.)			
Pre-requisite of course	EI-PRES-06, Basic Electronic Lab	**Evaluation**			
		CIE: 20	**SEE: 30**		

Course Objectives:

1. To impart the basic practical aspects of one of the most widely used active components of analog electronics Operational Amplifier.
2. To design and study various circuits using active components mainly OpAmp.
3. To lay the experimental foundation for the courses in electronics related to instrumentation.

Course Outcomes: On completion of the course, student would be able to:

CO1	Understand the basic design of Operational amplifier and its parameters.
CO2	Understand the basic circuit design using IC opamp for different applications .
CO3	Understand the uses of opamp in Instrumentation.
CO4	Understand the advantages of the applications when performed using active components in integrated form like opamp.

	COURSE SYLLABUS	
Expt. No	**CONTENTS OF MODULE**	**COs**
1	Study opamp as inverter and scale changer.	**CO1, CO2, CO3, CO4**
2	Study opamp as non inverting amplifier and unity gain amplifier.	
3	Study of Opamp as Differentiator.	
4	Study of opamp as Integrator.	
5	Study and measurement of Opamp Parameters Offset voltages and currents.	
6	Measurement of CMRR for Opamp.	
7	Design and study of Opamp as half wave rectifier.	
8	Design and study of opamp as full wave rectifier.	
9	Design and study of opamp as Logarithmic amplifier.	
10	Design and study of opamp as square wave generator.	
11	Design and study of opamp as triangular wave generator.	
12	Design and study of opamp as Astable multivibrator.	
13	Design and study of opamp as monostable multivibrator.	

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-PROE-13	**Course Name:** Open Elective V Lab (ii) Computer Networks	**L**	**T**	**P**	**C**
		0	**0**	**3**	**1.5**
Year and Semester	**2nd Year III rd Semester**	**Contact hours per week:** (3 Hrs) **Exam:** (3hrs.)			
Pre-requisite of course	The course does not assume prior knowledge of networking.	**Evaluation**			
		CIE: 20	**SEE: 30**		

Course Objectives:

1. To understand the functionalities of various layers of OSI model
2. To understand the operating system functionalities.
3. To give comprehensive knowledge of TCP/IP layers.
4. To provide good understanding of Internet and networking design aspects.

Course Outcomes: On completion of the course, student would be able to

CO1	Understand the encryption and decryption concepts in Linux environment
CO2	Apply appropriate algorithm for the finding of shortest route
CO3	Configure the routing table.
CO4	Students should be able to use his knowledge to develop/design at LAN.

System/ Software Requirement

Intel based desktop PCs LAN connected with minimum of 166 MHZ or faster process with at least 64 MB RAM and 100 MB free disk space.

Expt. No	**COURSE SYLLABUS** **CONTENTS OF MODULE**	**COs**
1	Implementing the data link layer framing methods such as character, stuffing and bit stuffing.	**CO1, CO2, CO3, CO4**
2	Implement on a data set of characters the three CRC polynomials- CRC 12, CRC 16 and CRC CCIP.	
3	Practice the basic network commands and network configuration commands.	
4	Configure a network topology using packet tracer software.	

5	Configure a network using dynamic source distance vector (DSDV) routing protocol.	
6	Configure a network using link state routing (LSR) protocol.	
7	Configure a network using dynamic source routing (DSR) protocol.	
8	Configure a network using open shortest path first (OSPF) protocol.	
9	Write program for DES Encryption.	
10	Write program for DES decryption.	
11	Write program for RSA Encryption.	
12	Write program for RSA decryption.	

Text Books: Linux Manuals and Lab Manuals

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-PRPC-15	**Course Name:** Power System-I Lab	**L**	**T**	**P**	**C**
		0	**0**	**2**	**1**
Year and Semester	**2nd Year III rd Semester**	**Contact hours per week:** (2Hrs) **Exam:** (3hrs.)			
Pre-requisite of course	**Basic Electrical Engineering Lab**	**Evaluation**			
		CIE: 20	**SEE: 30**		

Course Objectives:

1. To study the layouts of Power system and its components.
2. To familiarize power system elements, devices, equipments and applications.
3. To study different type of transmission line model and their applications.
4. To familiarize with the safety rules for power system laboratory.

Course Outcomes: On completion of the course, student would be able to:

CO1	Impart the conceptual knowledge of basic layouts of power system and its components.
CO2	Ability to analyze the performance as well as handling of electrical elements and equipments like line conductors, cables, insulators etc.
CO3	Acknowledge the principles of operation and the main features of transmission line.
CO4	Develop skills to use power system elements and devices in different technological field.

Expt. No	**COURSE SYLLABUS CONTENTS OF MODULE**	**COs**
1	To study and draw the layout of 33KV substation.	**CO1 CO2 CO3 CO4**
2	To study and draw the layout of 110/220 KV substation.	
3	To study distribution network with measurement of distribution voltage and current in distributors.	
4	To study different types of Line insulators and obtain breakdown characteristics of any one type of insulator.	
5	To study and designing of Earthing / Grounding.	
6	To measure Potential distribution across different units of a string insulators: with guard ring and without guard ring and also determine the string efficiency.	
7	To plot equi-potential curve and voltage gradient in i. Two/three core cable ii. Single-core cable.	

8	To study the different parts of a power cable and measurement of insulation resistance of a cable.	
9	To study the core to core & core to sheath capacitance of a three phase cable.	
10	To study and obtain A B C D parameter of a transmission line (model).	
11	To study Ferranti Effect of transmission line model.	
12	To obtain Voltage Regulation of a long transmission line with resistive, inductive and capacitive loads	
13	To obtain Voltage Profile of a long transmission line when: i. Open circuited ii. Using shunt/series capacitive compensation iii. Using shunt inductive compensation.	
14	To study filtration and treatment of transformer oil.	
15	To study and determine dielectric strength of transformer oil.	

Reference books:

1. Power System Engg: I.J.Nagrath and D.P.Kothari (TMH)
2. A Course in Electrical Power: Gupta, Soni & Bhatnagar (Dhanpat Rai & Sons).
3. Electric Power System: B.M.Weedy, John Wiley & Sons.
4. Transmission & Distribution of Electrical Engineering: Westing House & Oxford Univ. Press, New Delhi.

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-PC-202	**Course Name:** Power Electronics-I	**L**	**T**	**P**	**C**
		3	**1**	**0**	**4**
Year and Semester	**2nd Year (IVth Semester)**	**Contact hours per week:** (4Hrs) Exam: (3 Hrs)			
Pre-requisite of course	Brief knowledge of in the following topics: Basic Electrical and Electronics engineering, Semiconductor devices, Digital Electronics, rectifiers.	**Evaluation**			
		CIE: 40		**SEE: 60**	

Course Objectives:	
1. To introduce, study the Constructional features & characteristics of power devices.	
2. To study the various Triggering & switching techniques and devices.	
3. To study the series parallel operation and thyristors protection	
4. To study the single phase and three phase thyristors at different types of loadings.	
5. To study the principle and different types of cycloconverters.	
6. To study the various modes of cycloconverter under continuous and discontinuous conduction, effect of source inductance on the performance of cycloconverter.	
Course Outcomes: On completion of the course, student would be able to:	
CO1	To Familiarize with construction and characteristics of power devices.
CO2	To understand and analyze the various triggering techniques and devices..
CO3	To understand series parallel operation and protection of thyristor.
CO4	To understand the output response of rectifiers at different loading.
CO5	To understand and analyze the operation of cycloconverters under different modes.
CO6	To understand the effect of source impedance on performance of cycloconverters.

Module No	COURSE SYLLABUS CONTENTS OF MODULE	Hrs	COs
1	Introduction to power devices: Constructional features & characteristics of thyristors, MOSFET, IGBT, MCT. Triggering & switching: Various triggering devices used for thyristor.	**7**	**I & II**
2	Thyristor Analogy: Two transistor analogy, series and parallel operation of thyristors. Protection: Protection of SCR against over current, over voltage, high dv/dt, and high di/dt.	**8**	**III**
3	Classification of Rectifiers, Phase Controlled Rectifiers: Single phase half wave controlled, Fully wave and half controlled rectifiers with Resistive, Inductive and e.m.f. loading and their performance parameters. Three phase half wave, full wave and half controlled rectifiers with resistive and inductive and emf loading and their performance.	**11**	**IV**
4	Cycloconverter: Introduction & principle of working cycloconverter; types of cycloconverter; enveloped type & phase controlled type , features of cycloconverter; voltage wave form, circulating mode of operation, circulating current free modes, cycloconverter under discontinuous conduction, effect of source inductance on the performance of cycloconverter, network reaction, Advantages and disadvantages of cycloconverter .	**10**	**V & VI**

Text Books:

1. Modern Power Devices by B.Jayant Balica, New Age Inter.
2. Power Electronics by P.C. Sen (TMH)
3. An Introduction to Thyristors and Their Applications by M. Ramamurthy (EWP)
4. Power electronics by Ned Mohan and Robins, John Wiley and Sons
5. Power Electronics by M. Rashid (PHI)
6. Thyristor Phase Controlled converters and Cyclo-converters by B.R.Pelly
7. Power Electronics by Vendem Subrahmanyam, New Age International

Note for Examiner(s): Question paper will comprise three sections,

1. Section-A will be compulsory and comprise 4-short answer type questions uniformly spread to the entire syllabus.

2. Section-B will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on concepts, definitions, derivations, principles, construction and working etc.

3. Section-C will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on derivations, numerical and applications of the various topics covered therein.

Note for Students:

1. Section – A is compulsory and attempt/answer all the four questions carrying 12 marks in total.

2. Attempt/answer two questions each out of the Section – B and Section – C. All questions will carry 12 marks.

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code:	**Course Name:** Electrical Measurements &	**L**	**T**	**P**	**C**
EI-PC-204	Instrumentation	**3**	**1**	**0**	**4**

Year and Semester	**2nd Year (IVth Semester)**	**Contact hours per week:** (4Hrs) Exam: (3 Hrs)	
Pre-requisite of course	Physics, Mathematics, Basic Electrical Engineering, Basic Electronics Engineering, basic Instrumentation.	**Evaluation**	
		CIE: 40	**SEE: 60**

Course Objectives:

1. To introduce electrical & electronics measurement techniques. To study the varioustypes of instruments and different types of measurements in AC/DC.
2. To study the low and high resistance measurements.
3. To study the principle and performance equations of galvanometers.
4. To study the principle and operation of wattmeters and energy meters.
5. To study the Construction, operation, and principle of power factor & frequency meters**.**
6. To study the AC bridges and CROs.

Course Outcomes: On completion of the course, student would be able to:

CO1	To learn different types of Instruments used in AC & DC supplies and Electrical & Electronics measurement techniques.
CO2	To understand and analyze the how to calculate low & high resistances.
CO3	To learn various types of Galvanometers.
CO4	To understand various types of wattmeters & energy meters and its applications.
CO5	To understand and analyze the Construction, operation, and principle of power factor & frequency meters**.**
CO6	To understand the AC bridges and CROs.

Module No	**COURSE SYLLABUS** **CONTENTS OF MODULE**	**Hrs**	**COs**
1	**Fundamentals of Electrical & Electronics measurements:** Principle, Construction, Features, Analysis & Performance of moving coil instruments, Moving iron instruments, Electrodynamic instruments, electrostatic instruments and Induction Instruments. Instrument cases (Covers).Construction, operating principle, Torque equation, Shape of scale. **MEASURING INSTRUMENTS (AC/DC):** use as Ammeter or as Voltmeter (Extension of Range), Use on AC/DC or both, Advantages & disadvantages, Errors (Both on AC/DC) of PMMC types, Electrodynamics Type, Moving iron type (attraction, repulsion & combined types), Induction type.	**6**	**CO1**
2	**LOW & HIGH RESISTANCE MEASUREMENTS:** Measurement of resistance (low, medium, high). Limitations of Wheatstone bridge; Kelvin's double bridge method, bridge controlled circuits, Sensitivity-Null indicators Difficulties in high resistance measurements, Measurement of high resistance by direct deflection, loss of charge method, Megaohm bridge. **GALVANOMETERS:** General principle and performance equations of D'Arsonval Galvanometers, Vibration Galvanometer and Ballistic Galvanometer.	**8**	**CO2, CO3**

3	**WATTMETERS & ENEGRY METERS:** Construction, operating principle, Torque equation, Shape of scale, Errors, Advantages & Disadvantages of Electrodynamic & Induction type Wattmeters; construction, theory, operation, Two element energy meter, average demand indicator. Single Phase Induction Type Energy meter, Compensation & creep in energy meter. **POWER FACTOR & FREQUENCY METERS:** Construction, operation, principle, Torque equation, Advantages & disadvantages of Single phase power factor meters (Electrodynamic & Moving Iron types) & Frequency meters (Electrical Resonance Type, Ferrodynamic & Electrodynamic types).	**12**	**CO4, CO5**
4	**A.C. BRIDGES:** General balance equation, Ckt. diagram, Phasor diagram, Advantages, disadvantages, applications of Maxwell's, inductance-capacitance, Hays, Owens, Schering & Wein's bridges, Shielding & earthing, wagner's device. **CRO:** Block diagram, Sweep generation, vertical amplifiers, use of CRG in measurement of frequency, phase, Amplitude and rise time of a pulse.	**10**	**CO6**

TEXT BOOK:

1. A Course in Elect. & Electronic Measurement & Instrumentation by A. K. Sawhney; Khanna Pub.

REFERENCE BOOKS:

1. Electrical Measurments by E.W. Golding
2. Electronic & Elect. Measurment&Instrumention by J.B.Gupta; Kataria& Sons.
3. Electronic Instrumentation &Measurment Technique, W.D. Cooper & A.D. Helfrick.
4. Measuring Systems by E.O. Doeblin; TMH.

Note for Examiner(s): Question paper will comprise three sections,

1. Section-A will be compulsory and comprise 4-short answer type questions uniformly spread to the entire syllabus.

2. Section-B will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on concepts, definitions, derivations, principles, construction and working etc.

3. Section-C will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on derivations, numerical and applications of the various topics covered therein.

Note for Students:

1. Section – A is compulsory and attempt/answer all the four questions carrying 12 marks in total.

2. Attempt/answer two questions each out of the Section – B and Section – C. All questions will carry 12 marks.

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code:	**Course Name: Program Elective- I**	**L**	**T**	**P**	**C**
EI-PE-206	(ii) Electrical Energy Conservation and Auditing	**2**	**1**	**0**	**3**
Year and Semester	**2nd Year (IVth Semester)**	**Contact hours per week:** (3 Hrs) Exam: (3 Hrs)			

Pre-requisite of course	Basic Science, Basic Electrical Engineering, Basic Instrumentation Engineering	Evaluation	
		CIE: 40	SEE: 60

Course Objectives:

1. To study the present Energy Scenario and Basics of various forms of Energy
2. To introduce the concept of Energy Management, Action Planning, Financial Management and Audit.
3. To study the Energy Monitoring and Targeting system, the Power Supply System and electric motors.
4. To introduce the concept of Lighting System, Energy Efficient Technologies.

Course Outcomes: On completion of the course, student would be able to:

CO1	To familiarized with the present Energy Scenario and Basics concept of various forms of Energy.
CO2	To impart conceptual knowledge and analysis of Energy Management, Action Planning, Financial Management and Audit.
CO3	To understand the concept of Energy Monitoring and Targeting system, the Power Supply System and electric motors, Lighting System, Energy Efficient Technologies.
CO4	Ability to use and learn the conventional techniques and skills ofengineering in the field of electrical and instrumentation engineering.
CO5	To impart technical education to learn and engage in the related fields. Ability to handle administrative responsibilities and manage projects and their related issues.

Module No	COURSE SYLLABUS CONTENTS OF MODULE	Hrs	COs
1	**Energy Scenario and Basics of Energy:** Energy scenario in world and India, Energy Conservation and its Importance, Energy Strategy for the Future, The Energy Conservation Act, 2001 and its Features, Various Forms of Energy, Electrical Energy Basics **Energy Management and Audit:** Definition & Objectives of Energy Management, Energy Audit: Types and Methodology, Energy Audit Reporting Format, Understanding Energy Costs, Benchmarking and Energy Performance, Matching Energy Usage to Requirement, Maximizing System Efficiency, Fuel and Energy Substitution, Energy Audit Instruments.	**7**	**CO1, CO2**
2	**Energy Action Planning and Financial Management:** Introduction, Energy Management System, Introduction, Investment Need, Appraisal and Criteria, Financial Analysis, Financial Analysis Techniques, Sensitivity and Risk Analysis, Financing Options. Introduction and steps in Project Management. **Energy Monitoring and Targeting:** Definition, Elements of Monitoring & Targeting System, A Rationale for Monitoring, Targeting and Reporting, Data and Information Analysis, Relating Energy Consumption and Production, CUSUM, Case Study.	**7**	**CO3, CO4, CO5**
3	**Electrical System and Motors :**Electrical Load Management and Maximum Demand Control, Power Factor Improvement and Benefits, Harmonics, Analysis of Electrical Power Systems Motor Selection, Energy Efficient Motors, Factors Affecting Energy Efficiency and Minimizing Motor Losses in Operation, Rewinding Effects on Energy Efficiency, Speed Control of AC Induction Motors, Motor Load	**7**	**CO3, CO4, CO5**

	Survey: Methodology.		
4	**Lighting System:** Introduction, Basic Terms in Lighting System and Features, Lamp Types and their Features, Recommended Illuminance Levels for Various Tasks/Activities/Locations, Methodology of Lighting System, Energy Efficiency Study, Case Examples, Some Good Practices in Lighting. **Energy Efficient Technologies in Electrical Systems:** Maximum Demand Controllers, Automatic Power Factor Controllers, Energy Efficient Motors, Soft Starter, Variable Speed Drives, Energy Efficient Transformers, Electronic Ballasts, Energy Efficient Lighting Controls.	**7**	**CO3, CO4, CO5**

Text/References:

1. B.R.Gupta, "Generation of Electrical Energy", Eurasia Publishing House, New Delhi.
2. A Ter-Gazarian,"Energy Storage for Power Systems", Peter Peragrinus Ltd.
3. Quarterly journals on Energy Managements, Energy Management Centre, Govt. of India, Ministry of Power, New Delhi.
4. Anthony J. Pansini, Kenneth D. Smalling, "Guide to Electric Load Management", Pennwell Pub; 1998
5. Howard E. Jordan, "Energy-Efficient Electric Motors and Their Applications", Plenum Pub Corp; 2ndedition, 1994.
6. Giovanni Petrecca, "Industrial Energy Management: Principles and Applications", The Kluwerinternational series -207, 1999.
7. Y P Abbi and Shashank Jain,"Handbook on Energy Audit and Environment Management", TERI,2006
8. Albert Thumannand William J. Younger,, "Handbook of Energy Audits", Terry Niehus, 2009.

Note for Examiner(s): Question paper will comprise three sections,

1. Section-A will be compulsory and comprise 4-short answer type questions uniformly spread to the entire syllabus.

2. Section-B will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on concepts, definitions, derivations, principles, construction and working etc.

3. Section-C will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on derivations, numerical and applications of the various topics covered therein.

Note for Students:

1. Section – A is compulsory and attempt/answer all the four questions carrying 12 marks in total.

2. Attempt/answer two questions each out of the Section – B and Section – C. All questions will carry 12 marks.

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-PE-206	**Course Name: Program Elective- I** (i) Control System Components	**L**	**T**	**P**	**C**
		2	**1**	**0**	**3**
Year and Semester	**2nd Year (IVth Semester)**	**Contact hours per week:** (3 Hrs) Exam: (3 Hrs)			
Pre-requisite of course	Mathematics, Physics, basic electrical and electronic engineering	**Evaluation**			
		CIE: 40	**SEE: 60**		

Course Objectives:	
1. Introduction, concept of Open loop & closed loop operation and to study the components for Mechanical, pneumatic, hydraulic and electrical systems	
2. Study of Mathematical Modeling of Dynamic system and find out the Transfer function of system by block diagram, reduction technique, signal flow graphs techniques	
3. To study the Basic control action & Industrial pneumatic automatic controllers and their mathematical Modeling and analysis	
4. To study Hydraulic control system and their mathematical Modeling and analysis	
5. To study Electronic control system and their mathematical Modeling and analysis	
6. Introduction the concept of control valve, their sizing and applications	
Course Outcomes: On completion of the course, student would be able to:	
CO1	Student understands the concept of Open loop & closed loop control system and familiarized with the Mechanical, pneumatic, hydraulic and electrical systems components.
CO2	Ability to derive Mathematical Modeling of various dynamical systems and able to find out the Transfer function of system by block diagram, reduction technique, signal flow graphs techniques.
CO3	Ability to identify, formulate and solve a problem using pneumaticsystem in instrumentation control engineering
CO4	Ability to identify, formulate and solve a problem using hydraulic system in instrumentation and control engineering
CO5	Ability to identify, formulate and solve a problem using electronic system in instrumentation and control engineering
CO6	Ability to understand and use the concept of control valve, their sizing and applications

Module No	**COURSE SYLLABUS** **CONTENTS OF MODULE**	**Hrs**	**COs**
1	Control System: Open loop & closed loop operation, Introduction to control system components, Representation of control components: Mechanical, Electrical, hydraulic and pneumatic. Transfer function of control system, Mathematical Modeling of Dynamic system: Mechanical, Electrical, Analogous system, Electromechanical system, hydraulic and pneumatic transfer function by block diagram, reduction technique, signal flow graphs techniques, Meson's gain formula for signal flow graph.	**8**	**CO1 CO2**
2	Basic control action & Industrial automatic controller: On/Off or two position, proportional, integral, proportional-Integral, proportional-derivative and proportional-integral-derivative control action. Pneumatic controller: Pneumatic amplifiers, pneumatic proportional controller, pneumatic derivative and integral control action, PID controller, PI controller action.	**7**	**CO3**
3	Hydraulic controller: Advantage and disadvantage of Hydraulic controllers, Hydraulic integral controller, proportional controller, Hydraulic PI controller, hydraulic PD controller. Comparison between pneumatic and hydraulic systems Electronic controller: On/Off or two position, proportional, integral, proportional-integral, proportional-derivative and proportional-integral-derivative, design and consideration.	**7**	**CO4 CO5**
4	Control valve: Type and characteristics, control valve sizing, selection	**6**	**CO6**

	criteria concept. Calculation of control valve size, positioner, necessity type & effects on performance of control valve. Pneumatic control valve characteristics, Auxiliary process components: Hydraulic pumps & power supply, Hydraulic servomotor, Hydraulic integrator, Amplidyne.		

Reference Books:

1. Process Control and Instrument Technology by C.D.Jhonson.
2. Instrumentation for Process Measurement and Control By N.A.Anderson
3. Automatic Control Engineering by Raven
4. Automatic Control System by C.Kuo
5. Modern Control Engineering by Katsuhiko & Ogata
6 Control System by Nagrath & Gopal

Note for Examiner(s): Question paper will comprise three sections,

1. Section-A will be compulsory and comprise 4-short answer type questions uniformly spread to the entire syllabus.
2. Section-B will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on concepts, definitions, derivations, principles, construction and working etc.
3. Section-C will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on derivations, numerical and applications of the various topics covered therein.

Note for Students:

1. Section – A is compulsory and attempt/answer all the four questions carrying 12 marks in total.
2. Attempt/answer two questions each out of the Section – B and Section – C. All questions will carry 12 marks.

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-PC-208	**Course Name:** Electrical Machines - I	**L**	**T**	**P**	**C**
		3	**1**	**0**	**4**
Year and Semester	**IInd Year IVth Semester**	**Contact hours per week:** (4Hrs) Exam: (3 Hrs)			
Pre-requisite of course	**Basic Electrical Engg**	**Evaluation**			
		CIE: 40		**SEE: 60**	

Course Objectives:	
1. To introduce students with the fundamentals of energy conversion.	
2. To familiarize and gain knowledge about DC generators and DC motors construction, working, staring and performance.	
3. To have good understanding of single phase transformers based on working and operation under different loading conditions.	
4. To introduce open circuit, short circuit, transmission, hybrid parameters and their interrelationship.	
5. To gain analytical skills based on operation of three phase transformers.	
Course Outcomes: On completion of the course, student would be able to:	
CO1	Acquire knowledge about the fundamental principles and electromagnetic energy conversion.
CO2	Acquire knowledge about the constructional details and principle of operation of dc

	machines, starting and speed control, including numerical problems.
CO3	Acquire knowledge about testing and applications of dc machines
CO4	Acquire knowledge about the constructional details, principle of operation, testing and applications of transformers.
CO5	Acquire knowledge about the constructional details, operation, testing, Analytical capability, and applications of single and 3 phase transformers.
CO6	Operate single phase and three phase transformers in parallel sharing the load. And Numerical analysis of this operation.

Module No	COURSE SYLLABUS CONTENTS OF MODULE	Hrs	Cos
1	**Principles of Electro-mechanical Energy Conversion:** Introduction, Review of magnetic system, Force and torque in magnetic field system, Energy balance equation, Energy conversion via electrical field, Determination of the Force and Torque from energy and co-energy, Generation of EMF in Machines.	**5**	**CO1, CO2**
2	**DC Machines-I:** Principle, Construction, and Classification of DC generators, EMF equation of generator, Armature winding, Armature reaction, Commutation, Performance characteristics of DC generators, and applications.	8	**CO2**
3	**DC Machines-II:** Principle, Construction, and Classification of DC motor, back emf, power equation, condition for maximum efficiency, armature torque and shaft torque, losses and efficiency, power stages, Performance characteristics of DC motors, Starting of DC motors; 3 point and 4 point starters, Speed control of DC motors; Field control, Armature control and Voltage control (Ward Leonard method); Efficiency and Testing of DC machines (Hopkinson's and Swinburne's Test).	**9**	**CO2, CO3.**
4	**Single Phase Transformer:** Construction & Principle, Ideal and practical transformer, shifting impedances, exact and approximate equivalent circuit, resistive, inductive and capacitive loading with phasor diagrams, losses in transformers. Efficiency and condition for maximum efficiency, voltage regulation, Testing of Transformers- O.C. and S.C. tests, Polarity test, Sumpner's test, parallel operation and load sharing, Auto Transformer- Single phase autotransformers, merits and de-merits and applications.	**10**	**CO4,**
5	**Three Phase Transformers:** Construction, Three phase transformer, phasor groups and their connections, open delta connection, three phase to 2 phase conversion, Three winding transformers from three single phase transformers. Parallel operation of three phase transformers.	**6**	**CO5, CO6**

Text Books:

1. Electrical Machines", I J Nagrath& D.P. Kothari, Tata McGraw Hill
2. Electrical Machines", Rajendra Prasad , PHI
3. Electrical Machines", S K Sahadev, Cambridge University Press.
4. Electrical Machinery", P S Bimbhra, Khanna Publisher.

Reference Books:

1. Electric Machinery, AE Fitggerald, C. Kingsley Jr and Umans, McGraw Hill, International.

2. Electrical Technology, H. Cotton, CBS Publication.
3. The Performance and Design of AC machines, M G Say, Pit man& Sons.
4. Generalized Theory, P S Bimbhra,Khanna Publishers

Note for Examiner(s): Question paper will comprise three sections,

1. Section-A will be compulsory and comprise 4-short answer type questions uniformly spread to the entire syllabus.
2. Section-B will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on concepts, definitions, derivations, principles, construction and working etc.
3. Section-C will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on derivations, numerical and applications of the various topics covered therein.

Note for Students:

1. Section – A is compulsory and attempt/answer all the four questions carrying 12 marks in total.
2. Attempt/answer two questions each out of the Section – B and Section – C. All questions will carry 12 marks.

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-OE-210	**Course Name: Open Elective- II** (i) Digital Techniques	**L**	**T**	**P**	**C**
		2	**1**	**0**	**3**
Year and Semester	**2nd Year (IVth Semester)**	**Contact hours per week:** (3Hrs) Exam: (3 Hrs)			
Pre-requisite of course	**EI-ES-108: Basic Electronics Engineering IInd Semester**	**Evaluation**			
		CIE: 40	**SEE: 60**		

Course Objectives:

1. To impart the basic concepts of Digital Electronics.
2. To design and study various logic circuits.
3. To study various switching applications.
4. To lay the foundation for the courses in electronics related to microprocessors and microcomputers.

Course Outcomes: On completion of the course, student would be able to:

CO1	Understand the basic concepts of Boolean theory and concepts of logic gates in digital electronics.
CO2	Understand the concept of sequential and combinational logical circuit.
CO3	Develop design capability in synchronous and asynchronous sequential circuits.
CO4	Design of memory cells and different memory circuits. Classify different semiconductor memories.

Module No	**COURSE SYLLABUS** **CONTENTS OF MODULE**	**Hrs**	**COs**
1	Number system and codes, Boolean relations, sum of products method, algebraic simplification, k-Maps, Karnaugh simplifications, binary addition, binary subtraction, Gates: OR, AND, inverter, the inhibit (enable) operation, XOR circuits, NAND & NOR gates. DeMorgan's Laws, Logic Hardware: DTL, TTL, PMOS, NMOS, CMOS Logic and their characteristics, Dynamic MOS circuits.	**7**	**CO1**
2	Binary Adders (Half Adder, Full adder,). Arithmetic functions	**7**	**CO2**

	(True/Complement, Zero/One Element, Binary Subtraction, Digital Comparator), Tristate logic and its uses in computers, Flip flops: RS Latches, Level clocking (Clocked SR flip flop), D latch, Edge triggered JK Flip Flop, JK Master Slave flip flop, T type Flip Flop.		
3	Decoder, Encoders, Multiplexers, Demultiplexures Registers, parallel and Shift Registers, MOS Shift registers, synchronous & Asynchronous counters, up/down counters, Applications of Counters.	**5**	**CO2 CO3**
4	A/D & D/A converters and their design. Digital storage devices: ROM, RAM, EPROM, EEPROM, MOS ROM, ROM Applications	**5**	**CO4**

Reference Books:

1. Digital Electronics by Gothman, Prentice-Hall
2. Digital Principals & Applications by Malvino& Leach, TMH
3. System Design by Sonde, TMH
4. Digital Computer Electronics by A.P.Malvino, TMH
5. Integrated Electronics by Millman&Halkias, McGraw Hill

Note for Examiner(s): Question paper will comprise three sections,

1. Section-A will be compulsory and comprise 4-short answer type questions uniformly spread to the entire syllabus.

2. Section-B will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on concepts, definitions, derivations, principles, construction and working etc.

3. Section-C will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on derivations, numerical and applications of the various topics covered therein.

Note for Students:

1. Section – A is compulsory and attempt/answer all the four questions carrying 12 marks in total.

2. Attempt/answer two questions each out of the Section – B and Section – C. All questions will carry 12 marks.

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-OE-210	**Course Name: Open Elective – II** (ii) Computer Organization	**L**	**T**	**P**	**C**
		2	**1**	**0**	**3**
Year and Semester	**2nd Year (IVth Semester)**	**Contact hours per week:** (3 Hrs) Exam: (3 Hrs)			
Pre-requisite of course	Brief knowledge in the following: Logic Circuit Design, Sequential Circuits, Fundamental programming skills	**Evaluation**			
		CIE: 40	**SEE: 60**		

Course Objectives:

1.	Understand the basics of computer organization: structure and operation of computers and their peripherals.
2.	Understand the concepts of programs as sequences or machine instructions.
3.	Expose different ways of communicating with I/O devices and standard I/O interfaces.
4.	Describe hierarchical memory systems including cache memories and virtual memory.
5.	Describe arithmetic and logical operations with integer and floating-point operands.
6.	Understand basic processing unit and organization of simple processor, concept of

	pipelining and other large computing systems.
Course Outcomes: On completion of the course, student would be able to:	
CO1	The basic structure of computers & machine instructions and programs, Addressing Modes, Assembly Language, Stacks, Queues and Subroutines. Input/output Organization such as accessing I/O Devices, Interrupts and Memory system
CO2	Some Fundamental Concepts of Basic Processing Unit organization and execution of instruction, buses, buses peripheral devices etc.
CO3	Apply the knowledge gained in the design of Computer.
CO4	Analyse and design arithmetic and logical units
CO5	Design and evaluate performance of memory systems
CO6	Understand the importance of life-long learning

Module No	COURSE SYLLABUS CONTENTS OF MODULE	Hrs	COs
1	**Basic Structure of Computers**: Basic Operational Concepts, Bus Structures, Performance – Processor Clock, Basic Performance Equation and Measurement.**Machine Instructions and Programs:** Memory Location and Addresses, Memory Operations, Instructions and Instruction Sequencing, Addressing Modes, Assembly Language, Basic Input and Output Operations, Stacks and Queues, Subroutines, Additional Instructions, Encoding of Machine Instructions.	**7**	**CO1, CO2**
2	**Input/Output Organization:** Accessing I/O Devices, Interrupts – Interrupt Hardware, Enabling and Disabling Interrupts, Handling Multiple Devices, Controlling Device Requests, Exceptions, Direct Memory Access, Buses, Interface Circuits,	**6**	**CO2, CO3**
3	**Memory System**: Basic Concepts, Semiconductor RAM Memories, Read Only Memories, Speed, Size, and Cost, Cache Memories – Mapping Functions, Replacement Algorithms, Performance Considerations, Virtual Memories, and Secondary Storage.	**7**	**CO2, CO3, CO5**
4	**Basic Processing Unit**: Some Fundamental Concepts, Execution of a Complete Instruction, Multiple Bus Organization, Hard-wired Control, Micro programmed Control.	**6**	**CO3, CO4, CO6**

Text Books:

1. Carl Hamacher, Zvonko Vranesic, Safwat Zaky: Computer Organization, 5th Edition, Tata McGraw Hill, 2002.

Reference Books:

1. William Stallings: Computer Organization & Architecture, 9th Edition, Pearson, 2015.
2. Patterson and Hennessy: Computer Organization & Design: The Hardware/Software Interface, Fourth Edition, Morgan Kaufmann Publishers, 2012.
3. J.P. Hayes: Computer Architecture and Organization, TMH
4. Microprocessor and Interfacing –Douglas V. Hall, TMGH 2nd edition

Note for Examiner(s): Question paper will comprise three sections,

1. Section-A will be compulsory and comprise 4-short answer type questions uniformly spread to the entire syllabus.

2. Section-B will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on concepts, definitions, derivations, principles, construction and working etc.

3. Section-C will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on derivations, numerical and applications of the various topics covered therein.

Note for Students:

1. Section – A is compulsory and attempt/answer all the four questions carrying 12 marks in total.

2. Attempt/answer two questions each out of the Section – B and Section – C. All questions will carry 12 marks.

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-HSM-212	**Course Name:** Project Planning Estimation and Assessment	**L**	**T**	**P**	**C**
		2	**0**	**0**	**2**
Year and Semester	**2nd Year (IVth Semester)**	**Contact hours per week:** (2Hrs) Exam: (3 Hrs)			
Pre-requisite of course	**Nil**	**Evaluation**			
		CIE: 40	**SEE: 60**		

Course Objectives:	
1. How to prepare project proposal and appraisal	
2. How to make market survey and demand analysis	
3. How to make technical analysis	
4. How to make finance planning	
5. Hoe to achieve project objectives and policies	
Course Outcomes: On completion of the course, student would be able to:	
CO1	Project appraisal documentation
CO2	Based on make market survey and demand analysis, to give demand forecast
CO3	Choice of Technology
CO4	Cost of the project and means of finance
CO5	To develop tools to arrive at project objectives

Module No	**COURSE SYLLABUS** **CONTENTS OF MODULE**	**Hrs**	**Cos**
1	**Project Development Cycle:** Pre-investment phase, implementation phase, operational phase. Aspects of Appraisal: Market Appraisal, Technical Appraisal, Financial Appraisal, Economic Appraisal. Objectives of investment decision making. Scouting for project ideas; Preliminary Screening, compatibility with the promoter, consistency with governmental prioritize, availability of inputs, Adequacy of the market, Reasonableness of cost, Acceptability of Risk Level.	**6**	**CO1**
2	**Market and Demand Analysis:** Information required for Market and Demand Analysis, Secondary sources of information, Market Survey - Steps in sample survey, Demand Forecasting, Uncertainty in Demand forecasting, Method of Forecasting, Environmental Changes, coping with uncertainties. **Technical Analysis:** Material and inputs; Product Technology; Choice of Technology, Acquiring Technology, Appropriateness, of Technology, Product Mix, Plant Capacity, Location of site.	**6**	**CO2**
3	**Financial Estimates:** Cost of Project, Main Components, Means	**6**	**CO3**

	of financing, Planning the Capital structure of a new company, Norms of the Controller of Capital issue, Norms and requirements of All India Financial Institutions, Stock Exchange stipulation, Difficulty in raising External Finance, Designing the capital structure.		**CO4**
4	**Project Planning & Control:** Functions of Planning, Areas of planning, Project objectives and policies, life cycle of a project, Tools of Planning, Hierarchy of plans; Project Control- Reasons for ineffective control, variance Analysis Approach, Performance Analysis, Modern Approach to Control.	**6**	**CO5**
5			

Reference Books:

1. Project Preparation, Appraisal, Budgeting Implementation by Prasanna Chandra, Tata Mc-Graw Hill. (2017)
2. O.P. Khanna – Industrial Engineering and Management – Dhanpat Rai and Sons, 2001
3. S. Elion – Elements of Production planning and control – Macmillan Co. 2007
4. I.M. Pandey – Financial Management – Vikas Publishing Co.
5. E.S. Baffa – Modern production management – John Wiley and Sons. 2008
6. I.W.Burr – Engineering Statistics and Quality Control – McGraw Hill, 2011
7. A.J. Ducan – Quality control and industrial statistics – Richard.D.Irwing Inc.

Note for Examiner(s): Question paper will comprise three sections,

1. Section-A will be compulsory and comprise 4-short answer type questions uniformly spread to the entire syllabus.

2. Section-B will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on concepts, definitions, derivations, principles, construction and working etc.

3. Section-C will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on derivations, numerical and applications of the various topics covered therein.

Note for Students:

1. Section – A is compulsory and attempt/answer all the four questions carrying 12 marks in total.

2. Attempt/answer two questions each out of the Section – B and Section – C. All questions will carry 12 marks.

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-PRPC-10	**Course Name:** Power Electronics-I Lab.	**L**	**T**	**P**	**C**
		0	**0**	**2**	**1**
Year and Semester	**2nd Year** **IVth Semester**	**Contact hours per week:** (2Hrs) **Exam:** (3hrs.)			
Pre-requisite of course	Brief knowledge of in the following topics: Basic Electrical and Electronics engineering, Semiconductor devices, Digital Electronics, rectifiers.	**Evaluation** **CIE: 20**		**SEE: 30**	
Course Objectives:					
1. Understand the Construction, principles and Characteristics of Power Devices Such as SCR, IGBT, MosFET etc .					

2. Understand the concepts of SCR triggering circuits and its firing techniques.	
3. Understand different types of supplies used for turning on of SCRs.	
4. Understand the output characteristics of converters at different firing angles and different types of loadings.	
Course Outcomes: On completion of the course, student would be able to:	
CO1	To understand the Construction, principles and Characteristics of Power Devices.
CO2	To understand the various types of SCR triggering circuits and its firing techniques.
CO3	To understand different methods of turning on of SCRs.
CO4	To understand the output characteristics of converters at different firing angles and different types of loadings.

Expt. No	COURSE SYLLABUS CONTENTS OF MODULE	COs
	LIST OF EXPERIMENTS STUDY EXPERIMENTS :	
1.	To Study the characteristics of SCR. find out the holding and latching current.	
2.	To plot the output characteristics of MOSFET	
3.	To plot the output characteristics of IGBT.	
4.	To trigger the SCR with DC triggering	
5.	To trigger the SCR with µ- controller based firing circuit.	
6.	To synchronize UJT firing circuit.	
7.	To perform the time delay with the help of UJT.	
8. t	To trigger single phase converter at different firing angles.	
9.	To study the resistance R and resistance-capacitance RC triggering of SCR.	
10.	To trigger SCR with digital circuit.	
11.	To turn on SCR using different methods.	
	SIMULATION EXPERIMENTS :	
1.	Single Phase Half wave controlled converter with R,RL&RLE Load (for firing angles 30,60,90)with/without FD	**CO1, CO2, CO3, CO4**
2.	Single Phase Half controlled converter with R,RL&RLE Load (for firing angles 30,60,90)with/without FD	
3.	Single Phase Full controlled converter with R,RL&RLE Load (for firing angles 30,60,90)with/without FD	
4.	Three Phase semi controlled converter with R,RL&RLE Load	
5.	Three Phase full controlled converter with R,RL&RLE Load	
6.	Single phase AC Voltage Controller with R&RL Loads	
7.	Boost converter and buck converter with open loop and closed loop operations	
8.	Single Phase cyclo converter	
	HARDWARE EXPERIMENTS :	
1.	Thyristorised drive for PMDC motor with speed measurement and Single Phase Half controlled rectifier and full controlled rectifier	
2.	Three Phase input Thyristorised drive for Dc Motor with closed loop control	
3.	Single Phase Series Inverter	
4.	Single Phase Parallel Inverter	

REFERENCE BOOKS:

1. Modern Power Devices by B.Jayant Balica, New Age Inter.
2. Power Electronics by P.C. Sen (TMH)
3. An Introduction to Thyristors and Their Applications by M. Ramamurthy (EWP)
4. Power electronics by Ned Mohan and Robins, John Wiley and Sons

5. Thyristor Phase Controlled converters and Cyclo-converters by B.R.Pelly
6. Power Electronics by Vendem Subrahmanyam, New Age International

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-PRPC-12	**Course Name:** Electrical Measurements & Instrumentation Lab	**L**	**T**	**P**	**C**
		0	**0**	**2**	**1**
Year and Semester	**2nd Year** **IVth Semester**	**Contact hours per week:** (2Hrs) **Exam:** (3hrs.)			
Pre-requisite of course	Brief knowledge of in the following topics: Basic Electrical and Electronics engineering, Semiconductor devices, Digital Electronics, rectifiers.	**Evaluation**			
		CIE: 20	**SEE: 30**		

Course Objectives:

1. Understand the Construction and principles of Construction and working principles of wattmeter and energy meters..
2. Understand the concepts of measurements of high and low resistances.
3. Understand the null deflection and implement it in CT & PT.

Course Outcomes: On completion of the course, student would be able to:

CO1	To understand the Construction and working principles of wattmeter and energy meters.
CO2	To understand the methods to measure high and low resistances..
CO3	To understand how to implement null deflection and in CT & PT.
CO4	To understand the displacement measurements in LVDT.

Expt. No	**COURSE SYLLABUS** **CONTENTS OF MODULE**	**COs**
	LIST OF EXPERIMENTS STUDY EXPERIMENTS :	**CO1, CO2, CO3, CO4**
1.	To calibrate D.C. Energy Meter at different loads.	
2.	To study the error in wattmeter at various p.f,s (power factors)	
3.	To measure resistance of the order of 5/10 ohm using (a) Ammeter, Voltmeter method. (b) Method of substitution (c) Carrey foster bridge.	
4.	To measure the inductance and resistance of given inductor at different audio frequencies 200 Hz to 10Kz, using Maxwell's inductance, capacitance bridge, Hays Bridge.	
5.	To measure low resistance using Kelvin's Double Bridge.	
6.	To determine the current ratio and phase angle of the given current transformer at different nominal current ratio using direct deflection method.	
7.	To study Lloyd fisher square and separate hysterises and eddy current losses of the specimen in the square.	
	Calibration of D.C. Voltmeter 0-300 V and Ammeter 0-10 mA using Crompton potentiometer.	
8.	Measurement of displacement with the help of LVDT.	
9.	Dielectric oil testing using H.T. testing Kit.	
10.	Calibration and Testing of single phase energy Meter.	
11.	Measurement of 3 - Phase reactive power with single-phase wattmeter.	
12.	Measure the capacitance using Schering bridge and find out the balance equation.	
13.	Measure the self-inductance using Anderson bridge and find out the balance equation.	

14.	Resistance strain gauge – strain measurements and Calibration.	
15.	C.T. testing using mutual Inductor – Measurement of % ratio error and phase angle of given CT by Null method.	
16.	PT testing by comparison – V. G. as Null detector – Measurement of % ratio error and phase angle of the given PT.	

REFERENCE BOOKS:

1. A Course in Elect. & Electronic Measurement & Instrumentation by A. K. Sawhney; Khanna Pub.

REFERENCE BOOKS:

1. Electrical Measurments by E.W. Golding
2. Electronic & Elect. Measurment&Instrumention by J.B.Gupta; Kataria& Sons.
3. Electronic Instrumentation &Measurment Technique, W.D. Cooper & A.D. Helfrick.
4. Measuring Systems by E.O. Doeblin; TMH.

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-PROE-14	**Course Name:** Open Elective-II Lab. (i) Digital Techniques	**L**	**T**	**P**	**C**
		0	**0**	**2**	**1**
Year and Semester	**2nd Year IVth Semester**	**Contact hours per week:** (2 Hrs) **Exam:** (3 hrs.)			
Pre-requisite of course	**Basic Electronics**	**Evaluation**			
		CIE: 20	**SEE: 30**		

Course Objectives:	
1. To impart the basic practical aspects of Digital Electronics.	
2. To make a differentiation between the Analog Electronics and Digital electronics through practical modes.	
3. To lay the foundation for the courses in electronics related to microprocessors, microcomputers and computers which are more advanced courses based on digital electronics and the revolution in electronics	
Course Outcomes: On completion of the course, student would be able to:	
CO1	Well verse with the fundamentals and the parameters of digital components related to their fabrication and internal circuitry.
CO2	To design and study various logic circuits.
CO3	Develop design capability in synchronous and asynchronous sequential circuits.

Expt. No	**COURSE SYLLABUS** **CONTENTS OF MODULE**	**COs**
1	Design and study Diode logic circuit AND and OR gate and verify the truth table.	**CO1, CO2, CO3**
2	Design and study DTL circuit NAND and NOR gate and verify the truth table.	
3	Design and study TTL NAND gate Circuit and verify the truth table.	
4	Draw EX-OR and EX-NOR logic circuit with the help of 7400 and verify its truth table.	
5	Draw the circuit of half adder and full adder and verify its truth table.	
6	Draw the SR and D flip flop and verify the truth table with the help of 7400.	
7	Draw the JK Flip flop and JK Master slave flip flop with 7400 and verify the truth table.	
8	Draw the Parallel in Parallel out registers with 7476 and verify its operation	

9	Draw the shift registers with 7476 and verify its operation.	
10	Draw the circuit of synchronous counter with 7476 and perform the up counting.	
11	Draw the circuit of asynchronous counter with 7476 and perform the up counting.	
12	Draw the circuit of asynchronous counter with 7476 and perform the down counting.	
13	Draw the mode 10 asynchronous up counter with 7476.	

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-PROE-14	**Course Name:** Open Elective-II Lab. (ii) Computer Organization	**L**	**T**	**P**	**C**
		0	**0**	**2**	**1**
Year and Semester	**2nd Year** **IVth Semester**	**Contact hours per week:** (2Hrs) **Exam:** (3hrs.)			
Pre-requisite of course	Brief knowledge of in the following topics: Logic Circuit Design, Sequential Circuits, Fundamental programming skills	**Evaluation**			
		CIE: 20	**SEE: 30**		

Course Objectives:

1. Understand the basics of computer organization: structure and operation of computers and their peripherals.
2. Understand the concepts of programs as sequences or machine instructions.
3. Expose different ways of communicating with I/O devices and standard I/O interfaces.
4. Describe hierarchical memory systems including cache memories and virtual memory.
5. Describe arithmetic and logical operations with integer and floating-point operands.
6. Understand basic processing unit and organization of simple processor, concept of pipelining and other large computing systems.

Course Outcomes: On completion of the course, student would be able to:

CO1	The basic structure of computers & machine instructions and programs, Addressing Modes, Assembly Language, Stacks, Queues and Subroutines. Input/output Organization such as accessing I/O Devices, Interrupts and Memory system
CO2	Some Fundamental Concepts of Basic Processing Unit organization and execution of instruction, buses, buses peripheral devices etc.
CO3	Apply the knowledge gained in the design of Computer.
CO4	Analyse and design arithmetic and logical units
CO5	Design and evaluate performance of memory systems
CO6	Understand the importance of life-long learning

Expt. No	**COURSE SYLLABUS** **CONTENTS OF MODULE**	**COs**
	Exercises in Micro Processor programming:	
1	Write the working of 8085 simulator GNUsim8085 and basic architecture of 8085 along with small introduction.	**CO1, CO2, CO3, CO4**
2	Study the complete instruction set of 8085 and write the instructions in the instruction set of 8085 along with examples.	
3	Write an assembly language code in GNUsim8085 to implement data transfer instruction.	

4	Write an assembly language code in GNUsim8085 to store numbers in reverse order in memory location.	
5	Write an assembly language code in GNUsim8085 to implement arithmetic instruction.	
6	Write an assembly language code in GNUsim8085 to add two numbers using lxi instruction.	
7	Write an assembly language code in GNUsim8085 to add two 8 bit numbers stored in memory and also storing the carry.	
8	Write an assembly language code in GNUsim8085 to find the factorial of a number.	
9	Write an assembly language code in GNUsim8085 to implement logical instructions.	
10	Write an assembly language code in GNUsim8085 to implement stack and branch instructions.	
	Write assembly language programs for the following using GNU Assembler.	
11	Write assembly language programs to evaluate the expressions: i) a = b + c – d * e ii) z = x * y + w – v +u / k a. Considering 8-bit, 16 bit and 32 bit binary numbers as b, c, d, e. b. Considering 2 digit, 4 digit and 8 digit BCD numbers. Take the input in consecutive memory locations and also Display the results by using “int xx” of 8086. Validate program for the boundary conditions.	
12	Write an ALP of 8086 to take N numbers as input. And do the following operations on them. a. Arrange in ascending and descending order.	
13	Write an ALP of 8086 to take N numbers as input. And do the following operations on them. a. Find max and minimum b. Find average Considering 8-bit, 16 bit binary numbers and 2 digit, 4digit and 8 digit BCD numbers. Display the results by using “int xx” of 8086. Validate program for the boundary conditions.	
14	Write an ALP of 8086 to take a string of as input (in ‘C’ format) and do the following Operations on it. a. Find the length b. Find it is Palindrome or n. Considering 8-bit, 16 bit binary numbers and 2 digit, 4digit and 8 digit BCD numbers. Display the results by using “int xx” of 8086. Validate program for the boundary conditions.	
15	Write an ALP of 8086 to take a string of as input (in ‘C’ format) and do the following Operations on it. a. Find whether given string substring or not.	
16	Write an ALP of 8086 to take a string of as input (in ‘C’ format) and do the following Operations on it a. Find the Armstrong number b. Find the Fibonacci series for n numbers Display the results by using “int xx” of 8086.	
17	Write the ALP to implement the above operations as procedures and call from	

	the main procedure.	
18	Write an ALP of 8086 to find the factorial of a given number as a Procedure and call from the main program which display the result.	

REFERENCE BOOKS:

1. Switching theory and logic design –A. Anand Kumar PHI, 2013
2. Advanced microprocessor & Peripherals-A. K. Ray and K. M. Bherchandavi, TMH, 2nd edition.
3. Switching and Finite Automatic theory-Zvi Kohavi, Niraj K.Jha Cambridge, 3rd edition
4. Digital Design –Morris Mano, PHI, 3rd edition
5. Microprocessor and Interfacing –Douglas V. Hall, TMGH 2nd edition

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-PRPC-16	**Course Name:** ELECTRICAL MACHINES-I LAB	**L**	**T**	**P**	**C**
		0	**0**	**3**	**1.5**
Year and Semester	**IInd Year** **IV th Semester**	**Contact hours per week:** (3Hrs) **Exam:** (3hrs.)			
Pre-requisite of course	**Basic Electrical Engg**	**Evaluation**			
		CIE: 30	**SEE: 45**		

Course Objectives:

1. To have practical knowledge about working of DC machines.
2. To be able to test DC machines for their performance.
3. To have practical knowledge of working of single and three phase transformers.
4. To be able to conduct experimentation on single and three phase transformers.

Course Outcomes: On completion of the course, student would be able to:

CO1	have sound practical understanding of DC generators and DC motors.
CO2	conduct experimentation on DC machines under different operating conditions.
CO3	have practical understanding of single phase and three phase transformers.
CO4	conduct various tests on single and three phase transformers.

Expt. No	**COURSE SYLLABUS** **CONTENTS OF MODULE**	**Cos**
1	Measurement of induced emf and magnetising current under open circuit condition in D.C. generators.	**CO1, CO2, CO3, CO4**
2	Determination of the relationship between terminal voltage and load current keeping speed constant for(a) Separately excited generator keeping excitation constant (b) D.C. shunt generator.	
3	To measure the variation in no load speed of a separately excited d.c. motor for the variation in (a) Armature circuit resistance(b) Field circuit resistance.	
4.	To study the working of DC motor starters.	
5	Speed control of DC shunt motor using (a) armature control (b) field control.	
6	To conduct brake test on dc shunt motor.	
7	To Perform Load test on a single phase transformer.	
8	To perform Open circuit and short circuit tests on a single phase transformer and hence find Equivalent circuit, voltage regulation and efficiency.	
9	To find the efficiency and voltage regulation of single phase transformer under different loading Conditions	
10	To perform parallel operation of two single phase transformers.	
11	Polarity test and 3-phase connections of single phase transformers.	

B. Tech Electrical and Instrumentation Engineering
SYLLABI for EXAMINATIONS
B. Tech. 3rd YEAR

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-OE-301	**Course Name: Open Elective-III** **(i)** Environment Monitoring Instrumentation	**L**	**T**	**P**	**C**
		3	**1**	**0**	**4**
Year and Semester	**3rd Year** **Vth Semester**	**Contact hours per week:** (4Hrs) **Exam:** (3hrs.)			
Pre-requisite of course	**NIL**	**Evaluation**			
		CIE: 40	**CIE: 60**		

Course Objectives:
1. To understand the concept of pollution monitoring
2. To Understand the concepts of Air pollution
3. To study the various air pollution monitoring instruments and methods
4. To study water pollution and its monitoring equipment

Course Outcomes: On completion of the course, student would be able to:	
CO1	Identify sources of air and water pollution and their effects
CO2	Sample and analyze air pollutants
CO3	Understand the air quality monitoring instruments
CO4	Sample and analyze water borne pollutants
CO5	Understand the water quality monitoring instruments

Module No	**COURSE SYLLABUS** **CONTENTS OF MODULE**	**Hrs**	**COs**
1	**Air and water Pollution: Sources & Effects:** Definition and concentrations, classification, emission sources, Air pollution standards, sources of pollutions, effects of Air pollution, Sources of contamination of surface and ground water.	**9**	**CO1**
2	**Air Pollution Sampling and Measurements:** Ambient air sampling, Collection of gaseous air pollutants, Collection of particulate pollutants, stack sampling, Analysis of Air pollutants.	**9**	**CO1, CO2**
3	**Air Pollution Monitoring Instruments:** Photometry, Mass spectrometry, NMR, X-ray Fluorescence, Infra-red spectrometry, Flame photometry, Atomic absorption spectroscopy, chromatography, Coulometry etc. for measurement of SO2, Nitrogen oxides, carbon monoxide, hydrocarbons and particulate matter.	**9**	**CO2, CO3**
4	**Water Pollution sampling and Measurements and Monitoring Instruments:** Sampling and Analysis, Samplers-Bailers, Heavy metal and trace metal analyzers, pH meters, Resistivity meters, Induced Polarization (IP) Meter for monitoring of industrial contamination. Waste water management and recycling equipment.	**9**	**CO1, CO4, CO5**

Recommended Books:

1. A Text Book in Environmental Pollution and control, Bhatia H.S., Galgotia Publication (1998)
2. Environmental Engineering and Management, Dhameja S.K., S.K Kataria (2000)
3. Air Pollution, Rao M.N. and Rao H.V., Tata McGraw Hill (2004)
4. Environmental Pollution Control, Rao. C.S., New Age International (P) Limited, Publishers (2006) 2nd ed.
5. Environmental Pollution Analysis, S M Khopkar, New Age International.
6. Industrial Pollution, V P Kudesa, PragatiPrakashan
7. Ground Water Hydrology, David Keith Todd, Wiley Publications

Note for Examiner(s): Question paper will comprise three sections,

1. Section-A will be compulsory and comprise 4-short answer type questions uniformly spread to the entire syllabus.
2. Section-B will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on concepts, definitions, derivations, principles, construction and working etc.
3. Section-C will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on derivations, numerical and applications of the various topics covered therein.

Note for Students:

1. Section – A is compulsory and attempt/answer all the four questions carrying 12 marks in total.
2. Attempt/answer two questions each out of the Section – B and Section – C. All questions will carry 12 marks.

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-OE-301	**Course Name: Open Elective-III** (ii) Electromagnetic Filed Theory		**L**	**T**	**P**	**C**
			3	**1**	**-**	**4**
Year and Semester	**3rd Yr. 5th Semester**	**Contact hours per week:** (4Hrs) Exam: (3 Hrs)				
Pre-requisite of course	**NIL**	**Evaluation**				
		CIE: 40	**SEE: 60**			

Course Objectives:	
1. To introduce the basic mathematical concepts related to electromagnetic vector fields.	
2. To impart knowledge on the concepts of electrostatics, electrical potential, energy density and their applications.	
3. To impart knowledge on the concepts of magnetostatics, magnetic flux density, scalar and vector potential and its applications	
4. To impart knowledge on the concepts of Faraday's law, induced emf and Maxwell's equations.	
5. To impart knowledge on the concepts of Concepts of electromagnetic waves and Pointing vector.	
6. To acquaint mathematically with transmission lines circuits and their characteristics.	
Course Outcomes: On completion of the course, student would be able to:	
CO1	Have a good understanding of various principles and phenomenon of electrostatics through analytical illustrations.
CO2	Gain sound knowledge of magnetostatics in terms of magnetic field, flux density,

	current density, and time varying equations (Maxwell's equations).
CO3	Understand and apply Maxwell's equations for time varying fields.
CO4	Understand and explain the characteristics, propagation of EM waves under different media and conditions.
CO5	Have knowledge of transmission times in terms of Characteristics Impedance, Propagation Constant, Phase and Group Velocities, Input Impedance Relations through illustrations.

Module No	COURSE SYLLABUS CONTENTS OF MODULE	Hrs	COs
1	**Electrostatics:** Coulomb's Law, Electric Field Intensity - Fields due to Different Charge Distributions, Electric Flux Density, Gauss Law and Applications, Electric Potential, Relations Between E and V, Maxwell's Two Equations for Electrostatic Fields, Energy Density, Illustrative Problems, Convection and Conduction Current, Dielectric Constant, Isotropic and Homogeneous Dielectrics, Continuity Equation, Relaxation Time.	**8**	**CO1**
2	**Magnetostatics:** Biot - Savart's Law , Ampere's Circuital Law and Applications, Magnetic Flux Density, Maxwell's Two Equations for Magnetostatic Fields, Magnetic Scalar and Vector Potentials, Forces due to Magnetic Fields, Ampere's Force Law, Inductance and Magnetic Energy, Illustrative Problem.	**6**	**CO2**
3	**Time Varying Fields (Maxwell's equations):**Ampere's Law and Displacement Current Density, Maxwell's Equations in Different Forms and Word Statements, Conditions at a Boundary Surface: Dielectric - Dielectric and Dielectric - Conductor Interfaces, Illustrative Problems	**6**	**CO3**
4	**EM Wave Characteristics** Wave Equations for Conducting and Perfect Dielectric Media, Uniform Plane Waves - Definition, All Relations Between E & H, Sinusoidal Variations, Wave Propagation in Lossless and Conducting Media, Conductors & Dielectrics - Characterization, Wave Propagation in Good Conductors and Good Dielectrics, Polarization, Illustrative Problems. **Reflection and Refraction of Plane Waves** - Normal and Oblique Incidence for both perfect Conductor and perfect Dielectrics, Brewster Angle, Critical Angle and Total Internal Reflection, Surface Impedance, Poynting Vector and Poynting Theorem - Applications, Power Loss in a Plane Conductor., Illustrative Problems.	**10**	**CO4**
5	**Transmission Lines** Types, Parameters, Transmission Line Equations, Primary & Secondary Constants, Expressions for Characteristics Impedance, Propagation Constant, Phase and Group Velocities, Infinite Line Concepts, Losslessness/Low Loss Characterization, Input Impedance Relations, SC and OC Lines, Reflection Coefficient,Illustrative Problems.	**6**	**CO5**

Text Books:

1. Electromagnetism – Theory and Applications, Ashutosh Pramanik, , PHI Learning Private Limited, New Delhi, Second Edition-2009.

2. Engineering Electro-magnetics : E. C. Jordan.
3. Electromagnetic Field Theory (including Antennaes and wave propagation,K.A. Gangadhar, P.M. Ramanthan 16th Edition, Khanna Publications, 2007.

Reference Books:

1. Field & Wave Electromagnetic: Cheng, Pearson Education
2. Principles of Electromagnetics', Mathew N. O. Sadiku, 4th Edition ,Oxford University Press Inc. First India edition, 2009.
3. Electromagnetics: Edminister, Schaum series, 2nd Ed.

Note for Examiner(s): Question paper will comprise three sections,

1. Section-A will be compulsory and comprise 4-short answer type questions uniformly spread to the entire syllabus.
2. Section-B will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on concepts, definitions, derivations, principles, construction and working etc.
3. Section-C will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on derivations, numerical and applications of the various topics covered therein.

Note for Students:

1. Section – A is compulsory and attempt/answer all the four questions carrying 12 marks in total.
2. Attempt/answer two questions each out of the Section – B and Section – C. All questions will carry 12 marks.

Program Name: B. Tech.-Electrical and Instrumentation Engineering

<table>
<tr><td>Course Code:
EI-OE-301</td><td colspan="2">Course Name: Open Elective-III
(iii) Mathematics– III</td><td>L
3</td><td>T
1</td><td>P
0</td><td>C
4</td></tr>
<tr><td>Year and Semester</td><td>3rd Year
5th Semester</td><td colspan="4">Contact hours per week: (4 Hrs)
Exam: (3 Hrs)</td></tr>
<tr><td rowspan="2">Pre-requisite of course</td><td rowspan="2">The course assume prior knowledge of Infinite series, Trigonometric relations, Partial Differentiation, Probability concepts</td><td colspan="4">Evaluation</td></tr>
<tr><td colspan="2">CIE: 40</td><td colspan="2">SEE: 60</td></tr>
<tr><td colspan="7">Course Objectives:</td></tr>
<tr><td colspan="7">9. To understand power series and possible application for solving differential equation</td></tr>
<tr><td colspan="7">10. To know and understand the Fourier series expansions and its utilities.</td></tr>
<tr><td colspan="7">11. To gain knowledge on complex domains and evaluate residues of series expansions in complex domains.</td></tr>
<tr><td colspan="7">12. To explore and analyze Probability distributions and probe its utilities in various situations.</td></tr>
<tr><td colspan="7">Course Outcomes: On completion of the course, student would be able to:</td></tr>
<tr><td>CO1</td><td colspan="6">Understand the fundamental of series expansions.</td></tr>
<tr><td>CO2</td><td colspan="6">Apply the series expansions to solve various Mathematical problem situations.</td></tr>
<tr><td>CO3</td><td colspan="6">Understand and analyze complex functions handling and its applications to solve various problems.</td></tr>
</table>

CO4	Students should be able to use his knowledge of probability to analyze and apply to communicate in technical ways.

Module No	COURSE SYLLABUS CONTENTS OF MODULE	Hrs	COs
1	**Bessel functions:** series solution of Bessel differential equation, Bessel function of first kind Jn(x), recurrence relations. **Legendre Polynomials:** Legendre differential equation, Legendre polynomials $P_n(x)$ as solution of Legendre differential equation for (n>0), recurrence relations.	**10**	**CO1, CO2**
2	**Fourier Series:** Euler's formulae, conditions for Fourier expansions, Fourier expansion of functions having points of discontinuity, change of interval, odd & even functions, half range series. **Fourier Transforms:** Fourier Integrals, Fourier transforms, Fourier cosine and sine transforms, **Properties of Fourier Transforms**: convolution theorem, Parseval's identity, relation between Fourier and Laplace transforms	**8**	**CO1, CO2**
3	**Function of a complex variables:** Cauchy-Riemann equations, necessary and sufficient conditions for a function to be analytic, harmonic functions, Taylor and Laurent series, singular points, residues, evaluation of residues at poles, and poles of m^{th} order, Cauchy's residue theorem, the Cauchy's principle value, evaluation of definite integrals.	**10**	**CO1, CO2, CO3**
4	**Probability Distributions:** Probability, Bayes theorem, Discrete & Continuous probability distributions, discrete random variable, probability function, distribution function, Mathematical expectation, expectation of a sum of random variables, expectation of product of independent variables, covariance, Moment generating function, probability generating function.	**8**	**CO1, CO2, CO4**

TEXT BOOKS:

1. Advanced Engineering Mathematics by E. Kreyszig. 10th Edition, John Wiley
2. Higher Engineering Mathematics by B.S. Grewal. 43rd Edition, Khanna Publications
3. Schaum's Outline of Complex Variables by Murray R. Spiegel, 2nd Edition, McGraw-Hill Education
4. Probability and Statistics for Engineers by J. Ravichandran, Wiley India Publication.

REFERENCE BOOKS:

1. Engineering Mathematics Part-I: S.S. Sastry, 4th Edition, PHI.
2. Advanced Engineering Mathematics: R.K. Jain, S.R.K. Iyengar, 3rd Edition, Narosa Publications
3. Probability and Statistics for Engineers by Richard A Johnson, 9th Edition, PHI

Note for Examiner(s): Question paper will comprise three sections,

1. Section-A will be compulsory and comprise 4-short answer type questions uniformly spread to the entire syllabus.

2. Section-B will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on concepts, definitions, derivations, principles, construction and working etc.
3. Section-C will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on derivations, numerical and applications of the various topics covered therein.

Note for Students:

1. Section – A is compulsory and attempt/answer all the four questions carrying 12 marks in total.
2. Attempt/answer two questions each out of the Section – B and Section – C. All questions will carry 12 marks.

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-OE-301	**Course Name: Open Elective-III** (iv) Energy Efficient Systems	**L**	**T**	**P**	**C**
		3	**1**	**0**	**4**
Year and Semester	**3rd Year (Vth Semester)**	**Contact hours per week:** (4Hrs) Exam: (3 Hrs)			
Pre-requisite of course	Brief knowledge of in the following topics: Electrical Machines, Electrical Power System and Generation.	**Evaluation**			
		CIE: 40	**SEE: 60**		

Course Objectives:	
1. To introduce the concept of single phase and three phase motors.	
2. To introduce the concept of Energy efficient machines and Economics of Power factor improvements.	
3. To study the concept of Energy efficient lighting and Economics of Energy power generation.	
4. To study the concept of economics of electrical energy distribution and electrical drives.	
Course Outcomes: On completion of the course, student would be able to:	
CO1	To Familiarize withthe concept of single phase and three phase motors.
CO2	To understand the concept of Energy efficient machines and Economics of Power factor improvements.
CO3	To Familiarize with the concept of Energy efficient lighting and Economics of Energy power generation.
CO4	To understand the concept of economics of electrical energy distribution and electrical drives.

Module No	**COURSE SYLLABUS** **CONTENTS OF MODULE**	**Hrs**	**COs**
1	**THREE PHASE INDUCTION MOTROS:** Cage motors-equivalent circuit-speed-torque characteristics-performance characteristics voltage unbalance-over motoring-slip ring induction motor characteristics multi speed motors. **SINGLE PHASE INDUCTION MOTORS:** Starting & running performance-split phase-capacitor type motor-characteristics reluctance motor.	**7**	**CO1**
2	**ENERGY EFFICIENT MOTORS:** Constructional details-factors affecting	**8**	**CO2**

	efficiency-losses distribution-characteristics calculation of pay back period. **ECONOMICS OF POWER FACTOR IMPROVEMENT:** Simple pay back method-return on investment-life cycle analysis.		
3	**ENERGY EFFICIENT LIGHTING:** Terminology-cosine law of illumination-types of lamps-characteristics-design of illumination systems-good lighting practice-lighting control-steps for lighting energy conservation. **ECONOMICS OF ELECTRICAL ENERGY GENERATION:**Definitions-connected load, maximum demand-demand factor-curve-base load and peck load.	**11**	**CO3**
4	**ECONOMICS OF ELECTRICAL ENERGY DISTRIBUTION:** Electrical load analysis-type of consumers& tariffs-line losses-corner losses-types of distribution systems- Kevin's law-loss load factor. **ECONOMICS OF ELECTRICAL DRIVES:** Selection of motors-types of loads-energy consumption during starting of ac and dc motors braking of motors-plugging-regenerative braking.	**10**	**CO4**

Text Books:

1. Electrical Machinery: Fitzerland, Kingsley, Kusko-MC Graw Hill Ltd.
2. Energy-Efficient Electrical motors: John C.Andreas-Marcel Decker Inc.
3. Electrical Technology: Edward Hughes-ElLBS. Energy Management and good lighting practice: Fuel Efficiency Booklet 12-eeo.

Note for Examiner(s): Question paper will comprise three sections,

1. Section-A will be compulsory and comprise 4-short answer type questions uniformly spread to the entire syllabus.
2. Section-B will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on concepts, definitions, derivations, principles, construction and working etc.
3. Section-C will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on derivations, numerical and applications of the various topics covered therein.

Note for Students:

1. Section – A is compulsory and attempt/answer all the four questions carrying 12 marks in total.
2. Attempt/answer two questions each out of the Section – B and Section – C. All questions will carry 12 marks.

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-PC-303	**Course Name:** Power Electronics-II	**L**	**T**	**P**	**C**
		3	**1**	**0**	**4**
Year and Semester	**3rd Year (Vth Semester)**	**Contact hours per week:** (4Hrs) Exam: (3 Hrs)			
Pre-requisite of course	Brief knowledge of in the following topics: Power Electronics I, Basic Electrical and Electronics engineering, Semiconductor devices, Digital Electronics, rectifiers.	**Evaluation**			
		CIE: 40	**SEE: 60**		
Course Objectives:					

1. To introduce the concept of Choppers.	
2. To introduce the concept of Inverters and types of inverters.	
3. To study the modulation & harmonics and techniques to remove harmonics.	
4. To study various types of chopper drives and its applications.	
Course Outcomes: On completion of the course, student would be able to:	
CO1	To Familiarize with control strategies of choppers, types of choppers.
CO2	To understand the working of Inverters.
CO3	To Familiarize with inverters, types of choppers and their mode of angles of operations.
CO4	To understand the applications of choppers and at different stages.

Module No	COURSE SYLLABUS CONTENTS OF MODULE	Hrs	COs
1	**Choppers:** Principle of choppers, Control strategies; Constant frequency system and Variable frequency system. Step-up choppers, Types of chopper Circuits; First Quadrant or Type-A choppers, Second-Quadrant or Type-b choppers, Two-Quadrant Type-a Chopper or Type-C chopper, Two-Quadrant Type-b Chopper or Type-D chopper, Four-Quadrant Type-a Chopper or Type-E chopper.	**7**	**CO1**
2	**Inverters:** operating Principle of Single Phase Voltage source inverter; Single –Phase bridge inverter, Force-commutated thyristor inverter; Modified Mcmurray-Bedford Half-bridge Inverter, Modified Mcmurray-Bedford Full-bridge Inverter, Three Phase Bridge Inverter; Three –Phase 180^0 Mode VSI and Three –Phase 120^0 Mode VSI.	**8**	**CO2**
3	**Modulation and Harmonics;** Pulse Width Modulated Inverter; Single-Phase Modulation, Multiple Phase Modulation, Sinusoidal Pulse Modulation (Sin M), Reduction Of Harmonics in the inverter output Voltage; Harmonics Reduction by PWM, Harmonics Reduction by Transformer connection, Harmonics Reduction by Stepped wave Inverter.	**11**	**CO3**
4	**Chopper Drives and Applications:** Thyristor Chopper Circuits; Voltage commutated choppers, Current-commutated choppers and Load commutated choppers. Chopper Drives; Power Control or Motoring Control. Regenerative-Breaking control, Two Quadrant chopper control and Four Quadrant Chopper control, Static Kramer Drives, Static Scherbius Drive. (No quantitative analysis)	**10**	**CO4**

Text Books:

1. Modern Power Devices by B.Jayant Balica, New Age Inter.
2. Power Electronics by P.C. Sen (TMH)
3. An Introduction to Thyristors and Their Applications by M. Ramamurthy (EWP)
4. Power electronics by Ned Mohan and Robins, John Wiley and Sons
5. Power Electronics by M. Rashid (PHI)
6. Thyristor Phase Controlled converters and Cyclo-converters by B.R.Pelly
7. Power Electronics by Vendem Subrahmanyam, New Age International

Note for Examiner(s): Question paper will comprise three sections,

1. Section-A will be compulsory and comprise 4-short answer type questions uniformly spread to the entire syllabus.

2. Section-B will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on concepts, definitions, derivations, principles, construction and working etc.
3. Section-C will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on derivations, numerical and applications of the various topics covered therein.

Note for Students:

1. Section – A is compulsory and attempt/answer all the four questions carrying 12 marks in total.
2. Attempt/answer two questions each out of the Section – B and Section – C. All questions will carry 12 marks.

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-PE-305	**Course Name: Program Elective-II** (i) Microprocessors	**L**	**T**	**P**	**C**
		3	**1**	**-**	**4**
Year and Semester	**3rd Yr.** **5th Semester**	**Contact hours per week:** (4Hrs) Exam: (3 Hrs)			
Pre-requisite of course	EI-OE-210 DIGITAL TECHNIQUES IVth Semester	**Evaluation**			
		CIE: 40	**SEE: 60**		

Course Objectives:

1. To equip the students with architecture and working of basic microprocessors.
2. To make the students understand the instructions sets of basic microprocessors and various assembly language programs.
3. To impart the knowledge of various programmable interfacing chips.
4. To design and study the various instrumentation systems with programmable chips.

Course Outcomes: On completion of the course, student would be able to:

CO1	Understand the basic of the internal organisation of 8086 Microprocessor.
CO2	Understand different addressing modes and instructions of 8086, design and develop assembly language programs using software interrupts, subroutines, macros.
CO3	Understand to interface memory and I/O devices with 8086 through programmable interface chips
CO4	Understand interrupt structure in 8086 and few case studies using interfacing chips useful in instrumentation systems.

Module No	**COURSE SYLLABUS CONTENTS OF MODULE**	**Hrs**	**COs**
1	Introduction and Evolution of microprocessors, Introduction to Microcomputer systems, 8086 Microprocessor - Architecture and signals, Pin diagram, Memory organisation,, Minimum mode 8086 system and Timing diagrams, Maximum Mode 8086 system and Timing diagrams.	**8**	**CO1**
2	8086 Addressing Modes, 8086 Instruction set and Assembler Directives - Assembly Language Programming, Basic interfacing concepts in a microprocessor, Peripheral and Memory mapped I/O, PPI 8255, Modes of operation – Mode-0 and BSR Mode	**8**	**CO2**

3	Block diagram, Control word format and modes of operation of Keyboard displace interface 8279 , DMA controller 8257 and Programmable interval timer 8253, Basic concepts of Serial Communication interface chip (e.g.8251)	**8**	**CO2 CO3**
4	Interrupts study - Types of Interrupts and Interrupt Service Routine. Handling Interrupts in 8086, Interrupt programming, Programmable Interrupt Controller - 8259 – Architecture only. Programming and applications Case studies using interface chips: Traffic Light control, Interfacing Keyboard display and and temperature Controller using 8255.	**8**	**CO2 CO3 CO4**

Reference Books:

1. Microprocessor Architecture Programming and Applications by Gaonkar, Penram International
2. Microprocessor system: The 8086/8088 family IInd ed. By Yu.Cheng & Gibson
3. Microprocessors and interfacing by D.V.Hall
4. Bhurchandi and Ray, Advanced Microprocessors and Peripherals, Third Edition McGraw Hill.

Note for Examiner(s): Question paper will comprise three sections,

1. Section-A will be compulsory and comprise 4-short answer type questions uniformly spread to the entire syllabus.

2. Section-B will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on concepts, definitions, derivations, principles, construction and working etc.

3. Section-C will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on derivations, numerical and applications of the various topics covered therein.

Note for Students:

1. Section – A is compulsory and attempt/answer all the four questions carrying 12 marks in total.

2. Attempt/answer two questions each out of the Section – B and Section – C. All questions will carry 12 marks.

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code:	**Course Name: Program Elective-II**	**L**	**T**	**P**	**C**
EI-PE-305	(ii) Analog and Digital Communication	**3**	**1**	**-**	**4**
Year and Semester	**3rd Yr. 5th Semester**	**Contact hours per week:** (4Hrs) Exam: (3 Hrs)			
Pre-requisite of course	**NIL**	**Evaluation**			
		CIE: 40	**SEE: 60**		

Course Objectives:
1. To introduce students with the need for electronic communication.
2. To familiarize with analog modulation and its formats.
3. To have understanding of angle modulation and its types.
4. To have knowledge of pulse modulation and digital modulation.
5. To gain analytical skills based information theory.

6. To have basic knowledge about source coding and error controlling codes.	
Course Outcomes: On completion of the course, student would be able to:	
CO1	Acquire knowledge about the analog modulation and its different formats including power and current relations in and AM wave.
CO2	Have good understanding of angle modulation including frequency modulation and phase modulation and respective demodulation techniques.
CO3	Acquire knowledge about pulse analog modulation and digital modulation and respective demodulation techniques.
CO4	To have acquaint about the basics of information theory and associated codes.
CO5	Acquire basic knowledge about source coding and error control coding techniques together with solving simple numerical problems.
CO6	

Module No	COURSE SYLLABUS CONTENTS OF MODULE	Hrs	COs
1	**Amplitude Modulation:** Need for modulation, Amplitude Modulation - Time and frequency domain description, single tone modulation, power relations in AM waves, Generation of AM waves, Detection of AM Waves - Envelope detector, DSBSC modulation, Generation of DSBSC Waves - Balanced Modulators, SSB modulation and demodulation.	**7**	**CO1**
2	**Angle Modulation:**Basic concepts of Phase Modulation, Frequency Modulation: Single tonefrequency modulation, Spectrum Analysis of Sinusoidal FM Wave, Narrow band FM and Wide band FM, Transmission bandwidth of FM Wave, Generation of FM Signal, Demodulation of FM, Comparison of FM and AM.,	**7**	**CO2**
3	**Pulse Modulation:** PCM Generation and Reconstruction, Differential Pulse code modulation, Delta Modulation and Adaptive Delta Modulation. **Digital Modulation Techniques:** ASK- Modulator, Coherent ASK Detector, FSK- Modulator, Non- Coherent FSK Detector, BPSK- Modulator, Coherent BPSK Detection. Principles of QPSK, Differential PSK.	**10**	**CO3**
4	**Information Theory:** Information, Average Information, Mutual Information, Entropy, Information Sources, Communication Channels, Channel Models, Channel Matrix, Joint probability Matrix, Binary Symmetric Channel, Channel Capacity.	**7**	**CO4**
5	**Source Coding:** Source coding theorem, Prefix Codes, Krafts inequality, Shannon's Encoding Algorithm Shannon Fano Encoding Algorithm, Huffman codes. **Basics of Error Control coding:**Longitudinal Redundancy Check (LRC), Vertical Redundancy Check (VRC), linear block codes, cyclic codes.	**7**	**CO5**

Text Books:

1. Communication systems, Sanjay Sharma, Katson, Publications
2. Modern Digital and Analog Communication Systems, B P Lathi, Zhi Ding, H M Gupta, Oxford publishers.

3. Electronics & Communication System, George Kennedy and Bernard Davis, TMH 2004

Reference Books:

1. Principles of Communication Systems" - Herbert Taub, Donald L Schilling, Goutam Saha, 3rd Edition, McGraw-Hill, 2008.
2. Electronic Communications" – Dennis Roddy and John Coolean , 4th Edition , PEA, 2004.

Note for Examiner(s): Question paper will comprise three sections,

1. Section-A will be compulsory and comprise 4-short answer type questions uniformly spread to the entire syllabus.
2. Section-B will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on concepts, definitions, derivations, principles, construction and working etc.
3. Section-C will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on derivations, numerical and applications of the various topics covered therein.

Note for Students:

1. Section – A is compulsory and attempt/answer all the four questions carrying 12 marks in total.
2. Attempt/answer two questions each out of the Section – B and Section – C. All questions will carry 12 marks.

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-PE-305	**Course Name: Program Elective-II** (iii) Switchgear and Protection	**L**	**T**	**P**	**C**
		3	**1**	**0**	**4**
Year and Semester	**3rd Year (Vth Semester)**	**Contact hours per week:** (4Hrs) Exam: (3 Hrs)			
Pre-requisite of course	Brief knowledge of in the following topics: Electrical Machines, Power Electronics.	**Evaluation**			
		CIE: 40	**SEE: 60**		

Course Objectives:
1. To introduce the concept of Electric Protection.
2. To Familiarize with Circuits Breakers and Lightning Arresters.
3. To understand the Protective relays.
4. To study the protection schemes.

Course Outcomes: On completion of the course, student would be able to:	
CO1	To Familiarize with Switches and Fuses.
CO2	To understand the Circuits Breakers and Lightning Arresters.
CO3	To understand the Protective relays.
CO4	To understand the protection schemes.

Module No	**COURSE SYLLABUS** **CONTENTS OF MODULE**	**Hrs**	**COs**
1	**SWITCHES AND FUSES:**Introduction, energy management of power system, definition of switchgear, switches - isolating, load	**7**	**CO1**

	breaking and earthing. Introduction to fuse, fuse law, cut -off characteristics,: Time current characteristics, fuse material, HRC fuse, liquid fuse, Application of fuse **PRINCIPLES OF CIRCUIT BREAKERS:**Introduction, requirement of a circuit breakers, difference between an isolator and circuit breaker, basic principle of operation of a circuit breaker, phenomena of arc, properties of arc, initiation and maintenance of arc, arc interruption theories - slepian's theory and energy balance theory, Restriking voltage, recovery voltage, Rate of rise of Restriking voltage, DC circuit breaking, AC circuit breaking, current chopping, capacitance switching, resistance switching, Rating of Circuit breakers.		
2	**CIRCUITS BREAKERS LIGHTNING ARRESTERS:**CIRCUITS BREAKERS: Air Circuit breakers – Air break and Air blast Circuit breakers, oil Circuit breakers - Single break, double break, minimum OCB, SF6 breaker - Preparation of SF6 gas, Puffer and non-Puffer type of SF6 breakers. Vacuum circuit breakers - principle of operation and constructional details. Advantages and disadvantages of different types of Circuit breakers, Testing of Circuit breakers, Unit testing, synthetic testing, substitution test, compensation test and capacitance test. LIGHTNING ARRESTERS: Causes of over voltages – internal and external, lightning, working principle of different types of lightning arresters. Shield wires.	**7**	**CO2**
3	**PROTECTIVE RELAYING:**Requirement of Protective Relaying, Zones of protection, primary and backup protection, Essential qualities of Protective Relaying, Classification of Protective Relays. **INDUCTION TYPE RELAY:**Non-directional and directional over current relays, IDMT and Directional characteristics. Differential relay – Principle of operation, percentage differential relay, bias characteristics, distance relay – Three stepped distance protection, Impedance relay, Reactance relay, Mho relay, Buchholz relay, Negative Sequence relay, Microprocessor based over current relay – block diagram approach.	**10**	**CO3**
4	**PROTECTION SCHEMES:**Generator Protection - Merz price protection, prime mover faults, stator and rotor faults, protection against abnormal conditions – unbalanced loading, loss of excitation, over speeding. Transformer Protection - Differential protection, differential relay with harmonic restraint, Inter turn faults Induction motor protection - protection against electrical faults such as phase fault, ground fault, and abnormal operating conditions such as single phasing, phase reversal, over load.	**12**	**CO4**

REFERENCE BOOKS:

1. Chakraborti, A., Soni, M.L., Gupta, P.V. and Bhatnagar, U.S., a Text Book on Power System Engineering, DhanpatRai and Co. (P) Ltd. (2008).
2. Pathinkar, Y.G. and Bhide, S.R., Fundamentals of Power System Protection, PHI Learning Pvt. Limited (2008).
3. Rao, S.S., Switchgear and Protection, Khanna Publishers (2007).

4. Deshpande, M.V., Switchgear and Protection, Tata McGraw–Hill (2005).
5. Elmore, W.A., Protective Relaying Theory and Applications, ABB Power T and D Company Inc. (2003).

Note for Examiner(s): Question paper will comprise three sections,

1. Section-A will be compulsory and comprise 4-short answer type questions uniformly spread to the entire syllabus.
2. Section-B will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on concepts, definitions, derivations, principles, construction and working etc.
3. Section-C will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on derivations, numerical and applications of the various topics covered therein.

Note for Students:

1. Section – A is compulsory and attempt/answer all the four questions carrying 12 marks in total.
2. Attempt/answer two questions each out of the Section – B and Section – C. All questions will carry 12 marks.

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-PC-307	**Course Name:** Power System - II	**L**	**T**	**P**	**C**
		3	**1**	**-**	**4**
Year and Semester	**3rd year 5th Semester**	**Contact hours per week:** (4Hrs) **Exam:** (3hrs.)			
Pre-requisite of course	**Basic Electrical Engineering, Power System-I**	**Evaluation**			
		CIE: 40	**SEE: 60**		

Course Objectives:	
1. To study the concept of corona and its impact in transmission line.	
2. To study the construction, features and types of underground cables.	
3. To introduce the concept of per unit system to study different faults in power system.	
4. To study the behavior of travelling waves on transmission lines.	
5. To study the concept of power system stability and methods to improve stability.	
Course Outcomes: On completion of the course, student would be able to:	
CO1	To understand the concept of corona and its impact in transmission line.
CO2	To understand the construction, features and types of underground cables.
CO3	Understand and implement the per-unit system and utilize it for fault analysis purpose.
CO4	To analyse the impact of travelling waves on transmission lines.
CO5	Understand the problem of power system stability and its impact on the system. The methods to improve stability.

Module No	**COURSE SYLLABUS CONTENTS OF MODULE**	**Hrs**	**COs**
1	**Corona:** Phenomenon of corona, disruptive critical voltage, visual critical voltage, corona loss, radio interference.	9	CO1, CO2

	Underground Cables: Classification and construction, insulation resistance, capacitance, capacitance determination, power factor in cables, capacitance grading, use of inter-sheaths, losses, heat dissipation and temperature rise in cables, current rating, comparison with overhead lines.		
2	**Per Unit System**: Change of base, per unit quantities in three phase system, selection of base values, base quantities in terms of KV and MVA, per unit load impendence, advantages of per unit representation, one-line diagrams, preparation of impendence and reactance diagrams. **Fault Analysis:** Transients on a transmission line, short circuit of synchronous machine at no load and on full load, Symmetrical component transformation, phase shift in star-delta transformation, sequence impedances, Single line to ground fault, line to line fault, double line to ground fault, open conductor fault.	8	CO3
3	**Travelling Waves on Transmission Line**: Lumped and Distributed Parameters – Wave Equation – Reflection, Refraction, Behaviour of Travelling waves at the line terminations – Lattice Diagrams – Attenuation and Distortion – Multi-conductor system and Velocity wave. **Transients of Transmission lines:** Transmission-line transients, Transient Analysis: Travelling Waves, reflections and refraction of waves.	9	CO4
4	**Power Systems Stability:** Definitions: angular stability- steady state stability, dynamic stability, transient stability, mechanics of angular momentum, swing equation, equal area criteria, critical clearing angle, solution of swing equation, stability study in multi-machine system, Technique of improving transient stability, Voltage stability, Voltage collapse, V-P and V-Q curves.	8	CO5

Suggested Text / Reference Books:

1. John J. Grainger, William D. Stevenson,"Power System Analysis", McGraw-Hill
2. B.Ram, D.N.Vishvakarma,"Power System protection and switchgear", TMH.
3. B. M. Weedy, B. J. Cory, "Electric Power Systems", John Wiley& Sons.
4. I.J. Nagrath and D.P. Kothari,"Power System Engg", TMH.
5. Soni, Gupta and Bhatnagar,"A course in Electrical Power", DhanpatRai& Sons.
6. K.R. Padiyar, " Power System Dynamics, Stability and Control", B. S. Publications,2002.
7. P. Kundur, " Power System Stability and Control", McGraw Hill,1995.
8. P. Sauer and M. A. Pai, " Power System Dynamics and Stability" , Prentice Hall,1997..

Note for Examiner(s): Question paper will comprise three sections,

1. Section-A will be compulsory and comprise 4-short answer type questions uniformly spread to the entire syllabus.
2. Section-B will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on concepts, definitions, derivations, principles, construction and working etc.
3. Section-C will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on derivations, numerical and applications of the various topics covered therein.

Note for Students:

1. Section – A is compulsory and attempt/answer all the four questions carrying 12 marks in total.
2. Attempt/answer two questions each out of the Section – B and Section – C. All questions will carry 12 marks.

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-PC-309	**Course Name:** Linear Automatic Control System	**L**	**T**	**P**	**C**
		3	**1**	**0**	**4**
Year and Semester	**3rd Year (V^{th} Semester)**	**Contact hours per week:** (4Hrs) Exam: (3 Hrs)			
Pre-requisite of course	**Control system components**	**Evaluation**			
		CIE: 40	**SEE: 60**		

Course Objectives:

1. Study the time response of various types (0, 1, 2, 3, etc.) of system Execute time response analysis of a second order control system using MATLAB/ simulation software
2. Study the Stability analysis of Linear system, Analyze and interpret stability of the system through Root Locus, Bode plot and Nyquist plot.
3. Study Lag, Lead, Lead-Lag compensators and verify experimental results using MATLAB.
4. Study the concept of state, state variables and various state models techniques and concept of controllability and observability, pole placement by state feedback

Course Outcomes: On completion of the course, student would be able to:

CO1	Ability to derive Mathematical Modeling various types (0, 1, 2, 3, etc.) of system and anayze their time responses
CO2	Able to Analyze the effect of P, PI, PD and PID controllers on a control system and design suitable controller for a typical process
CO3	Ability to Analyze and interpret stability of the systemthroughRoot Locus, Bode plot and Nyquist plot.
CO4	Able to design lead, lag, lead-lag compensators using time domain and frequency domain analysis techniques.
CO5	An ability to understand concept of state, state variables and the design output feedback controller in state space.

Module No	**COURSE SYLLABUS** **CONTENTS OF MODULE**	**Hrs**	**COs**
1	TIME DOMAIN ANALYSIS: Standard test signal (step, ramp, impulse, parabolic) time response of various types (0, 1, 2, 3, etc.) of system. Steady state error analysis, Design consideration of 2^{nd}order system, design of higher order system, performance indices.	**9**	**CO1 CO2**
2	STABILITY OF A CONTROL SYSTEM : Concept of stability, necessary conditions of stability, Hurwitz Stability criterion, Routh stability criterion, relative stability analysis, more on the Routh stability criterion, The Root locus technique: The root locus concept construction of root loci, root contours, system with transportation Lag.	**9**	**CO3 CO4**
3	FREQUENCY DOMAIN ANALYSIS: Correlation between time and frequency response, polar plots, bode plots, all- pass and minimum-	**10**	**CO3 CO4**

	phase system, experimental determination of transfer functions, log magnitudeversus phase plots. Stability in frequency domain: Nyquist stability criterion, assessment of relativestability using Nyquist criterion, closed-loop frequency response.		
4	STATE VARIABLE ANALYSIS AND DESIGN: Concept of state, state variables and state models, state models for linear continuous time system, diagonization, solution of state equations, concept of controllability and observability, pole placement by state feedback.	**10**	**CO5**

Reference Books:

1. Automatic Control System By Kuo
2. Feedback Control System By D'Azzo and Houpis
3. Modern Control Engineering By Oagata
4. Control Systems Engineering By Nagrath & Gopal.

Note for Examiner(s): Question paper will comprise three sections,

1. Section-A will be compulsory and comprise 4-short answer type questions uniformly spread to the entire syllabus.

2. Section-B will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on concepts, definitions, derivations, principles, construction and working etc.

3. Section-C will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on derivations, numerical and applications of the various topics covered therein.

Note for Students:

1. Section – A is compulsory and attempt/answer all the four questions carrying 12 marks in total.

2. Attempt/answer two questions each out of the Section – B and Section – C. All questions will carry 12 marks.

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-PRPC-17	**Course Name:** Power Electronics Lab. - II	**L**	**T**	**P**	**C**
		0	**0**	**3**	**1.5**
Year and Semester	**3rd Year** **Vth Semester**	**Contact hours per week:** (3Hrs) **Exam:** (3hrs.)			
Pre-requisite of course	Brief knowledge of in the following topics: Basic Electrical and Electronics engineering, Semiconductor devices, Digital Electronics, rectifiers.	**Evaluation**			
		CIE: 30	**SEE: 45**		

Course Objectives:
1. Understand operation of different types of choppers.
2. Understand the operation of series and parallel inverters.
3. Understand half & full wave Single phase and three phase converters.
4. Understand the concept of Dual Converter.
5. Understand the motor control
Course Outcomes: On completion of the course, student would be able to:

CO1	To understand the operation of John's and Morgon's of choppers.

CO2	To understand the operation of series and parallel inverters.
CO3	To understand the output characteristics of half & full wave Single phase and three phase converters.
CO4	To understand the significance and operation of Dual Converter.
CO5	To understand the motor control.

Expt. No	COURSE SYLLABUS CONTENTS OF MODULE	COs
	LIST OF EXPERIMENTS STUDY EXPERIMENTS :	**CO1, CO2, CO3, CO4**
1.	To Study the parallel inverter.	
2.	To study John's Chopper	
3.	To study the three phase full controlled converter.	
4.	To study the Morgon.s Chopper.	
5.	To study the three phase half controlled converter.	
6.	To Study the series inverter.	
7.	To study dual converter.	
8.	To study the single phase half and full controlled converter.	
9.	To study speed control of DC motor.	
10.	To study half controlled bridge converter under reactive load.	
	SIMULATION EXPERIMENTS :	
11.	Single Phase Half wave controlled converter with R,RL&RLE Load (for firing angles 30,60,90)with/without FD	
12.	Single Phase Half controlled converter with R,RL&RLE Load (for firing angles 30,60,90)with/without FD	
13.	Single Phase Full controlled converter with R,RL&RLE Load (for firing angles 30,60,90)with/without FD	
14.	Three Phase semi controlled converter with R,RL&RLE Load	
15.	Three Phase full controlled converter with R,RL&RLE Load	
16.	Single phase AC Voltage Controller with R&RL Loads	
17.	John's Chopper	
18.	Morgon.s Chopper	
	HARDWARE EXPERIMENTS :	
19.	Thyristorised drive for PMDC motor with speed measurement and Single Phase Half controlled rectifier and full controlled rectifier	
20.	Three Phase input Thyristorised drive for Dc Motor with closed loop control	
21.	Single Phase Series Inverter	
22.	Single Phase Parallel Inverter	

REFERENCE BOOKS:

1. Modern Power Devices by B.Jayant Balica, New Age Inter.
2. Power Electronics by P.C. Sen (TMH)
3. An Introduction to Thyristors and Their Applications by M. Ramamurthy (EWP)
4. Power electronics by Ned Mohan and Robins, John Wiley and Sons
5. Thyristor Phase Controlled converters and Cyclo-converters by B.R.Pelly
6. Power Electronics by Vendem Subrahmanyam, New Age International

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-PRPC-19	**Course Name:** Power System-II LAB	**L**	**T**	**P**	**C**
		0	**0**	**3**	**1.5**
Year and Semester	**3rdYear 5th Semester**	**Contact hours per week:** (3Hrs) **Exam:** (3hrs.)			
Pre-requisite of course	**Basic Electrical Engineering Lab, Power System-I Lab**	**Evaluation**			
		CIE: 30	**SEE: 45**		

Course Objectives:

To study the working operation of relays and its main components.

To familiarize with the power system elements, devices, equipments and applications.

To study different type of transmission cables and their applications.

To Familiarize with the safety rules for power system laboratory.

Course Outcomes: On completion of the course, student would be able to:

CO1	Impart the practical knowledge of basic of equipments of power system and its operation.
CO2	Ability to analyze the performance as well as handling of electrical elements and equipments like underground cables, insulators etc.
CO3	Acknowledge the operation and main features of protective relays
CO4	Develop skills to use power system elements and devices in different technological field.

Expt. No	**COURSE SYLLABUS** **CONTENTS OF MODULE**	**COs**
1	Single line diagram of electrical power flow of generalized power substation.	**CO1 CO2 CO3 CO4**
2	To study and designing of Earthing / Grounding	
3	To plot equi-potential curve and voltage gradient in iii. Two/three core cable iv. Single-core cable.	
4	To study the different parts of a power cable and measurement of insulation resistance of a cable.	
5	To study the core to core & core to sheath capacitance of a three phase cable.	
6	To draw the operating characteristics of IDMT over Voltage relay.	
7	To draw the operating characteristics of Differential current relay.	
8	To draw the operating characteristics of negative sequence relay.	
9	To draw the operating characteristics of IDMT over current relay.	
10	Study the burden effect on the performance of CT and measure ratio error.	
11	Find out the sequence components of currents in three 1-Phase transformers and 3- Phase transformer and compare their results.	
12	To determine the earth resistance using Megger.	

Reference books:

1. Power System Engg: I.J.Nagrath and D.P.Kothari (TMH)
2. A Course in Electrical Power: Gupta, Soni & Bhatnagar (Dhanpat Rai & Sons).
3. Electric Power System: B.M.Weedy, John Wiley & Sons.
4. Transmission & Distribution of Electrical Engineering: Westing House & Oxford Univ. Press, New Delhi.

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-PRPE-21	**Course Name: Program Elective- II Lab (i)** Microprocessors lab.	**L**	**T**	**P**	**C**
		0	**0**	**3**	**1.5**
Year and Semester	**3rd Year** **Vth Semester**	**Contact hours per week:** (3Hrs) **Exam:** (3hrs.)			
Pre-requisite of course	EI-PROE-14, Digital Techniques Lab.	**Evaluation**			
		CIE: 30	**SEE: 45**		

Course Objectives:

1. Understand the basics of microprocessors, architecture and operation of microprocessors and their peripherals.
2. Understand the concepts of machine instructions, assembly language and programs.
3. Expose different ways of communicating with I/O devices and standard I/O interfaces.
4. Analyze and design microprocessor based instrumentation system.

Course Outcomes: On completion of the course, student would be able to:

CO1	Get familiarized with the microprocessor based system.
CO2	Create and develop ALPs with arithmetic and logical Instructions, Loop instructions, use of directives and others.
CO3	Work on the ALPs involving the peripheral chips interface.
CO4	Design and develop programs for microprocessor based instrumentation system.

Expt. No	**COURSE SYLLABUS** **CONTENTS OF MODULE**	**COs**
1	Write the working of 8086 and basic architecture of 8086 along with small introduction	**CO1, CO2, CO3, CO4**
2	Study the complete instruction set of 8086 and write the instructions with examples.	
3	Write the note on assembly directives in 8086 with few examples.	
4	Write an ALP for 16 bit arithmetic operations for 8086 (using various addressing modes)	
5	Write an ALP of 8086 to take N numbers as input and arrange in ascending and descending order.	
6	Write an ALP of 8086 to take N numbers as input and find max and minimum number.	
7	Write an ALP of 8086 to take N numbers as input and find average.	
8	Program for searching for a number or character in a string for 8086.	
9	Program for digital clock design using 8086	
10	Interfacing ADC and DAC to 8086.	
11	Parallel communication between two microprocessors using 8255.	
12	Serial communication between two microprocessor kits using 8251.	
13	Interfacing and programming of 8086 and to control stepper motor	

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-PRPE-21	**Course Name: Program Elective –II LAB** **(ii)** Analog and Digital Communication Lab	**L**	**T**	**P**	**C**
		0	**0**	**3**	**1.5**

Year and Semester	**III[ed] Year V[th]Semester**	**Contact hours per week:** (3Hrs) **Exam:** (3hrs.)	
Pre-requisite of course	**Basic Electronics Engg**	**Evaluation**	
		CIE: 30	**SEE: 45**

Course Objectives:

1. To familiarize the students practically about different types of communication systems.
2. To make students able to work on electronic circuits used in communication engineering.
3. To have knowledge about the analog and digital communication systems and also be able to perform experimentation on various techniques.

Course Outcomes: On completion of the course, student would be able to:

CO1	Able to perform experimentation on analog communication techniques and able to analyze the results.
CO2	Able to perform experimentation on pulse and digital communication, modulation and demodulation techniques.
CO3	To have practical knowledge about delta modulation and demodulation.

Expt. No	COURSE SYLLABUS CONTENTS OF MODULE	Cos
1	Analog Communication Concepts and Circuit Board Familiarization	**CO1, CO2, CO3,**
2	To study the function of Amplitude Modulation & Demodulation (under modulation, perfect modulation & over modulation) and also to calculate the modulation index.	
3	To study the working of the Balanced Modulator and demodulator.	
4.	To study frequency modulation and demodulation techniques.	
5	Study of 4 Channel Analog Multiplexing and De multiplexing Techniques.	
6	To study the frequency division multiplexing and De multiplexing Techniques.	
7	To study the Pulse amplitude modulation & demodulation Techniques.	
8	To study the Pulse Width Modulation (PWM) and Demodulation Techniques	
9	To study the generation Pulse Position Modulation (PPM) and Demodulation.	
10	To study ASK Signal Generation and Asynchronous Detection.	
11	To study FSK Signal Generation, Asynchronous Detection, Synchronous Detection.	
12	To study PSK Signal Generation and Synchronous Detection.	
13	To study pulse code modulation and demodulation.	
14.	To study Delta modulation and demodulation.	
15.	To different gain pattern on antenna training system kit.	

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-PRPE-21	**Course Name: Program Elective-II Lab** (Switch Gear and Protection)	**L**	**T**	**P**	**C**
		-	**-**	**3**	**1.5**
Year and Semester	**3[rd] Yr. 5[th] Semester**	**Contact hours per week:** (3Hrs) Exam: (3 Hrs)			
Pre-requisite of course	Brief knowledge of in the following topics: Basic Electrical and Electronics engineering, Semiconductor devices, Digital	**Evaluation**			
		CIE: 30		**SEE: 45**	

	Electronics, rectifiers.		
Course Objectives:			
4. Understand the Construction and principles of Construction and working principles of various types of relays			
5. Understand the concepts of fuses.			
6. Understand the null deflection and implement it in CT & PT.			
Course Outcomes: On completion of the course, student would be able to:			
CO1	Identify various types of faults in Power system		
CO2	Explain working of different types of circuit breakers in power system.		
CO3	Explain working of different types of relays in power system.		
CO4	Maintain the protection of transmission line and feeder from various faults		
CO5	Protect transformer, alternator, motor and bus bar		
CO6	Protect power system against over voltages		

Expt. No	COURSE SYLLABUS CONTENTS OF MODULE	COs
	LIST OF EXPERIMENTS STUDY EXPERIMENTS :	**CO1, CO2, CO3, CO4**
17.	Check the Polarity of Current Transformer and Potential	
18.	Transformer and connect it with the relay.	
19.	Principle of working, construction and operation of electromagnetic induction (shaded pole, watt-hour meter and induction cup),Thermal relay.	
20.	Principle of working, construction and operation of Distance relay	
21.	Principle of working, construction and operation of Directional relay	
22. t	Find the fusing factor of a given fusing material.	
23.	Dismantle a Vacuum circuit breaker.	
24.	Identify the various components of SF6 circuit breaker.	
25.	Working principle of arc quenching in HVDC circuit breaker	
26.	Test overload relay and plot Time-Current characteristic	
27.	C.T. testing using mutual Inductor – Measurement of % ratio error and phase angle of given CT by Null method.	
28.	PT testing by comparison – V. G. as Null detector – Measurement of % ratio error and phase angle of the given PT.	

REFERENCE BOOKS:

2. A Course in Elect. & Electronic Measurement & Instrumentation by A. K. Sawhney; Khanna Pub.

REFERENCE BOOKS:

1. Electrical Measurments by E.W. Golding
2. Electronic & Elect. Measurment&Instrumention by J.B.Gupta; Kataria& Sons.
3. Electronic Instrumentation &Measurment Technique, W.D. Cooper & A.D. Helfrick.
4. Measuring Systems by E.O. Doeblin; TMH.

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-PRPC-23	Course Name: Control System Lab.	L	T	P	C
		0	0	3	1.5
Year and Semester	3rd Year Vth Semester	Contact hours per week: (3Hrs) Exam: (3hrs.)			
Pre-requisite of course	Control components engineering	Evaluation			
		CIE: 30	SEE: 45		

Course Objectives:

1. Study the time response of various types (0, 1, 2, 3, etc.) of system Execute time response analysis of a various order control system.
2. To study and tuned the different modes of Linear controller(PID)
3. To study the performance characteristics of a D.C. Motor Speed and angular position Control System.
4. To Relay control system
5. To Compensation Design study and designing controller for different physics variables control
6. To Study Digital control System with programming skill

Course Outcomes: On completion of the course, student would be able to:

CO1	Ability to derive the response of a variety of simulated linear systems and to correlate the studies with theoretical results.
CO2	Ability to analyze and tuned the different modes of Linear controller(PID) and able to design controller for different Linear process
CO3	Ability to understand DC, AC, stepper motors and implements their application in control system
CO4	Ability to Design and develop digital control system of a simulated system using an 8-bit microcomputer with development of programming skill

Expt. No	COURSE SYLLABUS CONTENTS OF MODULE	COs
1	To Study Potentiometric Error Detector :- To study the performance characteristics of an angular position error detector using potentiometers	CO1, CO2, CO3, CO4
2	To Study PID control Trainer: To study the performance characteristics of an analog PID controller using simulated systems.	
3	To Study Linear Systems Simulator: - To study the response of a variety of simulated linear systems and to correlate the studies with theoretical results.	
4	To Study DC Motor speed Control: - To study the performance characteristics of a D.C. Motor Speed Control System.	
5	To Study DC Position Control: - To study the performance characteristics of a d.c. motor angular position control system.	
6	To Study Stepper Motor Trainer: - To study the operation of a Stepper Motor.	
7	To Study Digital control System: to study of digital control system of a simulated system using an 8-bit microcomputer	
8	Relay control system: study of relay control system and to observe the effect of dead zone and hysteresis on stability	
9	Compensation Design: To design, implement and study the effect of different cascade compensation network for a given system	
10	To Study PID Temperature Control Trainer	
11	To Study Synchro Devices	

12	To Study AC Motor Study Trainer	
13	To Study DC Motor study Trainer	
14	To Study Light Intensity Control	

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-PE-302	**Course Name: Program Elective-III** (i) Electrical Machine Design	**L**	**T**	**P**	**C**
		2	**1**	**-**	**3**
Year and Semester	**3rd Yr.** **6th Semester**	**Contact hours per week:** (3Hrs) Exam: (3 Hrs)			
Pre-requisite of course	EI-PC-208:Electrical Machines-I EI-PC-304: Electrical Machines-II	**Evaluation**			
		CIE: 40	**SEE: 60**		

Course Objectives:

1. To familiarize the students about design and materials used in electrical machines.
2. To design the DC machines and its parts as per given data.
3. To design single phase and three phase transformer based on given parameters.
4. To design induction motor as per given parameters and loading conditions
5. To design synchronous machines as per given parameters.

Course Outcomes: On completion of the course, student would be able to:

CO1	Identify and list, limitations, modern trends in design, manufacturing of electrical machines and properties of materials used in the electrical machines.
CO2	Derive the output equation of DC machine, discuss selection of specific loadings and magnetic circuits of DC machines, design the field windings of DC machine, and design the stator and armature circuits of a DC machine.
CO3	Derive the output equations of transformer, discuss selection of specific loadings, and design of transformer based on given parameters.
CO4	Develop the output equation of induction motor, discuss selection of specific loadings and magnetic circuits of induction motor, and designthe stator and rotor circuits of an induction motor.
CO5	Formulate the output equation of alternator and design the slots and windings of Synchronous machine.

Module No	**COURSE SYLLABUS CONTENTS OF MODULE**	**Hrs**	**Cos**
1	**Fundamental Aspects of Electrical Machine Design:** Design of Machines, Design Factors,Limitations in design, Modern Trends in design, **Electrical Engineering Materials:** Desirability of Conducting Materials, Comparison of aluminum and Copper wires. Ferromagnetic Materials: Soft Magnetic materials – Solid Core Materials, Electrical Sheet and Strip, Cold Rolled Grain Oriented Steel. Insulating Materials: Desirable Properties, Temperature Rise and Insulating Materials, Classification of Insulating materials based on Thermal Consideration.	**3**	**CO1**
2	**Design of DC Machines:** Output Equation, Choice of Number of Poles, Main Dimensions of armature, Design of Armature Slot Dimensions, Commutator and Brushes. Estimation of Ampere Turns for the Magnetic Circuit. Dimensions of Yoke, Main Pole and Air Gap, Design of Shunt	**5**	**CO2**

	and Series Field Windings.		
3	**Design of Transformers:** Output Equations of Single Phase and Three Phase Transformers, Choice of Specific Loadings, Expression for Volts/Turn, Determination of Main Dimensions of the Core, Estimation of Number of Turns and Conductor Cross Sectional area of Primary and Secondary Windings, No Load Current. Expression for the Leakage Reactance of core type transformer with concentric coils, and calculation of Voltage Regulation. Design of Tank and Cooling (Round and Rectangular) Tubes.	**8**	**CO3**
4	**Design of Three Phase Induction Motors:** Output Equation, Choice of Specific Loadings, Main Dimensions of Stator. Design of stator slots and Winding, Choice of Length Air Gap, Estimation of Number of Slots for Squirrel Cage Rotor. Design of Rotor Bars and End Ring. Design of Slip Ring rotor. Estimation of No Load Current and Leakage Reactance.	**5**	**CO4**
5	**Design of Three Phase Synchronous Machines:** Output Equation, Choice of Specific Loadings, Short Circuit Ratio, Main Dimensions of Stator. Design of stator slots and Winding. Design of Salient and non-salient Pole Rotors. Magnetic Circuit and Field Winding.	**5**	**CO5**

Text Books:

1. A course in Electrical Machine design A.K.Sawhney DhanpatRai 6th Edition, 2013.
2. Performance and Design of Alternating Current Machines M.G. Say CBS Publisher 3rd Edition, 2002
3. Design Data Handbook A. Sanmugasundaram Et al New Age International 1st Edition,

Reference Books:

1. Electric Machinery, AE Fitggerald, C. Kingsley Jr and Umans, McGraw Hill, International.
2. Electrical Technology", H. Cotton, CBS Publication.
3. The Performance and Design of AC machines", M G Say, Pitman& Sons.

Note for Examiner(s): Question paper will comprise three sections,

1. Section-A will be compulsory and comprise 4-short answer type questions uniformly spread to the entire syllabus.
2. Section-B will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on concepts, definitions, derivations, principles, construction and working etc.
3. Section-C will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on derivations, numerical and applications of the various topics covered therein.

Note for Students:

1. Section – A is compulsory and attempt/answer all the four questions carrying 12 marks in total.
2. Attempt/answer two questions each out of the Section – B and Section – C. All questions will carry 12 marks.

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code: EI –PE-302	**Course Name: Program Elective-III** (ii) Mechanical Measurements in Instrumentation	**L**	**T**	**P**	**C**
		2	**1**	**0**	**3**
Year and Semester	**3rd Year VIth Semester**	**Contact hours per week:** (3 Hrs.) Exam: (3 Hrs.)			
Pre-requisite of course	**NIL**	**Evaluation**			
		CIE: 40	**SEE: 60**		

Course Objectives:

1. To introduce techniques and instrumentation used in mechanical measurement
2. Imparting the principles of measurement which include the working mechanism of various sensors and devices
3. To highlight the importance of measurement of non-electric quantities in instrumentation

Course Outcomes: On completion of the course, student would be able to:

CO1	Apply methods of measurement for various physical quantities
CO2	Select appropriate device for the measurement of physical parameters
CO3	Justify the use of particular device through characteristics and performance
CO4	Design a measurement system using acquired knowledge base

Module No	**COURSE SYLLABUS CONTENTS OF MODULE**	**Hrs**	**COs**
1	Introduction, Significance of mechanical measurements. Pressure measurement – pressure measurement terminology, Manometers – U tube manometer, bell type manometer, inclined tube manometer, Ring Balance manometer, Micromanometer. Bell gauges – balanced lever gauge, beam bell gauge, spring balanced bell gauge. Bourdon tube and its types, bellows and diaphragms	**9**	**CO1, CO2, CO3**
2	Measurement of torque – torque reaction method, strain gauge torque meter, stroboscopic method, inductance torque meter, Digital torque meter, magneto-strictive torque meter. Measurement of Angular velocity – Mechanical tachometers, Electrical tachometers, digital tachometers, stroboscopic tachometers. Measurement of Vibration.	**9**	**CO1, CO2, CO3**
3	Temperature measurements – liquid in glass thermometer, pressure gauge thermometer, liquid filled systems, gas filled systems and liquid vapor filled systems thermometer, static errors in filled systems thermometers, speed of response of filled systems. Bimetallic thermometers, Thermocouples – working principle, thermoelectric laws, series and parallel connection of thermocouples.	**9**	**CO1, CO2, CO3**

Text Books:

1. A course in mechanical measurements and instrumentation, A. K. Swahney, Dhanpatrai and Company, 2017
2. Mechanical Measurements and control, D.S. Kumar, Metropolitan Book Co. Pvt. Ltd., 2015
3. Measurement Systems, E. O. Doeblin, McGraw Hill, 2020

Note for Examiner(s):

Question paper will comprise three sections,

1. Section-A will be compulsory and comprise 4-short answer type questions uniformly spread to the entire syllabus.
2. Section-B will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on concepts, definitions, derivations, principles, construction and working etc.
3. Section-C will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on derivations, numerical and applications of the various topics covered therein.

Note for Students:

1. Section – A is compulsory and attempt/answer all the four questions carrying 12 marks in total.
2. Attempt/answer two questions each out of the Section – B and Section – C. All questions will carry 12 marks.

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-PE-302	**Course Name: Program Elective- III** (iii) Electric and Hybrid Vehicles	**L**	**T**	**P**	**C**
		2	**1**	**-**	**3**
Year and Semester	**3rd year** **6th Semester**	**Contact hours per week:** (3Hrs) **Exam:** (3hrs.)			
Pre-requisite of course	Electrical Machines, Power Electronics, Basic Science Engineering	**Evaluation**			
		CIE: 40	**SEE: 60**		

Course Objectives:
1. To introduce the upcoming technology of electric and hybrid system
2. To study the basics theory, operation and modeling of electric Hybrid system.
3. To study different topologies of electric Hybrid system
4. To study electric propulsion system in electric hybrid system

Course Outcomes: On completion of the course, student would be able to:	
CO1	To familiarize with upcoming technology of electric and hybrid system
CO2	To understand the basics theory, operation and modeling of electric Hybrid system.
CO3	To understand and analyze different drive train topologies electric of Hybrid system.
CO4	To learn the role of electric propulsion system in electric hybrid system andits application.
CO5	To impart basic technical knowledge of electric hybrid vehicle system and apply it to technological fields.

Module No	**COURSE SYLLABUS CONTENTS OF MODULE**	**Hrs**	**COs**
1	**Introduction:** Introduction to hybrid electric vehicles: history of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies. Conventional vehicles: basics of vehicle performance, vehicle power source characterization, transmission characteristics, and mathematical	7	CO1, CO2

	models to describe vehicle performance.		
2	**Hybrid Electric Drive:** Hybrid electric drive-trains: basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.	7	CO3
3	**Electric Propulsion Unit:** Introduction to electric components used in hybrid and electric vehicles, configuration and control of DC motor drives, configuration and control of induction motor drives, configuration and control of permanent magnet motor drives, configuration and control of switch reluctance motor drives, drive system efficiency.	7	CO4
4	**Case Studies:** Design of a hybrid electric vehicle (HEV), design of a battery electric vehicle (BEV).	5	CO5

Suggested Text / Reference Books:

1. Iqbal Hussein, *"Electric and Hybrid Vehicles, Design Fundamentals"*, CRC Press, 2003.
2. MehrdadEhsani, YimiGao, E Sebastian Gay, Ali Emadi, *"Modern Electric, Hybrid Electric and Fuel Cell VehiclesFundamentals", Theory and Design*, CRC Press, 2004.
3. James Larminie, John Lowry, *"Electric Vehicle Technology Explained"*, Wiley, 2003.

Note for Examiner(s): Question paper will comprise three sections,

1. Section-A will be compulsory and comprise 4-short answer type questions uniformly spread to the entire syllabus.
2. Section-B will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on concepts, definitions, derivations, principles, construction and working etc.
3. Section-C will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on derivations, numerical and applications of the various topics covered therein.

Note for Students:

1. Section – A is compulsory and attempt/answer all the four questions carrying 12 marks in total.
2. Attempt/answer two questions each out of the Section – B and Section – C. All questions will carry 12 marks.

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-PC-304	**Course Name:** Electrical Machines-II	**L**	**T**	**P**	**C**
		3	**1**	**-**	**4**
Year and Semester	**3rd Yr. 6th Semester**	**Contact hours per week:** (4Hrs) Exam: (3 Hrs)			
Pre-requisite of course	**NIL**	**Evaluation**			
		CIE: 40		**SEE: 60**	
Course Objectives:					
1. To study three phase induction motors and its associated numerical problems and applications.					
2. To study single phase and factional horse power motors.					
3. To have knowledge of three phase synchronous generators.					

4. To gain knowledge about three phase synchronous motors	
Course Outcomes: On completion of the course, student would be able to:	
CO1	Have theoretical as well as analytical knowledge of three phase synchronous motors in terms of working, testing and operation.
CO2	Understand single phase induction motors and special (FHP) motors and their applications.
CO3	Explain the working and operation of three phase alternator under different loading conditions, synchronization, parallel operation and load sharing and related phasor diagrams.
CO4	Acquire knowledge about the constructional details and principle of operation of synchronous motors, excitations (under, normal and over), effect of variation of excitation under constant load and V curves, inverted V curves, associated numerical problems.

Module No	COURSE SYLLABUS CONTENTS OF MODULE	Hrs	COs
1	**Three Phase Induction Machines:** Constructional details, Types of rotors, Principle of operation, Slip, cogging and crawling, Equivalent circuit, Torque-Slip characteristics, Condition for maximum torque, Losses and efficiency, Load test, No load and blocked rotor tests, Separation of losses, Double cage induction motors, Induction generators, Need for starting – Types of starters – DOL, Rotor resistance, Autotransformer and Star delta starters, Speed control, Voltage control, Frequency control and pole changing Cascaded connection-V/f control.	**12**	**CO1**
2	**Single Phase Induction Motors:** Constructional details of single phase induction motor, Double field revolving theory and operation – Equivalent circuit, Starting methods of single-phase induction motors, Capacitor-start capacitor run Induction motor, Shaded pole induction motor, Repulsion motor, Hysteresis motor, AC series motor.	**6**	**CO2**
3	**Synchronous Generators:** Constructional details – Types of rotors – winding factors- emf equation – Synchronous reactance – Armature reaction, Synchronizing and parallel operation – Synchronizing torque -Change of excitation and mechanical input- Voltage regulation – EMF, MMF, ZPF, steady state power- angle characteristics– Two reaction theory –slip test -short circuit transients.	**10**	**CO3**
4	**Synchronous Motors:** Principle of operation, Torque equation, Operation on infinite bus bars, V and Inverted V curves, Power input and power developed equations, Starting methods, Current loci for constant power input, constant excitation and constant power developed-Hunting, natural frequency of oscillations, damper windings- synchronous condenser.	**10**	**CO4**

Text Books:

1. A course in Electrical Machine design A.K.Sawhney DhanpatRai 6th Edition, 2013.
2. Performance and Design of Alternating Current Machines M.G. Say CBS Publisher 3rd Edition, 2002

3. Design Data Handbook A. Sanmugasundaram Et al New Age International 1st Edition,

Reference Books:

1. Electric Machinery", AE Fitggerald, C. Kingsley Jr and Umans, McGraw Hill, International.
2. Electrical Technology", H. Cotton, CBS Publication.
3. The Performance and Design of AC machines", M G Say, Pitman& Sons.

Note for Examiner(s): Question paper will comprise three sections,

1. Section-A will be compulsory and comprise 4-short answer type questions uniformly spread to the entire syllabus.
2. Section-B will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on concepts, definitions, derivations, principles, construction and working etc.
3. Section-C will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on derivations, numerical and applications of the various topics covered therein.

Note for Students:

1. Section – A is compulsory and attempt/answer all the four questions carrying 12 marks in total.
2. Attempt/answer two questions each out of the Section – B and Section – C. All questions will carry 12 marks.

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-PC-306	**Course Name:** Power Plant Engineering.	**L**	**T**	**P**	**C**
		2	**1**	**0**	**3**
Year and Semester	**3rd Year (VIth Semester)**	**Contact hours per week:** (3Hrs) Exam: (3 Hrs)			
Pre-requisite of course	Brief knowledge of in the following topics: Electrical Machines, Electrical Power System and Generation, Power System Engineering.	**Evaluation**			
		CIE: 40		**SEE: 60**	

Course Objectives:	
1. To introduce the concept of trends in power Generation.	
2. To introduce the Techniques of load forecasting and Generation planning.	
3. To study the concept types of energy sources.	
4. To study the concept of Energy Conservation and Management.	
Course Outcomes: On completion of the course, student would be able to:	
CO1	To Familiarize with available Energy sources and trends in power Generation.
CO2	To understand different types of loads, load forecasting and Generation planning.
CO3	To Familiarize with the Conventional and Non-Conventional types of energy sources.
CO4	To understand the concept of Energy management, Energy Auditing etc.

Module	**COURSE SYLLABUS**	**Hrs**	**COs**

No	CONTENTS OF MODULE		
1	**INTRODUCTION**: Energy sources, their availability, Recent trends in Power Generation, Interconnected Generation of Power Plants.	**7**	**I**
2	**POWER GENERATION PLANNING**: Load forecasting, load curves, load duration curve, Base load and Peak load Power Plants, connected Load, maximum demand, demand factor, Group diversity factor, load factor, significance of load factor, plant factor, capacity factor, selection of unit size, No. of Units, reserves, cost of power generation, Depreciation, tariff.	**7**	**II**
3	**CONVENTIONAL ENERGY SOURCES**: Selection of site, capacity calculations, classification, Schematic diagram and working of Thermal Power Stations, Hydro Electric Plant, Nuclear Power Plant and Diesel Power Stations. **NON-CONVENTIONAL ENERGY SOURCES**: Wind, Solar, Tidal, Ocean, and Geothermal sources of Energy, fuel cell, Magneto Hydro Dynamic (MHD) system.	**7**	**III**
4	**ELECTRIC ENERGY CONSERVATION & MANAGEMENT**:Energy management, Energy Audit, Energy Efficient Motors, Co-generation.	**7**	**IV**

TEXT BOOKS:

1. Electric Power Generation, B.R.Gupta
2. Power Generation, Operation and Control, Wood and Wollenberg, John Wiley & Sons, 1984.

REFERENCE BOOKS:

1. A Course in Electric Power System, Soni, Gupta, Bhatnagar, Dhanpat Rai & Sons
2. Power System Engineering, Nagrath & Kothari, Tata Mc-Graw Hill, New Delhi
3. Power Plant Engg: G.D. Rai
4. Electric Power: S.L. Uppal (Khanna Publishing)

Note for Examiner(s): Question paper will comprise three sections,

1. Section-A will be compulsory and comprise 4-short answer type questions uniformly spread to the entire syllabus.
2. Section-B will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on concepts, definitions, derivations, principles, construction and working etc.
3. Section-C will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on derivations, numerical and applications of the various topics covered therein.

Note for Students:

1. Section – A is compulsory and attempt/answer all the four questions carrying 12 marks in total.
2. Attempt/answer two questions each out of the Section – B and Section – C. All questions will carry 12 marks.

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-PC-308	**Course Name:** Digital Signal Processing	**L**	**T**	**P**	**C**
		3	**1**	**-**	**4**
Year and Semester	**3rd year** **6th Semester**	**Contact hours per week:** (4Hrs) **Exam:** (3hrs.)			
Pre-requisite of course	**Mathematics**	**Evaluation**			
		CIE: 40		**SEE: 60**	

Course Objectives:	
1. To study the basic of Z transform and its application in LTI discrete-time systems.	
2. To study the Discrete linear Time Invariant systems in Z domain and in frequency domain.	
3. To study different structure realization of Finite Impulse Response systems and Finite Impulse Response systems.	
4. To study the basic of Discrete-Fourier Transform (DFT), Fast Fourier Transform (FFT) algorithms and its application.	
5. To study the digital filters for filtering applications.	
Course Outcomes: On completion of the course, student would be able to:	
CO1	To learn the basic of Z transform and its application in LTI discrete-time systems.
CO2	To analyze the Discrete linear Time Invariant systems in Z domain and in frequency domain.
CO3	To understand the different structure realization of Finite Impulse Response systems and Finite Impulse Response systems.
CO4	To learn the basic of Discrete-Fourier Transform (DFT), Fast Fourier Transform (FFT) algorithms and its applications.
CO5	To Design digital filters for filtering applications.

Module No	**COURSE SYLLABUS CONTENTS OF MODULE**	**Hrs**	**COs**
1	**Discrete Time Systems &Analysis of LTI System:** Discrete system and its types, Z-transform and its properties, inverse Z-transform, region of convergence and its properties, Z-Domain analysis of Linear Time Invariant systems: transient and steady-state response, causality and stability. Frequency domain analysis of Linear Time Invariant systems: Frequency domain characteristics of LTI systems and frequency response of LTI systems.	9	CO1, CO2
2	**Structure Realization of Discrete Time Systems:** Introduction to structure realization and factor influencing structure realization, Structure realization of Finite Impulse Response (FIR) system: Direct form, transposed form, cascade form, frequency selective form and lattice form. Structure realization of Infinite Impulse Response (IIR) system: Direct form-I, Direct form-II, cascade form, parallel form and lattice form.	9	CO3
3	**Discrete and Fast Fourier Transform (DFT & FFT):**Discrete Fourier Transform (DFT), Inverse Discrete Fourier Transform (IDFT), relationship between DFT and Z-transform, Fast Fourier Transform: Decimation-in-time (DIT) FFT algorithm, decimation-in-frequency (DIF) FFT algorithm, Radix-2 FFT algorithms, linear filtering approach: Goertzel algorithm and Chirp z-transform algorithm, Quantization effect	9	CO4

	in computations, Effect of word length in digital filter.		
4	**Digital Filter Design:** Characteristics and properties of digital filter, FIR digital filter design by using Fourier series method, Use of window functions method, frequency sampling method. Design of IIR filter from analog filter: Approximations of derivatives method, Impulse Invariant method, Bilinear - transformation method.	9	CO5

Suggested Text / Reference Books:

1. John G. ProakisandDimitris G. Manolakis,"Digital Signal Processing", PHI Pub.
2. Allan Y. Oppenhein& Ronald W. Schater, "Digital Signal Processing", PHI, 2004.
3. J. R. Jhohnson, "Introduction to Digital Signal Processing", PHI, 2000.
4. B. Somanthan Nair, "Digital Signal Processing: Theory, Analysis & Digital Filter Design", PHI, 2004
5. Sanjit K. Mitra, "DSP a Computer based approach" , TMH, 2nd Ed., 2001.
6. Rafael C. Gonzalez, Richard E. Woods, "Digital Image Processing", PHI, Second Edition, 2008.
7. S. Salivahanan, C. Gnanapriya, "Digital Signal Processing", McGraw Hill.
8. S. Sridhar, "Digital Image Processing", Oxford, 2011.

Note for Examiner(s): Question paper will comprise three sections,

1. Section-A will be compulsory and comprise 4-short answer type questions uniformly spread to the entire syllabus.
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Note for Students:

1. Section – A is compulsory and attempt/answer all the four questions carrying 12 marks in total.
2. Attempt/answer two questions each out of the Section – B and Section – C. All questions will carry 12 marks.

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-PC-310	**Course Name:** Microcontroller & Embedded System	**L**	**T**	**P**	**C**
		3	**1**	**0**	**4**
Year and Semester	**3rd Year VIth Semester**	**Contact hours per week:** (4Hrs) Exam: (3 Hrs)			
Pre-requisite of course	Digital logic Circuits, microprocessors	**Evaluation**			
		CIE: 40	**SEE: 60**		
Course Objectives:					
1. In depth study of 8051 Architectures and programming of microcontrollers: embedded system applications.					
2. Use of assembler directives and programming in assembly language using Assembler					

3. This course concerns with Embedded systems basic knowledge: embedded architectures:	
4. To analyze and design the RTOS and applications.	
Course Outcomes: On completion of the course, student would be able to:	
CO1	Understand the fundamental concepts of Microcontroller Organization and Architecture (Intel 8051), Data Representation and Memory Usage
CO2	Apply the basic programming skills of microcontrollers for Problem Solving and Algorithm Development, Assembling/Compiling and Execution
CO3	Understand the basic of Embedded system, Understand the Embedded Product Development Life Cycle, Design embedded system in RTOS
CO4	Illustrate and design the hardware using Embedded System.
CO5	Apply various algorithms in solving sorting problems.
CO6	After study of this course it is expected that students will be able to develop interface for real time industrial process and write programs for different applications, Further it is expected that students will be able to do of their own for higher processors and microcontrollers.

Module No	COURSE SYLLABUS CONTENTS OF MODULE	Hrs	COs
1	Microcontrollers:- Introduction; comparison of microprocessors & microcontrollers; A survey of microcontrollers, Architecture of 8051: Input/Output Pins; Ports and Circuits; External memory; counter & timers; serial data input/output; & Interrupts. Addressing modes, 8051 Instruction Set – Data movement Instruction, arithmetic instruction, Logic instruction, Branch group Instruction	**9**	**CO1, CO2**
2	8051 software and programming memory interfacing and address decoding, programming Input/ Output port/ timer/ ADC/DAC, Serial data communication controller and interrupts controller for different application with respect to instrumentation & control.	**9**	**CO2, CO3**
3	Introduction to Embedded Systems – The build process for embedded systems- Structural units in Embedded processor, selection of processor & memory devices- DMA – Memory management methods- Timer and Counting devices, Memory Devices, Processor and Memory Selection, Memory Map and Applications, Memory Blocks for Different Structures.	**9**	**CO2, CO3, CO5**
4	Watchdog Timer, Real Time Clock, In circuit emulator, Target Hardware Debugging.Embedded Networking – Introduction – I/O Device Ports & Buses – Serial Bus communication protocols – RS232 standard – RS422 – RS485 – CAN Bus -Serial Peripheral Interface (SPI) –Inter Integrated Circuits (I2C) – need for device drivers	**9**	**CO3, CO4, CO6**

Text Books:

1. Embedded System Design - Frank Vahid, Tony Givargis, John Wiley.
2. The 8051 Microcontroller Architecture Programming & Application by Kenneth J. Ayala, Penram Inter.
3. The 8051 Microcontroller and Embedded Systems- Muhammad Ali Mazidi; Pearson Education India

4. Programming and Customizing the 8051 Microcontroller by Fredko Mike, TMH
5. Embedded Systems Architecture, Programming, and Design by Raj Kamal, TMH

REFERENCE BOOKS:

1. Microcontroller Architecture, Programming, Interfacing and System Design by Raj Kamal, Pearson Education India
2. Design with Micro-controllers by John. B. Pitman, Mc-Graw Hill
3. Introduction to Embedded Systems - Shibu K.V, Mc Graw Hill

Note for Examiner(s): Question paper will comprise three sections,

1. Section-A will be compulsory and comprise 4-short answer type questions uniformly spread to the entire syllabus.
2. Section-B will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on concepts, definitions, derivations, principles, construction and working etc.
3. Section-C will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on derivations, numerical and applications of the various topics covered therein.

Note for Students:

1. Section – A is compulsory and attempt/answer all the four questions carrying 12 marks in total.
2. Attempt/answer two questions each out of the Section – B and Section – C. All questions will carry 12 marks.

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-PRPC-18	**Course Name:** Electrical Machines Lab-II	**L**	**T**	**P**	**C**
		-	**-**	**3**	**1.5**
Year and Semester	**3rd Yr. 6th Semester**	**Contact hours per week:** (3Hrs) Exam: (3 Hrs)			
Pre-requisite of course	**NIL**	**Evaluation**			
		CIE: 30	**SEE: 45**		

Course Objectives:

1. To familiarize the students practically about working and operation of three phase induction motors
2. To provide hands on experimentation on single phase induction motors.
3. To explain practically the operation of three phase alternator along with performing standard test on it.
4. To know the working and starting of three phase synchronous motors.

Course Outcomes: On completion of the course, student would be able to:

CO1	Work practically on three phase and single phase induction motors
CO2	Operate and test three phase synchronous generators (alternators).
CO3	Operate and test three phase synchronous motors.

Expt. No.	**COURSE SYLLABUS CONTENTS OF MODULE**	**COs**
1	To perform load test on three-phase squirrel cage induction motor	**CO1,**

2	To perform load test on three-phase slip ring induction motor	**CO2, CO3,**
3	To perform No-load & blocked rotor test on three-phase induction motor	
4.	To perform load test on single-phase induction motor	
5	To perform No-load & Blocked rotor test on single-phase induction motor	
6	To study and implement Starting methods on single-phase induction motor	
7	To Study and Measure Synchronous Impedance and Short circuit ratio of Synchronous Generator.	
8	To perform O.C. test on synchronous generator and determine the full load regulation of a three phase synchronous generator by synchronous impedance method	
9	To conduct the process of synchronization of two Three Phase Alternators, by a) Synchroscope Method b) Three dark lamp Method c) Two bright one dark lamp Method	
10	To study Load sharing between two Three Phase alternators in parallel operation condition.	
10	To plot and analyse V- Curve of synchronous motor.	
11	To plot and analyse inverted V curves of synchronous motor.	

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-PRPC-20	**Course Name:**Micro-controller Lab	**L**	**T**	**P**	**C**
		0	**0**	**3**	**1.5**
Year and Semester	**3rd Year VIth Semester**	**Contact hours per week:** (3Hrs) **Exam:** (3hrs.)			
Pre-requisite of course	Digital logic Circuits, microprocessors	**Evaluation**			
		CIE: 30	**SEE: 45**		

Course Objectives:	
1. To provide in depth knowledge of 8051 and assembly language programming	
2. To learn how to interface devices with different modules on a microcontroller.	
3. To expertise working with Keil compiler and embedded C programming.	
4. To impart the I/O interfacing concepts for developing real time embedded systems.	
5. To encourage the students in building real time applications.	
Course Outcomes: On completion of the course, student would be able to	
CO1	Familiarize with the assembly level programming using lob kits.
CO2	Familiarize with the Keil and Embedded Workbench tools.
CO3	Design circuits for various applications using microcontrollers.
CO4	Apply the concepts on real- project design and development

Expt. No	**COURSE SYLLABUS** / **CONTENTS OF MODULE**	**COs**
	Programming	
1	Data Transfer - Block move, Exchange, Sorting, Finding largest element in an array.	**CO1, CO2, CO3, CO4**
2	Arithmetic Instructions - Addition/subtraction, multiplication and division, square, Cube(16 bits Arithmetic operations – bit addressable).	
3	Timers/Counters.	

4	Boolean & Logical Instructions (Bit manipulations).	
5	Conditional CALL & RETURN.	
6	Code conversion: BCD – ASCII; ASCII – Decimal; Decimal - ASCII;	
7	HEX - Decimal and Decimal - HEX.	
8	Programs to generate delay, Programs using serial port and on-Chip timer /Counter.	
	Interfacing	
9	Simple Calculator using 6 digit seven segment displays and Hex Keyboard interface to 8051.	
10	Alphanumeric LCD panel and Hex keypad input interface to 8051.	
11	External ADC and Temperature control interface to 8051.	
12	Generate different waveforms Sine, Square, Triangular, Ramp etc. using DAC interface to 8051; change the frequency and amplitude.	
13	Stepper and DC motor control interface to 8051.	
14	Elevator interface design and testing using 8051.	

Note:

1. **For Programming** exercise is to be done on both 8051 & simulator.
2. **For interfacing** Write C and ALP programs to interface 8051 chip to Interfacing modules to develop single chip solutions.

Text Books:

1. Embedded System Design - Frank Vahid, Tony Givargis, John Wiley.
2. The 8051 Microcontroller Architecture Programming & Application by Kenneth J. Ayala, Penram Inter.
3. The 8051 Microcontroller and Embedded Systems- Muhammad Ali Mazidi; Pearson Education India
4. Programming and Customizing the 8051 Microcontroller by Fredko Mike, TMH
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2. Design with Micro-controllers by John. B. Pitman, Mc-Graw Hill
3. Introduction to Embedded Systems - Shibu K.V, Mc Graw Hill

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-PRPC-22	**Course Name:** Digital Signal Processing Lab	**L**	**T**	**P**	**C**
		0	**0**	**3**	**1.5**
Year and Semester	**3rd Year** **5th Semester**	**Contact hours per week:** (3Hrs) **Exam:** (3hrs.)			
Pre-requisite of course	Knowledge of programming and Mathematics	**Evaluation**			
		CIE: 30		**SEE: 45**	

Course Objectives:
1. To study the fundamentals of MATLAB programming in digital signal processing.
2. To study the mathematical concept of discrete system and implement it in MATLAB programming.

3. To utilize MATLAB programming for the analysis of discrete systems.	
4. To utilize MATLAB programming for the design digital filters.	
Course Outcomes: On completion of the course, student would be able to:	
CO1	To introduce the MATLAB programming in discrete signal and system.
CO2	Ability to use MATLAB programming to get solutions of mathematical of discrete system.
CO3	To develop a skill to do the analysis of discrete systems by MATLAB programming.
CO4	To develop a skill to do the design digital filters by MATLAB programming.

Expt. No	**COURSE SYLLABUS** **CONTENTS OF MODULE**	**COs**
1	Develop a program to represents basic elementary discrete signals.	**CO1 CO2 CO3 CO4**
2	Develop a program P to calculate the convolution and correlation of two discrete signals.	
3	Develop a program to determine Z-transform and inverse z-transformof given discrete signal.	
4	Develop a program to determine Fast Fourier transform of given discrete signal.	
5	Develop a program to describe discrete LTI system in Z-domain and draw its plot pole-zero.	
6	Develop a program to determine the impulse response and step response of given LTI discrete system.	
7	Develop a program to determine the Frequency response of Discrete LTI system.	
8	Develop a program to describe a digital filter and determine its output response.	
9	Develop a program to design a FIR filter by using window techniques.	
10	To design analog filter (low-pass, high pass, band-pass, band-stop)	
11	Develop a program to design a Butterworth IIR filter.	
12	To develop a program for computing direct forms realization values of IIR digital filter	
13	To develop a program for computing parallel realization values of IIR digital filter	
14	To develop a program for computing direct form realization values of FIR digital filter	

B. Tech Electrical and Instrumentation Engineering
SYLLABI for EXAMINATIONS
B. Tech. 4th YEAR

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-OE-401	**Course Name: Open Elective IV** (i) Computer Graphics and CAD/CAM	**L**	**T**	**P**	**C**
		3	**1**	**0**	**4**
Year and Semester	**4th Year** **VIIth Semester**	**Contact hours per week:** (4Hrs) **Exam:** (3 Hrs)			
Pre-requisite of course	Programing in C, General Math	**Evaluation**			
		CIE: 40	**SEE: 60**		

Course Objectives:	
1. To learn and understand Graphics fundamentals.	
2. To develop the algorithm design capability for creating different 2-D and 3-D graphical objects To learn creation of animated scenes for virtual objects creations	
3. To further the acquired knowledge to utilize it in different research works on Pattern Recognition and Image Processing.	
4. To learn and understand Graphics fundamentals.	
Course Outcomes: On completion of the course, student would be able to:	
CO1	Understand how to write algorithms for generating different 2-D and 3-D graphical objects.
CO2	Apply the knowledge to create and filling polygon (solid area fill),
CO3	Implement the different techniques of 2-D
CO4	Implement different line and polygon clipping algorithms,
CO5	Draw different types of projections in 3-D vector algebra, different 3-D transformation techniques, curves and surfaces and rendering methods
CO6	Animate scenes entertainment and apply the knowledge to research work.

Module No	**COURSE SYLLABUS** **CONTENTS OF MODULE**	**Hrs**	**COs**
1	Introduction of computer Graphics and its applications, Overview of Graphics systems, Video display devices, Raster scan display, Raster scan systems, video controller, Raster scan display processor, Random scan display, random scan systems, color CRT monitor, Flat panel display, Interactive input devices, Logical classification of input devices, Keyboard, mouse, Trackball and spaceball, Joysticks, Image scanner, Light pens, Graphics software, Coordinates representations, Graphics primitives and functions.	**9**	**CO1, CO2**
2	Points and lines, Line drawing algorithms, midpoint circle and ellipse algorithms. Filled area primitives: scan line polygon fill algorithm, boundary-fill and flood fill algorithms. Translation, scaling, rotation, reflection and shear transformations, matrix representations and homogeneous coordinates, composite transforms, transformation between coordinate systems. 2-D Viewing: The viewing pipeline, viewing coordinate reference frame, window to viewport coordinate transformation, viewing functions, Cohen-Sutherland and Cyrus beck line clipping algorithms	**9**	**CO2, CO3, CO5**
3	Polygon surfaces, quadric surfaces, spline representation, Hermite	**9**	**CO3,**

	Curve, Bezier Curve and BSpline curves, Bezier and B-Spline surfaces, sweep representations, 3-D Geometric Transformations: Translation, Rotation, Scaling, Reflection and Shear transformations, composite transformations, 3-D viewing, viewing pipeline, viewing coordinates, view volume and general projection transforms and clipping.		**CO4**
4	Classification, back-face detection, depth-buffer, scan line, depth sorting, BSP- tree methods, are subdivision and octree methods Illumination models and surface rendering methods: Basic illumination models, polygon rendering methods. Design of animation sequence general computer animation functions, raster animation, computer animation languages, key frame systems, motion specifications.	**9**	**CO4, CO6**

TEXT BOOKS

1. COMPUTER GRAPHICS C VERSION by Donald Hearn and M. Pauline Baker, Pearsosn Education.
2. Principles of Interactive Graphics, Neuman and Sproul, TMH
3. Computer Graphics second edition "Zhigand Xiang, Roy Plastock, Schaum's outlines Tata McGraw Hill Edition.

REFERENCE BOOKS

1. Computer Graphics Principles & Practice", Second Edition in C, Foley, VanDam, Feiner and Hughes, Pearson Education.
2. Procedural Elements for Computer Graphics, David F Rogers, Tata McGraw Hill, 2nd edition.
3. An Integrated Introduction to Computer Graphics and Geometric Modelling, R. Goldman, CRC Press, Taylor & Francis Group.

Note for Examiner(s): Question paper will comprise three sections,

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3. Section-C will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on derivations, numerical and applications of the various topics covered therein.

Note for Students:

1. Section – A is compulsory and attempt/answer all the four questions carrying 12 marks in total.

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Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-OE-401	**Course Name: Open Elective-IV** (ii) IoT and It's Applications	**L**	**T**	**P**	**C**
		3	**1**	**0**	**4**
Year and Semester	**4st Year** **VIIth Semester**	**Contact hours per week:** (4 Hrs.) **Exam:** (3 Hrs.)			
Pre-requisite of course	Microprocessor, Microcontrollers and Embedded Systems	**Evaluation**			
		CIE: 40	**SEE: 60**		

Course Objectives:	
1. To understand what Internet of Things is.	
2. In this course, student will explore various components of Internet of things such as Sensors, internetworking and cyber space.	
3. In the end they will also be able to design and implement IoT circuits and solutions.	
Course Outcomes: On completion of the course, student would be able to:	
CO1	Identify the main components of Internet of Things.
CO2	Program the sensors and controller as part of IOT.
CO3	Assess different Internet of Things technologies and their applications.
CO4	Design a component or a product applying all the relevant standards and within realistic constraints.
CO5	Identify a suitable hardware and software solution for the given electrical and instrumentation problems.
CO6	Execute their electrical and instrumentation product ideas into a real-time working model.

Module No	COURSE SYLLABUS CONTENTS OF MODULE	Hrs	COs
1	**INTRODUCTION TO INTERNET OF THINGS**: Definition & Characteristics of IoT - Challenges and Issues - Physical Design of IoT, Logical Design of IoT - IoT Functional Blocks, Security. **COMPONENTS IN INTERNET OF THINGS:** Control Units – Communication modules –Bluetooth – Zigbee –Wifi – GPS- IOT Protocols (IPv6, 6LoWPAN, RPL, CoAP), MQTT, Wired Communication, Power Sources. Current trends in IoT.	**9**	**CO1, CO2**
2	**PROGRAMMING THE MICROCONTROLLER FOR IOT:** Introduction of Raspberry Pi 3 B+ - About Raspberry version and processor, specification, pin details, features. Raspberry OS, IP configuration, Wi-Fi configuration, supporting package installation. Basic Linux commands, basic python programming, web server installation, Basic HTML and PHP, connecting My SQL data base. Different type of IoT Gate way	**9**	**CO2, CO3**
3	**HARDWARE INTERFACING:** Working principles of sensors – IOT deployment for Raspberry Pi – Reading from Sensors, Communication: Connecting microcontroller with mobile devices – communication through Bluetooth, Wi-Fi and USB - Contiki OS. Camera interface, Think speck IoT platform, Android interface with IoT.	**9**	**CO2, CO3**
4	**RESOURCE MANAGEMENT IN IOT:** Clustering, Clustering for Scalability, Clustering Protocols for IoT - From the internet of things to the web of things - The Future Web of Things – Set up cloud environment – Cloud access from sensors– Data Analytics for IOT- Case studies- Open Source 'e-Health sensor platform' – 'Be Close Elderly monitoring' – Other recent projects. **IOT APPLICATIONS:** Business models for the internet of things, Home energy management, home automation etc.	**10**	**CO2, CO3, CO4, CO5, CO6**

Text Books:

1. Architecting the Internet of Things, Dieter Uckelmann et.al Springer, 2011

2. Internet of Things – A Hand-on Approach, ArshdeepBahga and Vijay Madisetti, Universities press, 2015

Reference Books:

1. Building Internet of Things with the Arduino, CharalamposDoukas, Create space, April 2002.
2. Internet of Things: From research and innovation to market deployment, Dr.OvidiuVermesan and Dr. Peter Friess, River Publishers 2014.
3. 8051 Microcontroller: An Application Based Introduction, David Calcutt, Fred Hassan, Newness, 2008.
4. Contiki: The open source for IOT, www.contiki-os.org
5. Vijay Madisetti and ArshdeepBahga, **"Internet of Things (A Hands-on-Approach)",** 1st Edition, VPT, 2014
6. Francis daCosta, **"Rethinking the Internet of Things: A Scalable Approach to Connecting Everything",** 1st Edition, Apress Publications, 2013
7. CunoPfister, Getting Started with the Internet of Things, O"Reilly Media, 2011, ISBN: 978-1-4493- 9357-1

List of Open Source Software/learning website:

1. https://github.com/connectIOT/iottoolkit
2. https://www.arduino.cc/
3. Contiki (Open source IoT operating system)
4. https://www.ubuntupit.com/best-iot-operating-system-for-your-iot-devices/
5. Arduino (open source IoT project)
6. IoT Toolkit (smart object API gateway service reference implementation)
7. Zetta (Based on Node.js, Zetta can create IoT servers that link to various devices and sensors)

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Program Name: B. Tech.-Electrical and Instrumentation Engineering

<table>
<tr><td>Course Code:
EI-PE-403</td><td colspan="2">Course Name: Program Elective-IV
(i) Bio Medical Instrumentation</td><td>L
2</td><td>T
1</td><td>P
0</td><td>C
3</td></tr>
<tr><td>Year and Semester</td><td>4th Year
(VII th Semester)</td><td colspan="4">Contact hours per week: (3Hrs)
Exam: (3 Hrs)</td></tr>
<tr><td rowspan="2">Pre-requisite of course</td><td rowspan="2">Brief knowledge of in the following topics: Physics, Basic Electrical Engg.</td><td colspan="4">Evaluation</td></tr>
<tr><td colspan="2">CIE: 40</td><td colspan="2">SEE: 60</td></tr>
<tr><td colspan="7">Course Objectives:</td></tr>
<tr><td colspan="7">1. To introduce the concept of Bio Medical Instrumentation.</td></tr>
</table>

2. To introduce Bio Potential Electrodes and Biomedical Recorders.	
3. To introduce the Heart Sound and Ultrasound.	
4. To study the Imaging System.	
Course Outcomes: On completion of the course, student would be able to:	
CO1	To Familiarize with Bio Medical Instrumentation.
CO2	To understand with Bio Potential Electrodes and Biomedical Recorders.
CO3	To understand the Heart Sound and Ultrasound.
CO4	To understand the Imaging System.

Module No	COURSE SYLLABUS CONTENTS OF MODULE	Hrs	COs
1	**Introduction;** Bio-electric potential and electrode: Instrumentation system, Living Instrumentation system, Bio-metric, the anatomy of nervous system, origin of bio-potentials, resting and action potentials, propagation of action potentials, the Bio-electric potentials.	**5**	**I**
2	**Bio-potential electrode and Biomedical recorders:** Bio-potential electrode: Microelectrodes, skin surface electrode, Needle electrodes. EEG: Electrode for EEG, Block diagram of EEG Machine, EMG Recording, pre amplifier for EMG, EMG recording method.	**7**	**II**
3	**Heart Sound Monitoring and Ultrasonic Imaging system:** Basic functioning of heart, Electrocardiograph Block diagram of ECG, ISOLATION AMPLIFIER, the ECG leads, Microprocessor based ECG Machine, PCG, Microphones for PCG, amplifier for PCG, Physics of ultrasonic waves, Biological effect of ultrasound.	**6**	**III**
4	**Imaging System:** X-ray Machine and Computed Tomography: X-ray machine, X-ray image Intensifier T.V. system, X-ray computed Tomography (CT Scanner). NMR imaging system: Imager system. Application of NMR Imaging, Advantage & disadvantage of NMR Imaging system	**6**	**IV**

REFERENCE BOOKS:

1. Introduction to Biomedical Equipment Technology By Carr & Brown.
2. Biomedical Instrumentation and Measurement by Cromwell, PHI.
3. Handbook of Biomedical Instrumentation by R.S.Khandpur, TMH.

Note for Examiner(s): Question paper will comprise three sections,

1. Section-A will be compulsory and comprise 4-short answer type questions uniformly spread to the entire syllabus.
2. Section-B will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on concepts, definitions, derivations, principles, construction and working etc.
3. Section-C will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on derivations, numerical and applications of the various topics covered therein.

Note for Students:

1. Section – A is compulsory and attempt/answer all the four questions carrying 12 marks in total.
2. Attempt/answer two questions each out of the Section – B and Section – C. All questions will carry 12 marks.

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-PE-403	**Course Name: Program Elective- IV** **(ii)** Reliability Engineering	**L**	**T**	**P**	**C**
		2	**1**	**-**	**3**
Year and Semester	**4th year** **7th Semester**	**Contact hours per week:** (3Hrs) **Exam:** (3hrs.)			
Pre-requisite of course	Basic Engineering Mathematics	**Evaluation**			
		CIE: 40	**SEE: 60**		

Course Objectives:

1. To study the basic concept of reliability, maintainability and availability engineering.
2. To study the evaluation techniques of engineering models and reliability improvement methods.
3. To study the concept of fault tree analysis and optimization techniques.
4. To study evaluation modesl for reliability, maintainability, availability testing.
5. To study the applications of fuzzy theory and neural networks to reliability engineering,

Course Outcomes: On completion of the course, student would be able to:

CO1	To understand the basic concept of reliability, maintainability and availability engineering.
CO2	To understand the evaluation techniques of engineering models and reliability improvement methods.
CO3	To learn the fault tree analysis and optimization techniques.
CO4	Ability to do testing and evaluate the reliability, maintainability, availability of engineering models.
CO5	To study the applications of fuzzy theory and neural networks to reliability engineering,

Module No	**COURSE SYLLABUS CONTENTS OF MODULE**	**Hrs**	COs
1	Review of basic concepts in reliability engineering, reliability function, different reliability models etc., and reliability evaluation techniques for complex system: Non path set and cutest approaches, path set and cut set approaches, different reliability measures and performance indices, modeling and reliability evaluation of system subjected to common cause failures.	7	CO1
2	Reliability improvement, Reliability allocation/apportionment and redundancy optimization techniques, Fault tree analysis.	7	CO2, CO3
3	Maintainability Analysis: measure of system performance, types of maintenance, reliability centered maintenance, reliability and availability evaluation of engineering systems using Markov models. Reliability testing, Design for reliability and maintainability.	7	CO1, CO4
4	Applications of fuzzy theory and neural networks to reliability engineering, Typical reliability case studies.	7	CO5

Suggested Text / Reference Books:

1. M.L Shooman, “Probabilistic reliability- an engineering approach” RE Krieger Pub, 1990.
2. K.K Aggarwal, “Reliability Engineering” Springer Pub, 1993.
3. E. Balaguruswamy, “Reliability Engineering” McGraw hill, 2002.
4. R. Ramakumar, “Engineering Reliability” Prentice, NJ, 1993.

Note for Examiner(s): Question paper will comprise three sections,

1. Section-A will be compulsory and comprise 4-short answer type questions uniformly spread to the entire syllabus.
2. Section-B will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on concepts, definitions, derivations, principles, construction and working etc.
3. Section-C will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on derivations, numerical and applications of the various topics covered therein.

Note for Students:

1. Section – A is compulsory and attempt/answer all the four questions carrying 12 marks in total.
2. Attempt/answer two questions each out of the Section – B and Section – C. All questions will carry 12 marks.

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-PE-403	**Course Name: Program Elective – IV** **(iii)** Wind and Solar Energy Systems	**L**	**T**	**P**	**C**
		2	**1**	**-**	**3**
Year and Semester	**4th year** **7th Semester**	**Contact hours per week: (3Hrs)** **Exam: (3hrs.)**			
Pre-requisite of course	Electrical Machines, Power Electronics, Basic Science Engineering	**Evaluation**			
		CIE: 40	**SEE: 60**		

Course Objectives:
1. To familiarize the energy scenario and the consequent growth of the power generation from renewable wind and solar energy sources.
2. To study the basic science of wind and solar energies.
3. To study the wind and solar energy conversion systems for electrical power system.
4. To studyintegration issues of the wind and solar generation.

Course Outcomes: On completion of the course, student would be able to:	
CO1	Understand the energy scenario and the consequent growth of the power generation from renewable wind and solar energy sources.
CO2	Understand the basic science of wind and solar energies.
CO3	Understand the wind and solar energy conversion systems for electrical power system.
CO4	Understand the power electronic interfaces for wind and solar generation.
CO5	Understand the issues related to the grid-integration of solar and wind energy systems.

Module No.	**COURSE SYLLABUS CONTENTS OF MODULE**	**Hrs**	**COs**
1	**Wind Energy Systems:** Historical developments of Wind Energy, energy and power in wind, wind energy dynamics, power extracted, axial thrust on turbines, torque, maximum power and Beltz coefficient, wind turbine operational characteristic, site selection. Wind energy conversion system, basic integration issues related to wind power, status of Wind power in India.	7	CO1, CO2
2	**Wind Energy Conversion Systems:** HAWT and VAWT constructions, basic rotor differences, relative merits and operational difficulties, lift and drag turbines, upwind and down wind machines. Basic components, fixed and variable speeds systems, type of generators used-D.C.,	7	CO3, CO4, CO5

	induction and synchronous machines; grid, standalone, and hybrid schemes.		
3	**Solar Energy Systems:** Fundamentals of solar cell, semiconductors as basis for solar cells materials and properties, P-N junction, sources of losses and prevention, estimating power and energy demand, site selection, land requirements, choice of modules, economic comparison, balance of systems. Overview of different types of solar cells/panels. Photovoltaic industries in India and world.	7	CO1, CO2
4	**Solar PV Power Plants System:** Array design, inverter types and characteristics, power conditioning system: working algorithms, performance analysis; design of stand alone, hybrid and grid interactive plants, commissioning of solar PV plant.	7	CO3, CO4, CO5

Suggested Text / Reference Books:

1. T. Ackermann, "Wind Power in Power Systems", John Wiley and Sons Ltd., 2005.
2. G. M. Masters, "Renewable and Efficient Electric Power Systems", John Wiley and Sons, 2004.
3. S. P. Sukhatme, "Solar Energy: Principles of Thermal Collection and Storage", McGraw Hill, 1984.
4. H. Siegfried and R. Waddington, "Grid integration of wind energy conversion systems" John Wiley and Sons Ltd., 2006.
5. G. N. Tiwari and M. K. Ghosal, "Renewable Energy Applications", Narosa Publications, 2004.
6. J. A. Duffie and W. A. Beckman, "Solar Engineering of Thermal Processes", John Wiley & Sons, 1991.
7. V. Yaramasu and B.Wu, "Model Predictive Control of Wind Energy Conversion Systems",Wiley- IEEE Press, 2016.
8. L. L. Freris, "Wind Energy Conversion System", Prentice Hall, (U.K.) 1990.
9. Thomas Ackermann, "Wind Power in Power System", John Wiley & Sons Ltd., 2005.
10. SuneelDeambi,"Photovoltaic System Design: Procedures, Tools and Applications", CRC Press 2016.
11. A. Freundlich, P. Verlinden, WvanSark, "Photovoltaic Solar Energy: From Fundamentals to Applications", John Wiley & Sons Ltd. 2017.
12. Md. Rabiul Islam, FazRahman, Wei Xu, "Advances in Solar Photovoltaic Power Plants", Springer-Verlag Berlin Heidelberg, 2016.

Note for Examiner(s): Question paper will comprise three sections,

1. Section-A will be compulsory and comprise 4-short answer type questions uniformly spread to the entire syllabus.
2. Section-B will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on concepts, definitions, derivations, principles, construction and working etc.
3. Section-C will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on derivations, numerical and applications of the various topics covered therein.

Note for Students:

1. Section – A is compulsory and attempt/answer all the four questions carrying 12 marks in total.

2. Attempt/answer two questions each out of the Section – B and Section – C. All questions will carry 12 marks.

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-PE-403	**Course Name: Program Elective – IV** **(iv)** POWER QUALITY AND FACTS	**L**	**T**	**P**	**C**
		2	**1**	**0**	**3**
Year and Semester	**IVth Year** **VIIth Semester**	**Contact hours per week:** (3Hrs) Exam: (3 Hrs)			
Pre-requisite of course	**EI-PC-202** POWER ELECTRONICS-I **EI-PC-303** POWER ELECTRONICS-II **EI-PC-307** POWER SYSTEM-II	**Evaluation**			
		CIE: 40	**SEE: 60**		

Course Objectives:
To introduce students about the power quality and its classification.
To learn the students about voltage profile under different types of events.
To give brief idea of integration of distributed generation.
To introduce the students about FACTS and FACTS based controllers.
To give a brief knowledge about series and shunt compensation.

Course Outcomes: On completion of the course, student would be able to:	
CO1	To understand the term power quality and its related issues like voltage unbalance, voltage sag/swell, harmonics etc.
CO2	To learn about different voltage profiles under the events of voltage sag/swell, transients, harmonic distortion, intra-harmonics etc.
CO3	To have a brief idea of distributed generation and its impact on power quality.
CO4	Learn about the FACTS and basics of FACTS controllers.
CO5	Know about the need of compensation and achieving it through static compensation; static series and shunt compensation.

Module No	**COURSE SYLLABUS CONTENTS OF MODULE**	**Hrs**	**Cos**
1	**Introduction:** Power quality-voltage quality, power quality terms, power quality evaluation procedures term and definitions, general classes of power quality problems, transients, long duration voltage variation, short duration voltage variations, voltage imbalance, waveform distortion.	**5**	**CO1, CO2**
2	**Voltage sags and interruptions:** Sources of sags and interruptions, estimating voltage sag performance, fundamental principles of protection, motor starting sags. **Transient over voltages:** Fundamentals of harmonics, Harmonic distortion, voltage harmonic indexes, harmonic sources from commercial loads, harmonic sources from Industrial loads, effects of harmonic distortion, intra harmonics. **Distributed generation and power quality**: DG technologies, interface to utility system, power quality issues.	**7**	**CO2, CO2**
3	**FACTS Concept and General System Considerations:** Transmission Interconnections, Flow of Power in an AC System, Power Flow and Dynamic Stability	**8**	**CO4, CO5**

	Basic Types of FACTS Controllers, Brief Description and Definitions of FACTS Controllers, **Static Shunt Compensators:** Objectives of Shunt Compensation - Midpoint Voltage Regulation for Line Segmentation, End of Line Voltage Support to Prevent Voltage Instability, Improvement of Transient Stability Thyristor Controlled Reactor.		
4	**Static Series Compensators:** Objectives of Series Compensation, Concept of Series Capacitive Compensation, Voltage Stability, Improvement of Transient Stability. GTO Thyristor-Controlled Series Capacitor, Thyristor-Switched Series Capacitor, Thyristor-Controlled Series Capacitor, The Static synchronous Series Compensator.	**6**	**CO5**

Text Books:

1. Narain G. Hingorani& Laszlo Gyugyi Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems Wiley
2. Arinthom Ghosh & Gerard Ledwich, Power Quality Enhancement Using Custom Power Devices Kluwer Academic Publishers
3. C. Sankaran, Power Quality CRC Press
4. S. Sivanagaraju& S. Satyanarayana, Electric Power Transmission and Distribution, Pearson Education

Reference Books:

1. Roger C Dugan, McGrahan, Santoso&Beaty, Electrical Power System Quality McGraw Hill
2. Power quality in power systems and electrical machines Ewald F Fuchs, Mohammad, A.S., Masoum Academic Press, Elsevier 2009.

Note for Examiner(s): Question paper will comprise three sections,

1. Section-A will be compulsory and comprise 4-short answer type questions uniformly spread to the entire syllabus.
2. Section-B will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on concepts, definitions, derivations, principles, construction and working etc.
3. Section-C will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on derivations, numerical and applications of the various topics covered therein.

Note for Students:

1. Section – A is compulsory and attempt/answer all the four questions carrying 12 marks in total.
2. Attempt/answer two questions each out of the Section – B and Section – C. All questions will carry 12 marks.

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-PC-405	**Course Name:** Electric Drives	**L**	**T**	**P**	**C**
		3	**1**	**0**	**4**
Year and Semester	**4TH Year (VIIth Semester)**	**Contact hours per week:** (4Hrs) Exam: (3 Hrs)			
Pre-requisite of course	Brief knowledge of in the following topics: Electrical Machines, Power Electronics.	**Evaluation**			
		CIE: 40	**SEE: 60**		

Course Objectives:	
1. To introduce the concept of types of Electric Drives.	
2. To introduce the DC Motor Drives.	
3. To introduce the AC Motor Drives.	
4. To study the Motor power rating.	
5. To implement Traction Drives.	
Course Outcomes: On completion of the course, student would be able to:	
CO1	To Familiarize with Dynamics and Control of Electric Drives.
CO2	To understand efficient speed control techniques in DC Motor Drives.
CO3	To understand efficient speed control techniques in AC Motor Drives.
CO4	To understand the significance and selection of power rating.
CO5	To familiarization of Load and choice of traction for suitable load.

Module No	COURSE SYLLABUS CONTENTS OF MODULE	Hrs	COs
1	**Electrical Drives:** Introduction, advantages, choice of electrical drives, status of ac and dc drives. **Dynamics of Electrical Drives:** Fundamental torque equations, multi-quadrant operation, equivalent values of drive parameters, load torque components, types of loads, steady state stability, load equalization. **Control of Electrical Drives:** Modes of operation, closed loop control of drives, sensing of current and speed**.**	**7**	**CO1**
2	**DC Motor Drives:** Speed-torque characteristics of different types of dc motors, starting, types of braking, transient analysis, speed control methods, static control of dc motors. Converter fed dc drive & chopper fed dc drive.	**7**	**CO2**
3	**Induction motor Drives:** Characteristics, analysis and performance, starting methods, braking methods, transient analysis, methods of speed control, vector control. Static control techniques- stator frequency control, stator voltage control, rotor resistance control. Static Scherbius system & static Kramer system.	**10**	**CO3**
4	**Selection of motor power rating:** Heating and cooling, determination of motor rating, continuous, short time and intermittent duties, determination of moment of inertia of the flywheel. **Traction Drives:** Nature of traction load, important features of traction drives, static control of traction drives; comparison between ac and dc tractions.	**12**	**CO4**

TEXT BOOKS:

1. Fundamentals of Electrical Drives, G.K.Dubey, Narosa Publishing House

REFERENCE BOOKS:

1. Power Semiconductor controlled drives, G.K.Dubey, Prentice Hall.
2. Electric Drives: V.Subrahmaniyam TMH
3. Electric Drives: Leonard, Narosa Pub.
4. Electric Drives: Diwan

Note for Examiner(s): Question paper will comprise three sections,

1. Section-A will be compulsory and comprise 4-short answer type questions uniformly spread to the entire syllabus.

2. Section-B will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on concepts, definitions, derivations, principles, construction and working etc.
3. Section-C will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on derivations, numerical and applications of the various topics covered therein.

Note for Students:

1. Section – A is compulsory and attempt/answer all the four questions carrying 12 marks in total.
2. Attempt/answer two questions each out of the Section – B and Section – C. All questions will carry 12 marks.

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-PC-407	**Course Name:** Advance Process Dynamics and Control	**L**	**T**	**P**	**C**
		3	**1**	**0**	**4**
Year and Semester	**4th year** **VIIIth Semester**	**Contact hours per week:** (4Hrs) Exam: (3 Hrs)			
Pre-requisite of course	EI-PC-309 Linear Automatic Control System	**Evaluation**			
		CIE: 40	**SEE: 60**		

Course Objectives:

5. Acquire knowledge Process dynamics and various forms of mathematical models to express them
6. To understand the multiloop systems
7. To develop knowledge about controller tuning
8. To develop understanding about PI diagrams
9. To analyze samples data control systems

Course Outcomes: On completion of the course, student would be able to:

CO1	Formulate mathematical model of various systems
CO2	Design and develop multiloop control systems
CO3	Compute the tuning parameters of controllers
CO4	Construct PI diagrams
CO5	Develop the sample data control systems

Module No	**COURSE SYLLABUS CONTENTS OF MODULE**	**Hrs.**	**COs**
1	Need of mathematical modelling, lumped and distributed parameters, state variables and state equations of chemical processes, mathematical modelling of CSTR, interacting system and non-interacting system. Control of jacketed kettle systems, dynamic response of gas absorber, heat conduction into solids, heat exchanger.	**10**	**CO1**
2	Review and limitation of single loop control, need of multi loops, cascade, selective override, auctioneering, split range, feed forward, feed forward feedback, adaptive, inferential, ratio control, Self-adaptive control: MRAC, TR.	**8**	**CO1, CO2**
3	Tuning of PID controller, Zeigler – Nichols methods, Process reaction curve, Ultimate gain and period method, quarter decay ratio advance method of tuning, IAE, ISE, IATE tuning of controllers. Effect of measurement and transportation lag on process response, Effect of	**8**	**CO1, CO3**

	disturbances.		
4	Standard Instrumentation Symbols for Devices, Signal Types, Representation of a Process Control Loop using PI diagram. Sampling, open loop and closed loop response, Stability, sampled data control of first order process with transport lag, Design of sampled data controllers.	**10**	**CO4, CO5**

Text books:

1. Stephanopoulos, G., Chemical Process Control, Prentice–Hall of India Private Limited (1983).
2. Johnson, C.D., Process Control Instrumentation Technology, Prentice–Hall of India Private Limited (1992).
3. Process Systems Analysis and Control, D. R. Coughanour, McGrawHill

Reference books:

1. Liptak, B.G., Instrument Engineers Handbook, Butterworth, Heinemann (2002)
2. Seborg, D.E. and Edgar, T., Process Dynamics and Control, John Wiley and Sons (1989).

Note for Examiner(s): Question paper will comprise three sections,

1. Section-A will be compulsory and comprise 4-short answer type questions uniformly spread to the entire syllabus.

2. Section-B will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on concepts, definitions, derivations, principles, construction and working etc.

3. Section-C will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on derivations, numerical and applications of the various topics covered therein.

Note for Students:

1. Section – A is compulsory and attempt/answer all the four questions carrying 12 marks in total.

2. Attempt/answer two questions each out of the Section – B and Section – C. All questions will carry 12 marks.

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-PRPC-27	**Course Name:** Electric Drives Lab	**L**	**T**	**P**	**C**
		0	**0**	**3**	**1.5**
Year and Semester	**4th Year** **VIIth Semester**	**Contact hours per week:** (3Hrs) **Exam:** (3hrs.)			
Pre-requisite of course	Brief knowledge of in the following topics: Basic Electrical and Electronics engineering, Semiconductor devices, Digital Electronics, rectifiers.	**Evaluation**			
		CIE: 30	**SEE: 45**		

Course Objectives:	
1. Understand the Chopper Control Drives	
2. Understand the concepts of Cyclocontroller based control.	
3. Understand the concept of Electric Breaking.	
4. Understand Current Source Inverter.	
Course Outcomes: On completion of the course, student would be able to:	
CO1	To understand the concept of chopper control DC motors.
CO2	To understand the cyclocontroller bases Induction Motor Control
CO3	To understand how to implement electric Breaking using Induction Motor.

CO4	To understand the current Source Inverter and Voltage Source Inverters for Induction motor Control.

Expt. No	**COURSE SYLLABUS** **CONTENTS OF MODULE**	**COs**
	LIST OF EXPERIMENTS STUDY EXPERIMENTS :	**CO1, CO2, CO3, CO4**
1.	Study of Chopper controller of DC Series motor	
2.	Study of Chopper controller of SE DC Series motor trainer	
3.	Study of half wave cycloconverter with IM	
4.	Study of DC dynamic breaking 3-phase slippering IM	
5.	VSI Controlled IM chopper trainer	
6.	Study of Self-controlled synchronous motor	
7.	To Study Current Source Inverter controlled IM	
8.	To study Voltage Source Inverter Controlled IM	

TEXT BOOKS:

1. Fundamentals of Electrical Drives, G.K. Dubey, Narosa Publishing House

REFERENCE BOOKS:

1. Power Semiconductor controlled drives, G.K. Dubey, Prentice Hall.
2. Electric Drives: V. Subrahmaniyam TMH
3. Electric Drives: Leonard, Narosa Pub.
4. Electric Drives: Diwan

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-PROE-29	**Course Name: Open Elective IV Lab.** (i) Computer Graphics and CAD/CAM	**L**	**T**	**P**	**C**
		0	**0**	**3**	**1.5**
Year and Semester	**4th Year** **VII th Semester**	**Contact hours per week:** (3Hrs) **Exam:** (3hrs.)			
Pre-requisite of course	Programing in C, General Math	**Evaluation**			
		CIE: 30	**SEE: 45**		

Course Objectives:	
5. To learn and understand fundamentals of Graphics programming	
6. How to design and develop the algorithm for creating different 2-D and 3-D graphical objects and procedure to create animated scenes for virtual objects.	
7. To further the acquired knowledge to utilize it in different research works on Pattern Recognition and Image Processing.	
Course Outcomes: On completion of the course, student would be able to	
CO1	Write algorithms for generating different 2-D and 3-D graphical objects.
CO2	Implement various 2D and 3D transformations
CO3	Design various types of graphical animation and complex designs
CO4	Apply the concepts on real- project design and development

Expt. No	**COURSE SYLLABUS** **CONTENTS OF MODULE**	**COs**
1	Study of Fundamental Graphics Functions.	**CO1, CO2, CO3, CO4**
2	Implementation of Line drawing algorithms: DDA Algorithm, Bresenham's Algorithm	
3	Implementation of Circle drawing algorithms: Bresenham's Algorithm, Mid-	

	Point Algorithm.	
4	Ellipse Generation Algorithm	
5	Creating various types of texts and fonts	
6	Creating two dimensional objects	
7	Programs using 2-D transformations in C.	
8	Programs to study 3-D transformations in C.	
9	Implement Polygon filling algorithms [Flood-Fill Algorithm] in C.	
10	Programs to study window to viewport transformations in C.	
11	Program for Cohen Sutherland Line clipping algorithm in C.	
12	Write a program to implement Cohen Sutherland line clipping algorithm	
13	Write a program to draw Bezier curve.	
14	Key Frame Animation	

Text Books:

1. Procedural Elements for Computer Graphics, David F Rogers, Tata McGraw Hill, 2nd edition.
2. An Integrated Introduction to Computer Graphics and Geometric Modelling, R. Goldman, CRC Press, Taylor & Francis Group.

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-PROE-29	**Course Name:Open Elective- IV lab.** (ii) IoTand Its Application Lab	**L**	**T**	**P**	**C**
		0	**0**	**3**	**1.5**
Year and Semester	**4th Year** **VII th Semester**	**Contact hours per week:** (3 Hrs.) Exam: (3 hrs.)			
Pre-requisite of course	Microprocessor, Microcontrollers and Embedded Systems	**Evaluation**			
		CIE: 30	**SEE: 45**		

1. **Course Objectives:**	
2. To understand what Internet of Things is.	
3. In this course, student will explore various components of Internet of things such as Sensors, internetworking and cyber space.	
4. In the end they will also be able to design and implement IoT circuits and solutions.	
Course Outcomes: On completion of the course, student would be able to:	
CO1	Understand general concepts of Internet of Things (IoT)
CO2	Recognize various devices, sensors and applications
CO3	Apply, Analyze and Evaluate various design concept to IoT solutions
CO4	Create IoT solutions using sensors, actuators and Devices

Expt. No	**COURSE SYLLABUS** **CONTENTS OF MODULE**	**COs**
1	Introduction to various sensors and various actuators & its Application (Students have to prepare Report for the same). Perform Experiment using Arduino Uno to measure the distance of any object using Ultrasonic Sensor. a) PIR Motion Sensor. b) Rain Drop Sensor. c) Moisture Sensor. d) Temperature Sensor. e) Touch Sensor.	**CO1, CO2, CO3, CO4**

	f) Infrared Sensor. g) Servo Moto. h) RFID Sensor. i) Bluetooth Module. j) Wi-Fi Module.	
2	Demonstrate NodeMCU and its working	
3	Getting Started with (ESP8266 Wi-Fi SoC	
4	Hands-on with on-board peripherals of ESP8266	
5	Demonstrate Arduino and its pins.	
6	Perform Experiment using Arduino Uno to measure the distance of any object using Ultrasonic Sensor.	
7	Create a circuit using Arduino and sensors. Perform experiment using Arduino Uno to Learn Working of Servo Motor	
8	Creating a webpage and display the values available through Arduino.	
9	Demonstration of Setup & Working of Raspberry Pi. (Students have to prepare the Report for the same.).	
10	OPEN Ended problem: Students are required to submit an IOT based project using the Microcontroller or a Raspberry Pi and connecting various sensors and actuators. The data for the same should be displayed via a webpage or a web app.	

Supplementary Resources: Students will use supplementary resources such as online videos, NPTEL videos, e-courses, Virtual Laboratory

References: Web

a) https://www.udemy.com/course/internet-of-things-iot-for-beginners-getting-started/
b) https://playground.arduino.cc/Projects/Ideas/
c) https://runtimeprojects.com/
d) https://www.megunolink.com/articles/arduino-garage-door-opener/
e) https://www.willward1.com/arduino-wifi-tutorial/
f) https://www.makeuseof.com/tag/pi-overdose-heres-5-raspberry-pi-alternatives/
g) https://www.electronicshub.org/arduino-project-ideas/
h) http://homeautomationserver.com/
i) http://toptechboy.com/arduino-lessons/
j) https://www.eprolabs.com/

YouTube

a) https://www.youtube.com/watch?v=dC2GdEWHRxQ&list=PLy6JR9IR8VKOZBpDcETs
b) https://www.youtube.com/watch?v=kLd_JyvKV4Y
c) https://www.youtube.com/watch?v=TkA2LJctU1c

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-OE-402	**Course Name: Open Elective-V** (i) Artificial Intelligence	**L**	**T**	**P**	**C**
		2	**1**	**0**	**3**
Year and Semester	**4th Year** **VIIIth Semester**	**Contact hours per week:** (3Hrs) Exam: (3 Hrs)			
Pre-requisite of course	The course assume prior knowledge of basic programming, management skills.	**Evaluation**			
		CIE: 40		**SEE: 60**	
Course Objectives:					

1. To explore the basics of Artificial Intelligence.	
2. To introduce the concepts of a Rational Intelligent Agent and that can be designed to solve problems.	
3. To gain knowledge on blind and heuristic search in AI.	
4. To create an understanding of the basic issues of knowledge representation and Logic.	
5. To be able to design expert systems with intelligence.	
Course Outcomes: On completion of the course, student would be able to:	
CO1	Recognize the role of AI to solve real world problems
CO2	Explain and implement representation of knowledge, problem solving methods in AI.
CO3	Know how to build simple knowledge-based systems.
CO4	Solve complex engineering and real-world problems using AI.

Module No	COURSE SYLLABUS CONTENTS OF MODULE	Hrs	COs
1	**Introduction:** History, the turning test, overview of AI applications, problem & problem spaces, problems characteristics.	**7**	**CO1, CO2**
2	**Knowledge Representation Logic**: Proportional & first order prediction logic, inference rules, resolution limitation of logic. **Production system:** Definition & history, examples of search in production system, advantages.	**9**	**CO1, CO2, CO3**
3	**Search:** Informal and informal, algorithms of depth 1st, breadth 1st, hill climbing, best 1st search; **Game playing:** minimax search, alpha and beta pruning, forward and backward reasoning.	**9**	**CO2, CO3, CO4**
4	**Expert system:** Introduction & examples, architecture (rule based system), development, knowledge engineering process, limitations.	**7**	**CO3, CO4**

TEXT BOOKS

1. A.I by Elaine Tich, Kevin Knoght, Shiv Sankar B Nair, 3rd Edition, McGraw Hill Education
2. Artificial Intelligence: A Modern approach by Stuart J Russel, Peter Norvig, 3rd edition, Pearson
3. Introduction to Artificial Intelligence & Expert systems by Dass W. Patterson, PHI Publications.
4. PROLOG Programming for Artificial Intelligence, Ivan Bratko, 4th Edition, Addison-Wesley Educational Publishers Inc

REFERENCE BOOKS

1 A.I: an engineering approach by Robert J. Schlkoff, McGraw Hill.

Note for Examiner(s): Question paper will comprise three sections,

1. Section-A will be compulsory and comprise 4-short answer type questions uniformly spread to the entire syllabus.

2. Section-B will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on concepts, definitions, derivations, principles, construction and working etc.

3. Section-C will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on derivations, numerical and applications of the various topics covered therein.

Note for Students:

1. Section – A is compulsory and attempt/answer all the four questions carrying 12 marks in total.

2. Attempt/answer two questions each out of the Section – B and Section – C. All questions will carry 12 marks.

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-OE-402	**Course Name: Open Elective-V** (ii) Robotics	**L** 2	**T** 1	**P** 0	**C** 3
Year and Semester	**4th Year VIII th Semester**	**Contact hours per week:** (3Hrs) Exam: (3 Hrs)			
Pre-requisite of course	General Mathematics, Computer Graphics	**Evaluation**			
		CIE: 40	**SEE: 60**		

Course Objectives:	
1. To develop the student's knowledge in various robot structures and their workspace.	
2. To develop student's skills in performing spatial transformations associated with rigid body motions.	
3. To develop student's skills in perform kinematics analysis of robot systems.	
4. To provide the student with knowledge of the singularity issues associated with the operation of robotic systems.	
5. To provide the student with some knowledge and analysis skills associated with trajectory planning.	
6. To provide the student with some knowledge and skills associated with robot control	
Course Outcomes: On completion of the course, student would be able to:	
CO1	Outline the structure of a typical robotic system, understand its link and joint parameters, and perform robot kinematics.
CO2	Identify the geometric parameters of a robot by applying the knowledge of robot kinematics and generalized differential model of the robot.
CO3	Analyse planar and spatial parallel robots in context to its forward and inverse kinematics, and evaluate its singularity, condition number and maneuverability.
CO4	Identify the dynamic parameters of a robot by applying the knowledge of general form of dynamic equation of motion.
CO5	Identify the independent joint control and torque
CO6	Design a robotic manipulator and evaluate its primary and secondary workspace. Evaluate the performance of a robot.

Module No	**COURSE SYLLABUS** **CONTENTS OF MODULE**	**Hrs**	**COs**
1	**Introduction to Robotics**, terminology and definitions, Classification: Cylindrical, Spherical, Revolute, Rectangular; Work volume, Robot drive systems, Precision of movement – Spatial resolution, Accuracy, Repeatability. **End effectors** – Tools and grippers Components of Robotic Systems: Actuators, Sensors, Controllers, and Manipulators.	**7**	**CO1, CO2, CO3**
2	**Position and Orientation**: Description & frames, Rotation, Homogeneous transform, Translations, Transformation matrix. Robot Arm Kinematics: Introduction to Robot Arm Kinematics, Homogeneous Coordinate transformations, Direct & Inverse Kinematics, Composite Homogeneous transformation matrix.	**7**	**CO2, CO3**

3	**Link, joint and parameters:**DenavitHarten Berg Notation, D-H Matrix, Kinematic equations. Exercises on Direct & Inverse Kinematics up to six degree of freedom Robots.	**7**	**CO2, CO3, CO5**
4	**Manipulator Dynamics**: Euler-Lagrange Equation, KE and PE Expressions, Equations of motion, Newton-Euler transformation, some examples; Independent Joint control: Actuator Dynamics, set point tracking, Trajectory Interpolation	**7**	**CO3, CO4**

Text Book:

1. **Robotics control sensing Vision and Intelligence**- K.S.Fu, R.C.Gonzalez, C.S.G. Lee, McGraw Hill, 1987.
2. **Robot Technology Fundamentals -** James G.Keramas, Cengage learning
3. Robot and Controls By Mittal and Nagarath, Tata McGraw-Hill, 2003
4. Introduction to Robotics: Mechanics and control By J. J. Craig, AddisionWeslay Pub. Co.
5. Robot Dynamics and Control, By W. Sponge & M. Vidyasagar, John Wiley and Sons, New York, 1989.

Reference Books:

1. Bruno Siciliano and OussamaKhatib, Handbook of Robotics, Springer, 2016.
2. S. K. Saha, Introduction to Robotics, McGraw Hill Education, 2008.
3. P. Marlett, Parallel Robots, Springer, 2006.
4. Harry Asada &Slottine "Robot Analysis& Control" , Wiley Publications, 2014

Note for Examiner(s): Question paper will comprise three sections,

1. Section-A will be compulsory and comprise 4-short answer type questions uniformly spread to the entire syllabus.

2. Section-B will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on concepts, definitions, derivations, principles, construction and working etc.

3. Section-C will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on derivations, numerical and applications of the various topics covered therein.

Note for Students:

1. Section – A is compulsory and attempt/answer all the four questions carrying 12 marks in total.

2. Attempt/answer two questions each out of the Section – B and Section – C. All questions will carry 12 marks.

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-OE-402	**Course Name: Open Elective-V** **(iii)** High Voltage Engineering	**L**	**T**	**P**	**C**
		2	**1**	**-**	**3**
Year and Semester	**4th year** **8th Semester**	**Contact hours per week: (3Hrs)** **Exam: (3hrs.)**			
Pre-requisite of course	Power System Engineering, Basic Science Engineering	**Evaluation**			
		CIE: 40	**SEE: 60**		
Course Objectives:					
1. To introduce the concepts of high voltage engineering and methods of generation.					
2. To study with different high voltage measurements and required necessary instruments.					
3. To study the basics theories of lightening phenomenon, voltage surges and their					

characteristics.	
4. To introduce the protection methods and measurement methods for lightening and voltage surges.	
Course Outcomes: On completion of the course, student would be able to:	
CO1	To understand the concepts of high voltage engineering and methods of generation.
CO2	To familiarize with different high voltage measurements and required necessary instruments.
CO3	To understand the basics theories of lightening phenomenon, voltage surges and their characteristics.
CO4	To learn the protection methods of against lightening and surges.
CO5	To learn about the measuring instruments of lightening surges and its measurement methods.

Module No	COURSE SYLLABUS CONTENTS OF MODULE	Hrs	COs
1	**CONDUCTION AND BREAKDOWN:** Recent trends in high voltage transmission Conduction & breakdown in gases, liquids and solid dielectrics, insulator breakdown, insulation characteristics of long air gaps.	7	CO1
2	**METHODS OF HIGN VOLTAGE GENERATION:** Methods of generation of power frequency high voltage: cascaded transformers and resonance transformers Generation of high voltage DC, voltage multiplier circuits. Electrostatic Generation:Van de Graff machine and its voltage stabilization. Impulse voltage Generation: Basic impulse circuit, single stage impulse generator, multistage impulse generator (Marx circuit).	7	CO1, CO2
3	**PROTECTION OF SYSTEM AGAINST SURGES:**Ground wires, protective angle,tower footing resistance,surge diverters, Gap type and gapless lightning arresters, Insulation coordination, basic insulation levels, Voltage-time curve, impulse ratio.	7	CO3, CO4
4	**LIGHTENING:** Lightening phenomenon, lightning stroke mechanism, principle of lightning protection, tower foot resistance, insulator flash over and withstand voltage, lightning arresters and their characteristics, testing, generation of direct voltage, measurement of high voltage, general layout of H.V. Laboratory.	7	CO4, CO5

Suggested Text / Reference Books:

1. R.D. Begamudre,"E.H.V. AC Transmission", Wiley Eastern Ltd.
2. V. Kamaraju and M.S. Naidu, "H.V. Engg"',T.M.H., N.Delhi.
3. M.S. Naidu and V. Kamaraju,"High Voltage Engineering",TMH Publication
4. C.L Wadhwa,"High Voltage Engineering", Pub.: New Age International Ltd.

Note for Examiner(s): Question paper will comprise three sections,

1. Section-A will be compulsory and comprise 4-short answer type questions uniformly spread to the entire syllabus.
2. Section-B will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on concepts, definitions, derivations, principles, construction and working etc.

3. Section-C will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on derivations, numerical and applications of the various topics covered therein.

Note for Students:

1. Section – A is compulsory and attempt/answer all the four questions carrying 12 marks in total.

2. Attempt/answer two questions each out of the Section – B and Section – C. All questions will carry 12 marks.

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-PE-404	**Course Name: Program Elective-V** (i) Utilization of Electrical Energy	**L**	**T**	**P**	**C**
		3	**1**	**0**	**4**
Year and Semester	**4th Year (VIIIth Semester)**	**Contact hours per week:** (4Hrs) Exam: (3 Hrs)			
Pre-requisite of course	Brief knowledge of in the following topics: Electrical Machines, Electrical Power System and Generation, Energy efficient System.	**Evaluation**			
		CIE: 40	**SEE: 60**		

Course Objectives:
1. To introduce the concept of Illumination.
2. To introduce the concept of Electric Heating and Welding.
3. To study the concept of Electrolytic Process.
4. To study the concept of Electric Traction.

Course Outcomes: On completion of the course, student would be able to:	
CO1	To Familiarize with the concept of Illumination.
CO2	To understand the concept of Electric Heating and Welding.
CO3	To Familiarize with the concept of Electrolytic process.
CO4	To understand the concept of economics of Electric Traction.

Module No	**COURSE SYLLABUS** **CONTENTS OF MODULE**	**Hrs**	**COs**
1	**ILLUMINATION:** Basic laws of illumination, light sources and their characteristics, sources of light, design of lighting schemes, incandescent lamp, sodium lamp, mercury lamp and fluorescent lamp, comparison of various lamps, LED,CFL Lamp.	**7**	**I**
2	**ELECTRIC HEATING & WELDING:**Principle and application of resistance, induction and dielectric heating.,Resistance welding, arc welding, welding generator and welding transformer, properties of arcing electrode.	**8**	**II**
3	**ELECTROLYTIC PROCESS:** Principles and applications of electrolysis. Faraday's law of electrolysis, electroplating, charging and discharging. Capacity and efficiency of battery, defects in battery, maintenance of battery.	**11**	**III**
4	**ELECTRIC TRACTION:** Systems of electric traction, traction motors, traction motor control, multiunit control, braking of electric motors, thyristor control of electric traction., Types of services, speed	**10**	**IV**

	time and speed distance curves, average and schedule speed, Estimation of power and energy requirements: specific energy consumption. Mechanics of train movement coefficient of adhesion, Adhesive weight, effective weight.		

REFERENCE BOOKS:

1. Utilization of Electrical Energy: Open Shaw Taylor; ELBS
2. Art and Science of Utilization of Electrical Energy: H. Pratab ;DhanpatRai& Sons, Delhi.
3. Generation, Distribution and Utilization of Electrical Power: C.L. Wadhwa; Khanna Pub.
4. H. Pratab,"Electric Traction", Dhanpat Rai & Sons.

Note for Examiner(s): Question paper will comprise three sections,

1. Section-A will be compulsory and comprise 4-short answer type questions uniformly spread to the entire syllabus.
2. Section-B will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on concepts, definitions, derivations, principles, construction and working etc.
3. Section-C will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on derivations, numerical and applications of the various topics covered therein.

Note for Students:

1. Section – A is compulsory and attempt/answer all the four questions carrying 12 marks in total.
2. Attempt/answer two questions each out of the Section – B and Section – C. All questions will carry 12 marks.

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-PE-404	**Course Name: Program Elective- V** **(ii)** Instrumentation and System Design	**L**	**T**	**P**	**C**
		3	**1**	**0**	**4**
Year and Semester	**4th Year** **VIIIth Semester**	**Contact hours per week:** (4 Hrs) **Exam:** (3 hrs.)			
Pre-requisite of course	EI-ES-108 Basic Electronics Engineering	**Evaluation**			
		CIE: 40	**CIE: 60**		

Course Objectives:	
5. To provide a coherent knowledge about concepts of instrument system design	
6. to develop knowledge about system characteristics and performance attributes	
7. To elaborate relevant issues of physical, architecture design at printed circuits board level of complex electronic systems	
8. To understand the fundamentals circuit layout	
9. To develop concept of power distributions systems	
Course Outcomes: On completion of the course, student would be able to:	
CO1	Apply basic principles and guidelines of physical architecture design for complex electronic systems
CO2	Analyze the various system attributes and their impact on system performance
CO3	Analyze the influence of interconnects at different levels on electronic system performance
CO4	Develop system model on the basis of learned concepts

Module No	COURSE SYLLABUS CONTENTS OF MODULE	Hrs	COs
1	**Introduction** - overview of system engineering, system perspective, documentation, concept development, requirements, design development, rapid prototyping and field testing, validation, verification and integration, maintenance and life-cycle costs, failure, iteration and judgment. **Packaging and Enclosures:** Packaging influence, packaging design, wiring, temperature, vibration and shock, component packaging, mechanical issues	**8**	**CO1**
2	**Grounding and Shielding:** Safety, Noise, principle of energy coupling, Grounding, filtering, shielding, electrostatic discharge and it protection, general rules for design; Case study-EMC design of an oscilloscope.	**8**	**CO1, CO2**
3	Fundamentals of circuit design, high speed design, low power design, noise and error limitation, standard data buses and networks **Circuit Design:**, reset and power failure detection, input/output interfaces.	**8**	**CO2, CO3**
4	**Circuit layout and Power:** Circuit boards, component placement, routing of signals and traces, grounds, returns and shields, connectors and cables, design for manufacture, testing and maintenance; Power: Power requirements, sources of power, power conversion, definitions and specifications, power distribution and conditioning, electromagnetic interfaces.	**8**	**CO1, CO4**

Recommended Books:

1. Noise reduction techniques in electronic systems, 2nd ed. New York: Wiley By H.W.Ott
2. Electronic Instrument Design, Oxford Univ. Press, By Kim R. Fowler
3. Intuitive Operational Amplifiers, MeGraw-Hill, By T.M.Frederiksen
4. Printed Circuit Boards, CEDT Series TMH By Walter C. Bosshart

Note for Examiner(s): Question paper will comprise three sections,

1. Section-A will be compulsory and comprise 4-short answer type questions uniformly spread to the entire syllabus.

2. Section-B will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on concepts, definitions, derivations, principles, construction and working etc.

3. Section-C will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on derivations, numerical and applications of the various topics covered therein.

Note for Students:

1. Section – A is compulsory and attempt/answer all the four questions carrying 12 marks in total.

2. Attempt/answer two questions each out of the Section – B and Section – C. All questions will carry 12 marks.

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code:	**Course Name: Program Elective- V**	**L**	**T**	**P**	**C**
EI-PE-404	**(iii)** Fuzzy Logic Control	**3**	**1**	**-**	**4**
Year and Semester	**4th year** **8th Semester**	**Contact hours per week:** (4Hrs) **Exam:** (3hrs.)			

Pre-requisite of course	Basic Engineering Mathematics, Control system	Evaluation	
		CIE: 40	SEE: 60

Course Objectives:	
To study and acquire the basic knowledge of fuzzy logic.	
To study the basic architecture of FKBC and its design parameters	
To study nonlinear & adaptive fuzzy controllers.	
To identify, formulate and solve the neuro fuzzy logic based problems.	
Course Outcomes: On completion of the course, student would be able to:	
CO1	To understand working of basic fuzzy system and its architecture.
CO2	Able to fuzzy techniques in different field, which involve perception, reasoning and learning.
CO3	Analyze and design a real world problem for implementation and understand the dynamic behavior of a system.
CO4	Assess the results obtained by FKBC and Neuro fuzzy systems.

Module No	COURSE SYLLABUS CONTENTS OF MODULE	Hrs	COs
1	**FUZZY CONTROL & ITS MATHEMATICS :** Fuzzy control from an industrial perspective, knowledge representation in KBC's,Vagueness, fuzzy logic versus probability theory, fuzzy sets; their properties & operations on fuzzy sets, fuzzy relations & operations on fuzzy relations, the Extension Principle, Fuzzy propositions, The Compositional Rule of Inference, Different implications, Representing a set of rules.	8	CO1
2	**FKBC DESIGN PARAMETERS:** The FKBC architecture, choice of variables & content of rules, Derivation of rules, choice of membership functions, choice of scaling factors, choice of fuzzification procedure, choice of defuzzification procedure, comparison and evaluation of defuzzification methods.	8	CO1, CO2
3	**NONLINEAR & ADAPTIVE FUZZY CONTROL:** The Control Problem, The FKBC as a Non-Linear Transfer Element, Types of FKBC such as PID-like FKBC, Sliding Mode FKBC, Sugeno FKBC, Adaptation mechanism for FKBC Design & Performance Evaluation, Approaches to Design such as membership function tuning using gradient descent, membership function tuning using performance criteria, the self-organizing controller, model based controller.	8	CO2, CO3, CO4
4	**STABILITY OF FKBC & INTRODUCTION TO NEURO FUZZY CONTROLLERS:** The State space approach, Stability and robustness indices , input-output stability, circle criterion, Application of the Circle Criterion to Design, Conicity criterion, Neural networks based Fuzzy controllers & their applications.	8	CO3, CO4

Suggested Text / Reference Books:

1. D. Driankov, H.Hellendoorn and M.Reinfrank,"An Introduction to Fuzzy Control",Narosa Publications.
2. G.J. Klir andB Yuan, "Fuzzy sets and Fuzzy logic, theory and applications", Prentice Hall India Private Limited.
3. Abraham Kandel and Gideon Imngholz,"Fuzzy Control Systems",Narosa Publications.
4. Bart Kosko, "Neural Network & Fuzzy System", PHI

Note for Examiner(s): Question paper will comprise three sections,

1. Section-A will be compulsory and comprise 4-short answer type questions uniformly spread to the entire syllabus.
2. Section-B will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on concepts, definitions, derivations, principles, construction and working etc.
3. Section-C will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on derivations, numerical and applications of the various topics covered therein.

Note for Students:

1. Section – A is compulsory and attempt/answer all the four questions carrying 12 marks in total.
2. Attempt/answer two questions each out of the Section – B and Section – C. All questions will carry 12 marks.

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-PE-404	**Course Name: Program Elective- V** (iv) Optical Instrumentation	**L**	**T**	**P**	**C**
		3	**1**	**-**	**4**
Year and Semester	**4th year** **8th Semester**	**Contact hours per week:** (4Hrs) **Exam:** (3hrs.)			
Pre-requisite of course	Optics, EM theory, digital communication, workshop	**Evaluation**			
		CIE: 40	**SEE: 60**		

Course Objectives:
1. To expose the basic concepts of optical fibers and their industrial applications.
2. To provide adequate knowledge about Industrial application of optical fibres.
3. To provide basic concepts of lasers.
4. To provide knowledge about Industrial application of lasers
5. To provide knowledge about Industrial application of Holography and Medical applications of Lasers.

Course Outcomes: On completion of the course, student would be able to:	
CO1	Student will be able to Understand the working of optical fiber as a sensor
CO2	Ability to Study and identify applications of LASER in instrumentation & measurement
CO3	Perceive different industrial applications through optical instrumentation
CO4	To make precise and accurate measurement in medical applications
CO5	Apply LASER and Optical fiber for various physical parameter measurements.
CO6	Analyzing the optical sensor technology on various parameters of measurements.

Module No	**COURSE SYLLABUS CONTENTS OF MODULE**	**Hrs**	**COs**
1	**Optical fiber and Transmission characteristics:** Principles of light propagation through a fibre - Different types of fibres and their properties, fibre characteristics – manufacturing of optical fiber. Attenuation, material absorption losses, scattering losses, nonlinear and linear scattering, fiber bend loss, dispersion, intermodal dispersion, dispersion modified single mode fiber, dispersion flattened fibers, polarization, nonlinear phenomena.Connectors and splicers –Fibre termination.	8	CO1 CO5

2	**Optical sources and detectors, Optical fiber sensors** (10 hrs) Optical sources – Optical detectors.Optical emission from semiconductor, semiconductor LASER, non-semiconductor LASER, LED as an optical source, optical detector principles, absorption, quantum efficiency, responsively, photo diodes, modulation. Introduction to fiber optics sensors, sensors based on intensity modulation, Fibre optic instrumentation system – Different types of modulators – Interferometric method of measurement of length – Moire fringes – Measurement of pressure, temperature, current, voltage, liquid level and strain application of optical fiber for displacement, strain, stress and pressure measurement. Active multimode FO sensors, micro-bend optical fiber sensors, current sensors, phase modulated, polarization modulated optical fiber sensors, fiber optic gyroscope.	10	CO1 CO2 CO5 CO6
3	**Industrial and Medical Applications of Lasers:** Introduction, application of laser in biomedical instrumentation, Medical applications of lasers, laser and tissue interactive – Laser instruments for surgery, removal of tumours of vocal cards, brain surgery, plastic surgery, gynaecology and oncology. Laser interferometry, performance parameters, laser telemeters, measurement of distance, LIDAR, Laser for measurement of distance, length, velocity, acceleration, current, voltage and Atmospheric effect – Material processing – Laser heating, welding, melting and trimming of material – Removal and vaporization. Holography – Basic principle - Methods – Holographic interferometry and application, Holography for non-destructive testing – Holographic components measurement of strain, stress, bending moments and vibrations using hologram.	12	CO3 CO4 CO5
4	**Optical amplification and integrated optics:** Optical amplifiers, integrated optics integrated optical devices: beam splitters, directional couplers, modulators, switches, optoelectronics integration and differentiation, analog arithmetic operations, digital optics.	6	CO1 CO2 CO5 CO6

Text Books:

1. R.P.Khare, Fiber Optics and Optoelectronics, Oxford university press, 2008.
2. J. Wilson and J.F.B. Hawkes, Introduction to Opto Electronics, Prentice Hall of India, 2001.
3. Jose Miguel Lopez, ―Optical fiber sensing technology‖, John Wiley & Sons, 2002
4. AjoyGhatak, ―Optics, Tata Mc- Graw Hill Publishing, 5thed., 2012

Reference Book:

1. Asu Ram Jha, Fiber Optic Technology Applications to commercial, Industrial, Military and Space
2. Optical systems, PHI learning Private limited, 2009.
3. M. Arumugam, Optical Fibre Communication and Sensors, Anuradha Agencies, 2002.
4. John F. Read, Industrial Applications of Lasers, Academic Press, 1978.
5. Joseph T Verdeyen, ―LASER Electronics‖, Prentice Hall of India, 3rded., 2003
6. John M. Senior, ―Optical fiber Communications Principles and Practice, PHI publication, 2nd ed., 2008

Note for Examiner(s): Question paper will comprise three sections,

1. Section-A will be compulsory and comprise 4-short answer type questions uniformly spread to the entire syllabus.

2. Section-B will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on concepts, definitions, derivations, principles, construction and working etc.
3. Section-C will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on derivations, numerical and applications of the various topics covered therein.

Note for Students:

1. Section – A is compulsory and attempt/answer all the four questions carrying 12 marks in total.
2. Attempt/answer two questions each out of the Section – B and Section – C. All questions will carry 12 marks.

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-PE-404	**Course Name: Program Elective- V** (v) Remote Sensing	**L**	**T**	**P**	**C**
		3	**1**	**-**	**4**
Year and Semester	**4th year** **8th Semester**	**Contact hours per week:** (4Hrs) **Exam:** (3hrs.)			
Pre-requisite of course	Optics, EM theory, digital communication, image processing, DSP, Mathematics	**Evaluation**			
		CIE: 40	**SEE: 60**		

Course Objectives:
1. To expose the basic concepts of remote sensing and their application systems
2. To provide adequate knowledge of remote sensing data applications.
3. To provide basic concepts of sensors on board
4. To provide knowledge about GIS
5. To provide knowledge about Image processing

Course Outcomes: On completion of the course, student would be able to:	
CO1	Student will be able to Understand the working of different sensors
CO2	Ability to Study and identify applications of satellite derived data
CO3	Perceive different GIS applications through sustainable development.
CO4	To make precise and accurate measurement in optimum resolution.
CO5	Apply remote sensing data for various physical parameter measurements.
CO6	Analyzing the spectral sensor technology on various parameters of measurements.

Module No	**COURSE SYLLABUS CONTENTS OF MODULE**	**Hrs**	**COs**
1	Concepts and Foundations of Remote sensing - Introduction: Energy sources and radiation principles; radiation laws; energy interactions in the atmosphere; energy interactions with earth surface features; data acquisition and interpretation; global positioning system; ideal remote sensing system; characteristics of real remote sensing system; successful applications of remote sensing systems; geographic information systems - introduction.	9	CO2 CO3 CO6
2	Sensors and Instruments: Introduction, Photographic sensors, active and passive sensors, Visible and near infrared sensors; thermal infrared sensors; microwave sensors; sonic sensors; IR spectrometer Radiometers, Scanners, Sensors and Platforms, Resolution : spatial and	9	CO1 CO4 CO5

	temporal, geometric, angular. Satellite systems: Introduction, Land observation satellites, satellite remote sensing, satellite orbits, Landsat systems, land observation satellites, current satellite systems (Landsat class, spot, IRS, broad scale coverage, AVHRR, SeaWiFS, IKONOS, Cartosatetc)		
3	Multispectral thermal and hyper spectral sensing: Introduction, along track, across track scanning; operating principles, examples of Multispectral scanners and data, thermal scanners, along + across track thermal scanning, radiometric calibration of thermal scanners, FLIR systems, hyperspectral sensing, Microwave and lidar sensing : radar development, SAR, geometric characteristics of side looking radar, transmission of radar signals, radar image interpretation, radar remote sensing from space, Seasat, radarsat, ERS, JERS, ALOS, etc. shuttle radar topography mission, Lidar – introduction, sensors, resolution, sensors, development and applications.	9	CO1 CO4 CO6
4	Digital image processing fundamentals: Image rectification, enhancement, contrast manipulation, spatial and multi-image manipulation, image interpolation, edge detection, image restoration, image classification, , color imaging, data merging and GIS integration Applications of Remote sensing data: Applications to atmosphere, geosphere, hydrosphere, cryosphere, environmental applications, applications of data collection systems.	9	CO1 CO2 CO5 CO6

Suggested Text / Reference Books:

1. Remote sensing by FA Sabins, 1992
2. Introduction to Remote sensing by AP Cracknell and LWB Hayes Taylor & Francis Publ. 1991
3. Remote sensing and image interpretation by Thomas M Lillisand, RW Kiffer, JW Chipaman, John Weily 2004
4. Digital Singal Image Processing by Tamal Bose, JohnWeily, 2004
5. Introduction to JB Campbell, Taylor & Francis Publ.2002

Note for Examiner(s): Question paper will comprise three sections,

1. Section-A will be compulsory and comprise 4-short answer type questions uniformly spread to the entire syllabus.
2. Section-B will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on concepts, definitions, derivations, principles, construction and working etc.
3. Section-C will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on derivations, numerical and applications of the various topics covered therein.

Note for Students:

1. Section – A is compulsory and attempt/answer all the four questions carrying 12 marks in total.
2. Attempt/answer two questions each out of the Section – B and Section – C. All questions will carry 12 marks.

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code:	**Course Name:** Industrial Process Control	**L**	**T**	**P**	**C**

EI-PC-406			3	1	0	4
Year and Semester	**4th Year (VIIIth Semester)**	**Contact hours per week:** (4Hrs) Exam: (3 Hrs)				
Pre-requisite of course	**Control engineering**	**Evaluation**				
		CIE: 40	**SEE: 60**			

Course Objectives:

1. Basic concept and Study of FC and FO type control valve and their applications with examples, Gain of valve and concept of control valve sizing for liquid, Gas, vapor and steam. (Special reference to Masoneillian & Fisher Equation) and study control valve cavitation and flashing phenomenon
2. Study control Valve noise, its calculation & reduction techniques and Design & Construction of Globe Valve.
3. Study the characteristic function of PLC, its Architecture and various PLC programming languages and Demonstrate various PLC programming skill for industrial applications.
4. Detail study and applications of Distributed process control system and Understanding of various automotive standards and Protocols used in PLC network and DCS
5. Study DCS supervisory control techniques & considerations(Algorithms), Concept of field buses and their applications

Course Outcomes: On completion of the course, student would be able to:

CO1	Able to understand FC and FO type control valve and Able to learn and analyze the various principles & concepts involved in valve sizing for liquid, Gas, vapor and steam and control valve cavitation and flashing phenomenon
CO2	Able to understand control Valve noise, its calculation, reduction techniques and Acquire the knowledge and demonstrating the constructional details of Globe Valve.
CO3	Acquire the knowledge of performance characteristic function of PLC and its Architecture.
CO4	Able to learn the various PLC programming languages and Demonstratevarious PLC programming skill for industrial applications.
CO5	Able to learn and analyze the various principles & concepts of Distributed process control system and Understanding of various automotive standards and Protocols used in PLC network and DCS
CO6	Acquire the knowledge of DCS supervisory control techniques, the concept of field buses and their Industrial applications.
CO7	To implement new and emerging technologies to analyze, design, maintain reliable, safe, and cost effective solution for industry problems.

Module No	**COURSE SYLLABUS** **CONTENTS OF MODULE**	**Hrs**	**COs**
1	CONTROL VALVE DESIGN: Control valve flow characteristics, valve & process characteristics, effect of distortion coefficient on linear and percentage valve, range-ability of control valve, control valve sizing for liquid, Gas, vapor and steam. (Special reference to Masoneillian & Fisher Equation) control valve cavitation and flashing: flow control cavitation index, vibration curve cavitation index, calculation of flash fraction. Control valve gain, sequencing of control valve and viscosity correction of control valve.	**9**	**CO1, CO7**
2	Valve noise calculation & reduction: Sources of valve noise, noise control: path treatment source treatment valve noise calculation.	**9**	**CO2, CO7**

	Design & construction of Globe Valve: Valve trends, trim design, trim flow characteristics, flow rangeability, standard trim configuration, valve plug stems, Body form of single & double seated Globe valve, construction		
3	Discrete State Process Control System:Programmable controller, characteristic function of PLC, Architecture and block diagram of PLC, ladder diagram, ladder diagram elements, Development & analysis of ladder diagram, logic diagram from ladder diagram, Functional description of PLC difference between PLC & computer. Communication networking: Universal communications networking, Peer to Peer communications, PLC installations. Programming the Programmable controller: Programming languages, ladder diagram instructions, special functions, data transfer and data manipulation operations, arithmetic operations, flow control operations, Boolean mnemonics. Functional blocks data transfer operations arithmetic and logic operations, Programmable controller's industrial applications.	**9**	**CO3 CO4 CO5 CO7**
4	Distributed process control system: Functional requirement of DPCS, DCS configurations, control console equipment: Software configuration: Operating system configuration, controller function configuration, algorithm, libraries, relay rec. mounted equipment, communication between the components. DCS data high ways, field buses, multiplexers & party line system, DCS Supervisory computer and configurations: Supervisory computer functions, supervisory control techniques & considerations(Algorithms), DCS & Supervisory computer display, DCS. DCS system integration with PLC & computer.	**9**	**CO4 CO5 CO6 CO7**

Reference Books:

1. Microprocessor in process control: C.D.Johnson
2. Instrumentation for process measurement and control by N.A. Anderson.
3. Principles and practice of automatic process control: Carlos by A Smith.
4. Instrument Engineers' handbook - Process control by Bela G. Liptak.
5. Computer based Industrial Control by Krishan Kant

Note for Examiner(s): Question paper will comprise three sections,

1. Section-A will be compulsory and comprise 4-short answer type questions uniformly spread to the entire syllabus.

2. Section-B will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on concepts, definitions, derivations, principles, construction and working etc.

3. Section-C will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on derivations, numerical and applications of the various topics covered therein.

Note for Students:

1. Section – A is compulsory and attempt/answer all the four questions carrying 12 marks in total.

2. Attempt/answer two questions each out of the Section – B and Section – C. All questions will carry 12 marks.

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-PRPC-24	**Course Name:** Process Control Lab	**L**	**T**	**P**	**C**
		0	**0**	**3**	**1.5**
Year and Semester	**4th Year** **VIIIth Semester**	**Contact hours per week:** (3Hrs) **Exam:** (3hrs.)			
Pre-requisite of course	**Control Engineering Lab.**	**Evaluation**			
		CIE: 30	**SEE: 45**		

Course Objectives:

1. To Familiarization of PLC Ladder Programming Instructions Set
2. To compile and execute programs in Ladder Programming
3. To study the PC and PLC based control systems
4. To study and write PLC program for the multiple process control systems
5. To study and write PLC program for different strategies of control system such as feedback, feed forward, cascade, ratio control etc.
6. To write PLC programs to solve the different control problems

Course Outcomes: On completion of the course, student would be able to:

CO1	Ability to understand PC and PLC based control system and their implementation
CO2	Ability to develop PLC Ladder Programming skill
CO3	Analyse and implement PLC Ladder Programming for different type of process control system.
CO4	Ability to design and develop PLC program for different strategies of control system such as feedback, feed forward, cascade, ratio control for control of process variables

Expt. No	**COURSE SYLLABUS** **CONTENTS OF MODULE**	**COs**
1	Familiarization of PLC Ladder Programming Instructions Set	
2	**To Study** PC Based Traffic Light Control: Basic Traffic Light Sequence	
3	PLC Based Traffic Light Control: • PLC Connection Details • Dual Traffic Light Sequence • Traffic Counting • Green Time Alteration According to Traffic Flow • The Pedestrian Crossing • Complete System Control	
4	To Study Process Control – Ratio, feedback control flow & level	**CO1, CO2, CO3, CO4**
5	To Study Rotary Transfer Unit :- • Movement of Rotary Table • Initialization • Station Counting • Dispensing • A Production Line System • Follow a Set Routine	
6	To Study Industrial Control Trainer	
7	To Study Multiprocess Control Trainer : Feedback, feedforward cascade and ration Control system for flow, temperature and level control	
8	To study of Pressure Control Unit: Proportional Control : Run a loop experiments using ‘proportional only control’ with the following sets of SP and	

	PG values. Record the eventual 'steady state' rate values in the table below, once the initial oscillations have decayed. • Proportional and Integral Control	
9	To design, Level Control PC :- • Proportional Control • Proportional and Integral Control	
10	To Study .Flow control PC & PLC :- • Proportional Control • Proportional and Integral Control • Saturation and Integral Windup • Three Term or PID Control • Zeigler / Nichols Tuning	
11	To Study The System Rig :- • Proportional Control • Proportional and Integral Control • Saturation and Integral Windup • Three Term or PID Control • Ziegler / Nichols Tuning • Temperature Control • Batch Volume Control • Fluid Level Control • Open Loop Control • Bode Plots • Flow Loop Model using Caldwell's Method • Flo Loop Model using Sundaresan's Method • Design of Controller for PCU Flow Loop • PRT Signal Conditioning • Flowmeter Signal Conditioning	
12	Process Control Experiment :- • Proportional Control • Proportional and Integral Control • Saturation and Integral Windup • Three Term or PID Control • Ziegler / Nichols Tuning • Temperature Control • Batch Volume Control • Fluid Level Control • Open Loop Control • Bode Plots	

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code:	**Course Name: Open Elective-V Lab.**	**L**	**T**	**P**	**C**
EI-PROE-26	**(i)** Artificial Intelligence Lab	**0**	**0**	**3**	**1.5**
Year and	**4th Year**	**Contact hours per week:** (3Hrs)			

Semester	VIIIth Semester	Exam: (3hrs.)	
Pre-requisite of course	NIL	Evaluation	
		CIE: 30	SEE: 45

Course Objectives:

1. course introduces the basic concepts and techniques of Artificial Intelligence
2. writing code for AI problems in Prolog
3. Identify problems, errors in Prolog Programming codes
4. Introduce knowledge representation in Prolog and write code for drawing inferences
5. To Identify problems that are amenable to solution by specific AI methods

Course Outcomes: On completion of the course, student would be able to:

CO1	To compile and execute AI programs in Prolog.
CO2	To identify the syntax errors and semantic errors in Prolog Programming.
CO3	To Represent knowledge in Prolog and write code for drawing inferences
CO4	Sensitive towards development of responsible Artificial Intelligence

Expt. No	COURSE SYLLABUS CONTENTS OF MODULE	COs
1	Write a Prolog Program to test existence of data in the knowledge	**CO1, CO2, CO3, CO4**
2	Design and develop a Prolog Program enquire relationships in a family tree using Horn clauses.	
3	Design and develop a Prolog Program to check efficacy of Prolog for computations such as roots of quadratic equation	
4	Design and develop a Prolog Program to test fail and cut predicate to identify who likes whom from the data(knowledge).	
5	Write a Prolog Program to test fail and cut predicate to identify who likes whom from the data(knowledge) based on similar interests using Lists.	
6	Develop, implement, and execute a Prolog Program to search a Number in a list using *linear searching* Technique.	
7	Develop an algorithm, implement, and execute a Prolog Program to find all the paths between two nodes.	
8	Design and develop a Prolog Program to rotate a list N places to the left.	
9	Develop, implement, and execute a Prolog Program to search a record by name and phone number in Artificial Intelligence	
10	Write a Design and develop a Prolog Program to solve Towers of Hanoi puzzle	

Text Books:

1. Prolog Programming for Artificial Intelligence, by Ivan Bratko, 4Th Edition, Pearson.
2. Prolog Programming in Depth, by Michael A. Covington, Donald Nute, Andre Vellino, Prentice-Hall.
3. Programming in PROLOG, by William F. Clocksin, Christopher S. Mellish, Springer

Web resources:

1. https://www.cpp.edu/~jrfisher/www/prolog_tutorial/contents.html#2
2. https://www.javatpoint.com/prolog-programs
3. https://www.cs.ccu.edu.tw/~dan/prologProgs.html

Program Name: B. Tech.-Electrical and Instrumentation Engineering

Course Code:	Course Name: Open Elective-V Lab.	L	T	P	C

EI-PROE-26	(ii) Robotics	**0**	**0**	**3**	**1.5**
Year and Semester	**4th Year VIII th Semester**	**Contact hours per week:** (3Hrs) **Exam:** (3hrs.)			
Pre-requisite of course		**Evaluation**			
		CIE: 30	**SEE: 45**		

Course Objectives:

1. To introduce different types of robotics and demonstrate them to identify different parts and components.
2. To write programming for simple operations.
3. Simulate the work space for different industrial process

Course Outcomes: On completion of the course, student would be able to

CO1	Recognize different type of industrial robots and peripheral for simple industrial setup
CO2	To programs different parts and peripheral for controlling industrial robots using different ways.
CO3	Use of any robotic simulation software to model the different types of robots and calculate work volume for different robots
CO4	

Expt. No	**COURSE SYLLABUS CONTENTS OF MODULE**	**COs**
1	Determination of maximum and minimum position of links.	**CO1, CO2, CO3, CO4**
2	Verification of transformation (Position and orientation) with respect to gripper and world coordinate system	
3	Estimation of accuracy, repeatability and resolution.	
4	Robot programming and simulation for pick and place	
5	Robot programming and simulation for Colour identification	
6	Robot programming and simulation for Shape identification	
7	Robot programming and simulation for machining (cutting, welding)	
8	Robot programming and simulation for writing practice	
9	Robot programming and simulation for any industrial process (Packaging, Assembly)	
10	Robot programming and simulation for multi process.	

Kurukshetra University, Kurukshetra

(Established by the State Legislature Act XII of 1956)

('A+' Grade, NAAC Accredited)

।। योगस्थः कुरु कर्माणि ।।
समबुद्धि व योग युक्त होकर कर्म करो

(Perform Actions while Steadfasting in the State of Yoga)

DEPARTMENT OF INSTRUMENTATION (DOI)

LOCF/OBE/NBA CURRICULUM (2020 -2021)

Program Name: M. Tech. - Electrical and Instrumentation Engineering

(For the Batches from 2020-2021in phased manner)

9481

(UTD Only)

LOCF/OBE/NBA CURRICULUM (2020 -2021)

Program Name: M. Tech. - Electrical and Instrumentation Engineering

(For the Batches admittedfrom 2020-2021in phased manner)

VISION

Be globally acknowledged as a distinguished centre of academic excellence.

MISSION

To prepare a class of proficient scholars and professionals with ingrained human values and commitment to expand the frontiers of knowledge for the advancement of society**.**

DEPARTMENT VISION AND MISSION

VISION

- To become a model department as a Centre of quality education, research with innovation and recognition at National and International level for serving society.

MISSION

- **M1:** To provide quality education to aspiring young minds for improving their skills, inculcating values, creating leadership qualities and enhance research with innovative methods.
- **M2:** To produce young engineers capable to be utilized in the areas of New Technological Design, Environment, ethics and sustainable technologies.
- **M3:** To develop Teaching-Learning methods which can produce socially committed good professional human being who can contribute effectively in Nation building and represent Country Internationally.

Mapping of University Vision and Mission to Department Vision and Mission

Acclaimed as modal Centre of Learning and Research by

University Vision and Mission	Department Vision and Mission
High quality knowledge delivery through state of art infrastructure and ethical values to the students	**Yes**
Students excellence will make them professionals and innovators emerging as global leaders	**Yes**
Research and development will help in furtherance of Faculty knowledge	**Yes**

Programme Educational Objectives (PEOs):

The Department of Instrumentation in consultation with various stakeholders have formulated the Programme Educational Objectives (PEO's) that are broad statements that describe the career and professional accomplishments that the program is preparing its Post Graduate to achieve in few years, subsequent to receiving the degree. The PEO's of the M. Tech. programme in Electrical and Instrumentation Engineering are as follows:

- **PEO1:**The Post Graduate will become competent by applying their technical and managerial skills.
- **PEO2:**The Post Graduate will be able to adapt to any environment and succeed in higher positions in contemporary rapidly evolving technologies in Electrical and Instrumentation engineering field.
- **PEO3:**The Post Graduate will engage themselves in the life-long learning by pursuing higher education and participation in research and development activities to meet all challenges to transform them as responsible citizens of the nation

Program Specific Outcomes (PSO's):

- **PSO1:**Clearly understand the fundamental concepts of Electrical and Instrumentation Engineering
- **PSO2:** Post Graduate will be able to formulate and solve real life problems in the area of Electrical and Instrumentation Engineering
- **PSO3:** Post Graduate will possess the skills to communicate effectively in both oral and written forms, demonstrating the practice of professional ethics, and responsive to societal and environmental needs.

PEOs to Mission statement mapping

PEO's	MISSION OF THE DEPARTMENT		
	M1	M2	M3
PEO1	3	3	1
PEO2	2	3	2
PEO3	2	2	3

Program Outcomes (PO) with Post Graduate Attributes

Programme Outcomes are attributes of the Post Graduate from the programme that are indicative of the Post Graduate' ability and competence to work as an engineering professional upon graduation. Program Outcomes are statements that describe what students are expected to know or do by the time of graduation, they must relate to knowledge and skills that the students acquire from the programme. The achievement of all outcomes indicates that the student is well prepared to achieve the program

educational objectives down the road. The Department of Instrumentation engineering has following twelve PO's. The course syllabi and the overall curriculum are designed to achieve these outcomes:

S. No.	Post Graduate Attributes	Program Outcomes (POs)
PO1	Knowledge	Capable of demonstrating comprehensive disciplinary knowledge gained during course of study
PO2	Research Aptitude	Capability to ask relevant/appropriate questions for identifying, formulating and analyzing the research problems and to draw conclusion from the analysis
PO3	Communication	Ability to communicate effectively on general and Technical topics with the engineering community and with society at large
PO4	Problem Solving	Capability of applying knowledge to solve Engineering and other problems
PO5	Individual and Team Work	Capable to learn and work effectively as an individual, and as a member or leader in diverse teams, in multidisciplinary settings.
PO6	Investigation of Problems	Ability of critical thinking, analytical reasoning and research based knowledge including design of experiments, analysis and interpretation of data to provide conclusions
PO7	Modern Tool usage	Ability to use and learn techniques, skills and modern tools for scientific and engineering practices
PO8	Engineering and Society	Ability to apply reasoning to assess the different issues related to society and the consequent responsibilities relevant to the professional Engineering practices
PO9	Life-Long Learning	Aptitude to apply knowledge and skills that are necessary for participating in learning activities throughout life
PO10	Ethics	Capability to identify and apply ethical issues related to one’s work, avoid unethical behaviour such as fabrication of data, committing plagiarism and unbiased truthful actions in all aspects of work
PO11	Project Management	Ability to demonstrate knowledge and understanding of the engineering principles and apply these to manage projects

Mapping of PEO's with PO's

S. No.	Program Educational Objectives	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	The Post Graduate will become competent by applying their technical and managerial skills.	√	√	√	√	√	√	√	√	√	√	√	√	√	√
2	The Post Graduate will be able to adapt to any environment and succeed in higher positions in contemporary rapidly evolving technologies in Electrical and Instrumentation engineering field.	√	√	√	√	√	√	√	√	√	√	√	√	√	√
3	The Post Graduate will engage themselves in the life-long learning by pursuing higher education and participation in research and development activities to meet all challenges to transform them as responsible citizens of the nation			√	√		√	√	√	√		√	√	√	√

LOCF/OBE/NBA CURRICULUM (2020 -2021)

Program Name: M. Tech. - Electrical and Instrumentation Engineering

Post Graduate Degree Program

General, Course structure & Theme & Semester-wise credit distribution

A. Definition of Credit:

1 Hour Lecture (L) per week	1 credit
1 Hour Tutorial (T) per week	1 credit
1 Hour Practical (P) per week and/or 2 Hours Practical(Lab)/week	0.5 credits 1 credit

B. Total credits:

Total credits for a student to be eligible to get Post Graduate degree in Engineering are 66.0 credits.

C. Structure of Undergraduate Engineering program:

S. No.	Category	Breakup of Credits (Total)
1.	**Professional Core Courses**	**52**
2.	**Program Elective Coursesrelevant to the branch**	**09**
3.	**Seminars**	**04**
4.	**Research Methodology &IPR**	**01**
	Total	**66**

D. Course code and definition:

Category of Course/ Code	Definitions
L	Lecture
P	Practical
C	Credit
CIE	Continuous Internal Evaluation
SEE	Semester End Examination
EI	Electrical and Instrumentation Engineering
RM	Research Methodology
PC	Professional Core Courses
PE	Professional Elective courses
PRPC/ PRPE/ PRS	Practical Professional Core/ Program Elective/Seminar
ADC	Mandatory Audit Courses

E. Details of Structure and distribution of credits to various courses:

S. No	Category	Course No.	Course Title	C	Teaching Schedule			
					L	T	P	Cont Hrs.
Professional Core Courses								
1	**PC**	**EI-PC-103**	Biomedical Instrumentation	3	3	0	0	3
2	**PC**	**EI-PC-105**	Advanced Electric Drive	3	3	0	0	3
3	**PC**	**EI-PC-107**	Advance Process Control	3	3	0	0	3
4	**PC**	**EI-PC-104**	Power Quality Monitoring and Conditioning	3	3	0	0	3
5	**PC**	**EI-PC-106**	PLC & DCS	3	3	0	0	3
6	**PC**	**EI-PC-108**	Embedded System Design	3	3	0	0	3
7	**PC**	**EI-PC-110**	Advanced Power System	3	3	0	0	3
8	**PC**	**EI-PC-201**	Smart & Micro Sensor Design	3	3	0	0	3
9	**PRPC**	**EI-PRPC-101**	Process Control Lab	1.5	0	0	3	3
10	**PRPC**	**EI-PRPC-103**	Advanced Electric Drive Lab	1.5	0	0	3	3
11	**PRPC**	**EI-PRPC-102**	Advanced Power System Lab.	1.5	0	0	3	3
12	**PRPC**	**EI-PRPC-104**	Embedded Systems Lab	1.5	0	0	3	3
13	**PRPC**	**EI-PRPC-203**	Dissertation Phase-1	06	0	0	12	12
14	**PRPC**	**EI-PRPC-204**	Dissertation	16	0	0	32	--
			Total	**52**	**24**		**56**	**48**
Program Elective Courses								
1	**PE**	**EI-PE-101**	**Program Elective-I**	3	3	0	0	3
			(i) Control system Design					
			(ii) Process Equipment Design					
			(iii) Industrial Environmental Engineering					
			(iv) Power Plant Engineering					
			(v) Energy Auditing and methodology					
			(vi) Energy Efficient Machines					
2	**PE**	**EI-PE-102**	**Program Elective-II**	3	3	0	0	3
			(i) Renewable & Non-Conventional Energy					
			(ii) Theory and Design of Neuro fuzzy controllers					
			(iii) Digital Control System					
			(iv) HVDC Transmission System					

			(v) Energy Management					
			(vi) Process Modeling and Control					
			(vii) Advance Power Electronics					
3	**PE**	**EI-PE-203**	**Program Elective-III**	3	3	0	0	3
			(i) Digital Signal Processing					
			(ii) Sensors and Transducers					
			(iii) Reliability Engineering					
			(iv) Electrical Vehicle Engineering					
			(v) System Theory					
			(vi) Intelligent Instrumentations					
			(vii) Industrial Power Electronics					
			Total	**09**	**09**	**0**	**0**	**09**
1	**RM**	**EI-RM-109**	Research Methodology & IPR	**1**	**2**	**0**	**0**	**2**
Seminars								
1	**PRS**	**EI-PRS-105**	Seminar-I	1	0	0	2	2
	PRS	**EI-PRS-106**	Seminar-II	1	0	0	2	2
	PRS	**EI-PRS-201**	Current Literature Report & Seminar	2	0	0	4	4
			Total	**04**	**0**	**0**	**08**	**08**

Department of Instrumentation

M. Tech Electrical and Instrumentation Engineering

SCHEME OF EXAMINATIONS

M. Tech. 1st YEAR (SEMESTER–I)(from 2020 – 2021in phased manner)

Course No.	Course Title	C	Teaching Schedule			Allotment of marks			Exam Duration in Hrs.
			L	P	Cont. Hrs.	CIE	SEE	Total	
EI-PE-101	Program Elective-I	3	3	0	3	40	60	100	3 Hrs
EI-PC-103	Biomedical Instrumentation	3	3	0	3	40	60	100	3 Hrs
EI-PC-105	Advanced Electric Drive	3	3	0	3	40	60	100	3 Hrs
EI-PC-107	Advance Process Control	3	3	0	3	40	60	100	3 Hrs
EI-RM-109	Research Methodology & IPR	2	2	0	2	20	30	50	3 Hrs
EI-PRPC-101	Process Control Lab	1.5	0	3	3	20	30	50	3 Hrs
EI-PRPC-103	Advanced Electric Drive Lab.	1.5	0	3	3	20	30	50	3 Hrs
EI-PRS-105	Seminar-I	1	0	2	2	50	--	50	
	Total	**18**	**14**	**8**	**22**	**270**	**330**	**600**	

M. Tech. 1stYEAR (SEMESTER–II)

Course No.	Course Title	C	Teaching Schedule			Allotment of marks			Exam Duration in Hrs.
			L	P	Cont. Hrs.	CIE	SEE	Total	
EI-PE-102	Program Elective-II	3	3	0	3	40	60	100	3 Hrs
EI-PC-104	Power Quality Monitoring and Conditioning	3	3	0	3	40	60	100	3 Hrs
EI-PC-106	PLC & DCS	3	3	0	3	40	60	100	3 Hrs
EI-PC-108	Embedded System Design	3	3	0	3	40	60	100	3 Hrs
EI-PC-110	Advanced Power System	3	3	0	3	40	60	100	3 Hrs
EI-PRPC-102	Advanced Power System Lab.	1.5	0	3	3	20	30	50	3 Hrs
EI-PRPC-104	Embedded Systems Lab	1.5	0	3	3	20	30	50	3 Hrs
EI-PRS-106	Seminar-II	1	0	2	2	50	--	50	
	Total	**19**	**15**	**8**	**23**	**290**	**360**	**650**	

Program Elective-1	Program Elective-II
(i) Control system Design	(i) Renewable & Non-Conventional Energy
(ii) Process Equipment Design	(ii) Theory and Design of Neuro fuzzy controllers
(iii) Industrial Environmental Engineering	(iii) Digital Control System

(iv) Power Plant Engineering	(iv) HVDC Transmission System
(v) Energy Auditing and methodology	(v) Energy Management
(vi) Energy Efficient Machines	(vi) Process Modeling and Control

NOTE:

i) A program may have one or two laboratory courses spread over 3 periods.

ii) Sufficient number of electives to be offered subject to the condition that each elective should have at least five students.

M. Tech. 2nd YEAR (SEMESTER–III)

Course No.	Course Title	C	Teaching Schedule			Allotment of marks			Exam Duration in Hrs.
			L	P	Cont. Hrs.	CIE	SEE	Total	
EI-PC-201	Smart & Micro Sensor Design	3	3	0	3	40	60	100	3 Hrs
EI-PE-203	Program Elective-III	3	3	0	3	40	60	100	3 Hrs
EI-PRS-201	Current Literature Report & Seminar	2	0	4	4	50	--	50	
EI-PRPC-203	Dissertation Phase-1	6	0	12	12	50	--	50	
	Total	**14**	**6**	**16**	**22**	**180**	**120**	**300**	

Program Elective-III	
(i)	Digital Signal Processing
(ii)	Sensors and Transducers
(iii)	Reliability Engineering
(iv)	Electrical Vehicle Engineering
(v)	System Theory
(vi)	Intelligent Instrumentations
(vii)	Industrial Power Electronics

NOTE: The Preparatory Work for Dissertation Phase-I shall be evaluated by a committee comprising the following {on the basis of one mid semester seminar and one end semester seminar presented and one end semester report submitted by the candidate.

1. Chairperson or faculty nominee proposed by Chairperson
2. Dissertation Supervisor (and co-supervisor).
3. Two senior most faculty members of the department

M. Tech. 2nd YEAR (SEMESTER–IV)

Course No.	Course Title	C	Teaching Schedule	Allotment of marks			Exam Duration in Hrs.
			P	CIE	SEE	Total	
EI-PRPC-204	Dissertation	16	32	100	200	300	Final Viva Voce Exam

NOTE: The Dissertation shall be evaluated by a committee comprising the following through presentation cum viva-voce examination.

1. Chairperson or faculty nominee proposed by Chairperson.
2. Dissertation Supervisor (and co-supervisor).
3. One external expert appointed by the department.

Program Name: M. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-PE-101	Course Name: Program Elective-I CONTROL SYSTEM DESIGN (i)	L	T	P	C
		3	-	-	3
Year and Semester	1st Yr. 1st Semester	Contact hours per week: (3Hrs) Exam: (3 Hrs)			
Pre-requisite of course	Control System	Evaluation			
		CIE: 40	SEE: 60		

Course Objectives:

1. Study Design Specifications of control system.
2. Study the concept of multi-criteria optimization, norms of scalar & vector signals, norms of SISO LTI & MIMO LTI systems, state space methods for computing norms.
3. Study closed loop convex design specifications, convexity & duality.
4. Study the concept of Reliability & closed loop stability, regulation specifications,differential sensitivity specifications, robustness specifications.
5. Study, analysis and design of Compensators & controller using various techniques including Root locus & Bode plots
6. Study the state variable analysis, controllability and observability, state feedback for SISO system and MIMO systems and their design
7. Introduction to design of non-linear system.

Course Outcomes: On completion of the course, student would be able to:

CO1	Ability to understand the concept of multi-criteria optimization, norms of scalar & vector signals, norms of SISO LTI & MIMO LTI systems, state space methods for computing norms.
CO2	Ability to understand the concept of closed loop convex design specifications, convexity & duality.
CO3	Ability to understand the concept of Reliability & closed loop stability, regulation specifications, differential sensitivity specifications, robustness specifications.
CO4	Ability to analysis and designof Compensators& controllers by different techniques.
CO5	Ability to understand concept of state feedback for SISO system and MIMO systems and their design.

Module No	COURSE SYLLABUS CONTENTS OF MODULE	Hrs	COs
1	INTRODUCTION: Control System Architecture, Design Specifications Functional in-equally specifications, multi-criteria optimization, norms of scalar & vector signals, norms of SISO LTI & MIMO LTI systems, state space methods for computing norms, design specifications as sets, affine & convex sets and functions, closed loop convex design specifications, convexity & duality	**8**	**CO1, CO2**
2	DESIGN SPECIFICATIONS: Reliability & closed loop stability, I/O specifications, regulation specifications, actuator effort, combined effect of disturbances & commands, differential sensitivity specifications, robustness specifications via gain bounds.	**9**	**CO1, CO3**
3	Compensators & CONTROLLERS DESIGN: Selection criteria and design of lead, lag, lead-lag and cascade type of compensators using Root locus & Bode plots, Rate feedback. Controllers – configuration and fundamentals of design,	**10**	**CO3 CO4 CO5**

	cascade and feedback compensation using various controllers.		
4	STATE VARIABLE FEED BACK DESIGN: Introduction to state variable analysis, controllability and observability, state feedback for SISO system, state feedback design of SISO system using control canonical form. State variable feedback _ steady state error analysis, Use of steady state error coefficients, design of state observers, Introduction to design of MIMO systems. Introduction to design of non-linear system and software.	**10**	**CO4 CO5**

TEXT BOOKS/REFERENCE BOOKS:

1. Modern Control Systems – A manual of design methods by John A. Borrie (Prentice Hall International)
2. Control Systems – Principle & Design by M. Gopal (TMH publication)
3. Introduction to feed back control system by Pericles E. Manuel & Edward Leff (International Student Edition)
4. Linear controller designs – limits of performance by Stephen P. Boyd & Craig H. Barratt (Prentice Hall International).
5. Linear control analysis & design By John J. D'azzo& C. H. Houpis (McGraw Hill)

Note for Examiner(s): Question paper will comprise three sections,

1. Section-A will be compulsory and comprise 4-short answer type questions uniformly spread to the entire syllabus.
2. Section-B will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on concepts, definitions, derivations, principles, construction and working etc.
3. Section-C will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on derivations, numerical and applications of the various topics covered therein.

Note for Students:

1. Section – A is compulsory and attempt/answer all the four questions carrying 12 marks in total.
2. Attempt/answer two questions each out of the Section – B and Section – C. All questions will carry 12 marks.

Program Name: M. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-PE-101	**Course Name: Program Elective I, Process Equipment Design(ii)**		**L**	**T**	**P**		**C**
			3	**-**	**-**		**3**
Year and Semester	**1st Yr. 1st Semester**		**Contact hours per week:** (3 Hrs) Exam: (3 Hrs)				
Pre-requisite of course	**Process Control Systems**		**Evaluation**				
		CIE: 40			**SEE: 60**		
Course Objectives:							
1. It aims to equip the students with Equipment design							
2. To provide adequate knowledge about various types of equipment							
Course Outcomes: On completion of the course, student would be able to:							
CO1	Distinguish between various process devices and equipments						

CO2	Control and optimize process equipments
CO3	Characterize storage equipments
CO4	Design heat exchange equipment

Module No	COURSE SYLLABUS CONTENTS OF MODULE	Hrs	COs
1	Valve Noise calculation and reduction: Sources of valve noise, noise control, path treatment, valve treatment, valve noise calculation. Design & construction of Globe valve: valve trends, trim design, trim flow characteristics, flow range ability, standard trim configuration, valve plug stems, Body form of single and double seated globe valve, Bonnet design of global valve. Construction and flow characteristics of butterfly valve.	**8**	**CO1**
2	Boiler control and optimization, compressor control and optimization, cooling tower control and optimization, distillation controls, evaporator controls Basics of Process Equipment Design: General design procedure, Computer design, Fabrication techniques, Equipment classification, Power of rotational motion, Drives for process equipment.	**8**	**CO1, CO2**
3	Pressure Vessels: Pressure vessel code, Operating conditions – at low temperatures, at elevated temperatures, Design considerations and stresses, fabrication, inspection and tests, unfired vessel codes, High pressure vessels: Constructional features, materials, solid walled, multi shell, vessel closures, Jacket for vessels, Examples. Storage Vessels: Storage of fluids, Non-volatile liquids, volatile liquids and gases, Design of tanks, rectangular tanks, nozzles and mounting, Large capacity storage tanks, Examples. Reaction Vessels: Materials for construction, agitation, classification of reaction vessels, heating systems.	**8**	**CO1, CO3**
4	Heat Exchangers: Types of heat exchangers, design of shell and tube heat exchangers. Evaporators and Crystallisers: Types of evaporators, entrainment separators, materials and design considerations, crystallisers, Examples.Process Hazards and Safety Measures in Equipment design. Process flow diagrams.	**8**	**CO1 CO4**

Text Books:

1. Instrument Computer Aided Process control by S.K. Singh PHI
2. Computer Based Industrial Control by Krishna Kant PHI
3. Instrument Engineers Handbook- Process Control by Bela G. Liiptak

Note for Examiner(s): Question paper will comprise three sections,

1. Section-A will be compulsory and comprise 4-short answer type questions uniformly spread to the entire syllabus.

2. Section-B will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on concepts, definitions, derivations, principles, construction and working etc.

3. Section-C will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on derivations, numerical and applications of the various topics covered therein.

Note for Students:

1. Section – A is compulsory and attempt/answer all the four questions carrying 12 marks in total.

2. Attempt/answer two questions each out of the Section – B and Section – C. All questions will carry 12 marks.

Program Name: M. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-PE-101	**Course Name: Program Elective-I** INDUSTRIAL ENVIRONMENTAL ENGINEERING(iii)	**L**	**T**	**P**	**C**
		3	**-**	**-**	**3**
Year and Semester	**1st Yr. 1st Semester**	**Contact hours per week: (3Hrs)** Exam: (3 Hrs)			
Pre-requisite of course	**Nil**	**Evaluation**			
		CIE: 40	**SEE: 60**		
Course Objectives:					
1. To introduce the concept of air, water and noise pollution monitoring					
2. To study the concepts of emission type pollution controls					
3. To study the various air pollution monitoring instruments and methods for process industries.					
4. To introduce the pollution control and monitoring methods for pulp and paper industries.					
Course Outcomes: On completion of the course, student would be able to:					
CO1	Identify sources of air ,noise and water pollution and their effects				
CO2	Sample and analyze air pollutants				
CO3	Understand the air quality monitoring instruments				
CO4	Sample and analyze water borne pollutants				
CO5	Understand the water quality monitoring instruments				

Module No	**COURSE SYLLABUS CONTENTS OF MODULE**	**Hrs**	**COs**
1	INTRODUCTION: Source and classification of Air Pollution, Effect of Air Pollution in Human Health, Effect of Air Pollution on Animals, Effect of Air Pollution on Plants, Economics Effects of Air Pollution, Control of Air Pollution by Equipment, Control of Air Pollution by Process Changes, Air Pollution from Major Industrial Operations, Air Pollution legislation and regulation, Environment Protection Act, Air Pollution in Indian cities, Water & Noise Pollution. & its control, Green House effects & its control.	**8**	**CO1**
2	POLLUTION CONTROL FOR SPECIFIC POLLUTANTS: Industrial Pollution Emission and Indian Standards, Analysis of Pollutants, Control of BOD, Removal of Chromium, Removal of Mercury, Removal of Ammonia / urea, Treatment of Phenolic Effects, Removal of particular matter, Removal of Sulphur Dioxide, Removal of Oxides of Nitrogen, Removal of Vapour from Efficient case, Control of CO2 and CO.	**8**	**CO1, CO2**
3	POLLUTION CONTROL IN SELECTED PROCESS INDUSTRIES: General considerations of Pollution Control in Chemical Industries, Pollution Control aspects of fertilizer industries, Pollution Control in Petroleum & Petrochemical Units.	**8**	**CO2, CO3**
4	Pollution Control in Pulp & Paper Industries, Tanning Industries, Sugar Industries, Alcohol Industries, Electroplating & Metal Finishing Industries, Radioactive Wastes, Pollution Control methods used in Power Plants.	**8**	**CO1, CO4, CO5**

REFERENCE BOOKS:

1. Air Pollution by H V Rao, McGraw Hill
2. Pollution Control in Process Industries by S P Mahayar, McGraw Hill
3. Encyclopedia of Environmental Pollution & Control, Vol. 1 & 2, Enviro Media, Karad, India.
4. Environmental Water Pollution & its control by G R Chhatwal, M.C. Mehra& Others, Anmol Publication, Delhi.
5. Environmental Air Pollution & its control by G.R. Chhatwal& Others, Anmol Publication, Delhi.

Note for Examiner(s): Question paper will comprise three sections,

1. Section-A will be compulsory and comprise 4-short answer type questions uniformly spread to the entire syllabus.
2. Section-B will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on concepts, definitions, derivations, principles, construction and working etc.
3. Section-C will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on derivations, numerical and applications of the various topics covered therein.

Note for Students:

1. Section – A is compulsory and attempt/answer all the four questions carrying 12 marks in total.
2. Attempt/answer two questions each out of the Section – B and Section – C. All questions will carry 12 marks.

Program Name: M. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-PE-101	**Course Name: Program Elective-I POWER PLANT ENGINEERING(iv)**	**L**	**T**	**P**	**C**
		3	**-**	**-**	**3**
Year and Semester	**1st Yr. 1st Semester**	**Contact hours per week: (3Hrs)** Exam: (3 Hrs)			
Pre-requisite of course	**Basic Science**	**Evaluation**			
		CIE: 40		**SEE: 60**	

Course Objectives:	
1. To study the concept of steam power plant.	
2. To study the concept of Hydro-electric power plants and Nuclear power plants	
3. To study the concept of gas turbine and diesel power plants.	
4. To study the combined operation of different power plants.	
Course Outcomes: On completion of the course, student would be able to:	
CO1	To understand the operation of steam power plant.
CO2	To understand the operation of Hydro-electric power plants and Nuclear power plants
CO3	To understand the operation of gas turbine and diesel power plants.
CO4	To understand the combined operation of different power plants.

Module No	**COURSE SYLLABUS CONTENTS OF MODULE**	**Hrs**	**COs**

1	Steam generators, condensers and turbines: Classification of steam generators, selection, operation of locomotive, Babcock Wilcox, Cochran boilers, Types of condensers, effect of air in condensers, Dalton's law of partial pressure, cooling water calculations, steam nozzles, types of steam turbine efficiencies, compounding, governing and control. Steam power plant: Classification, Operation, Description of Rankin cycle, Regenerative cycle, Reheat-Regenerative Cycle, Binary Vapour Cycle, Selection of plant site and its layout, coal handling system, combustion system, Fluidised bed combustion, Ash handling, Feed pumps, Heat exchangers, Economizers, Super heaters, Reheaters, Air preheaters, Feed water heaters, Evaporators.	**8**	**CO1**
2	Hydro-electric power plants: Hydrological Cycle, Hydrograph, Flow duration curve, Selection of site, Essential features, Classification of hydro plants, Selection of water turbines for hydro power plant, Automatic and remote control of hydro-station, layout of hydro power plant. Nuclear power plants: Nuclear physics, Binding energy, Radioactive decay. Fertile material, Mass defect, Nuclear reactions type and application, Generation of nuclear energy by fission, Nuclear reactors. Site selections, safety measures, plant layout, Fusion reaction, Future of nuclear power.	**8**	**CO2**
3	Gas turbine: Elements of gas turbines, Open and closed cycles for gas turbines, Performance terms, Thermal refinement to gas turbines cycle, Plant layout, applications, gas turbines Cycle calculations. Diesel power plants: Classifications of IC Engines and their performance, Four stroke and two stroke diesel engines, combustion phenomenon; Essential components, Celane number, knocking, super charging, operation and layout of diesel power plant.	**8**	**CO3**
4	Combined operation of different power plants: Advantages of combined operation of plants, load division between power stations, coordination of different types of Power Plants. Pollution control: Pollution from thermal & nuclear plants, Particulate emission and control, electrostatic precipitator, solid waste disposal.	**8**	**CO4**

TEXT BOOKS/REFERENCE BOOKS:

1. Chakrabarti A., Soni, M.L. Gupta P.V. and Bhatanagar U.S., A Textbook on Power System Engineering, Dhanpat Rai & Co.
2. EI-Wakit M.M., Power Plant Engineering, McGraw Hill, USA
3. Rajput R.K., Power Plant Engineering, Luxmi Publications
4. Sharma P.C., Power Plant Engineering, Kataria& Sons
5. Skrotzki B.G.A. and Vapot W.A., Power Station Engineering and Economy, Tata McGraw-Hill

Note for Examiner(s): Question paper will comprise three sections,

1. Section-A will be compulsory and comprise 4-short answer type questions uniformly spread to the entire syllabus.
2. Section-B will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on concepts, definitions, derivations, principles, construction and working etc.
3. Section-C will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on derivations, numerical and applications of the various topics covered therein.

Note for Students:

1. Section – A is compulsory and attempt/answer all the four questions carrying 12 marks in total.
2. Attempt/answer two questions each out of the Section – B and Section – C. All questions will carry 12 marks.

Program Name: M. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-PE-101	**Course Name: Program Elective-I** ENERGY AUDITING AND METHODOLOGY(v)	**L**	**T**	**P**	**C**
		3	**-**	**-**	**3**
Year and Semester	**1st Yr. 1st Semester**	**Contact hours per week: (3Hrs)** Exam: (3 Hrs)			
Pre-requisite of course	**Electrical Measurements and Instruments**	**Evaluation**			
		CIE: 40	**SEE: 60**		

Course Objectives:	
1. To introduce the concept of Energy Management and Audit.	
2. To study the concepts of financial management.	
3. To study and analysis various type of appliance in electrical system.	
4. To study the conceptual theory and working of refrigeration system.	
Course Outcomes: On completion of the course, student would be able to:	
CO1	To understand the concept of Energy Management and Audit.
CO2	To understand the concepts of financial management.
CO3	To familiarize with various type of appliance in electrical system.
CO4	To understand conceptual theory and working of refrigeration system.

Module No	**COURSE SYLLABUS CONTENTS OF MODULE**	**Hrs**	**COs**
1	Energy Scenario: Energy needs of growing economy, Long term energy scenario, Energy pricing, Energy sector reforms, Energy and environment: Air pollution, Climate change, Energy security, Energy conservation and its importance, Energy strategy for the future, Energy conservation Act-2001 and its features. 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 and energy substitution, Energy audit instruments.	**8**	**CO1**
2	Material and Energy balance: Facility as an energy system, Methods for preparing process flow, Material and energy balance diagrams. Financial Management: Investment-need, Appraisal and criteria, Financial analysis techniques- Simple payback period, Return on investment, Net present value, Internal rate of return, Cash flows, Risk and sensitivity analysis, Financing options, Energy performance contracts and role of energy savings companies (ESCOs).	**8**	**CO2**

3	Electrical system: Electricity tariff, Load management and maximum demand control, Power factor improvement, Distribution and transformer losses. Losses in induction motors, Motor efficiency, Factors affecting motor performance, Rewinding and motor replacement issues, energy efficient motors. Light source, Choice of lighting, Luminance requirements, and Energy conservation avenues Compressed air system: Types of air compressors, Compressor efficiency, efficient compressor operation, Compressed air system components, Capacity assessment, Leakage test Factors affecting the performance and efficiency.	**8**	**CO3**
4	High Voltage Alternating Current and Refrigeration System: Vapor compression refrigeration cycle, Refrigerants, Coefficient of performance, Capacity, Factors affecting refrigeration and air conditioning system performance and savings opportunities, Vapor absorption refrigeration system: Working principle, Types and comparison with vapor compression system, Saving potential, Fans, Blowers and pumps- Types, Performance evaluation, Efficient system operation, Flow control strategies and energy conservation opportunities.	**8**	**CO4**

TEXT BOOKS/REFERENCE BOOKS:

1. Abbi, Y.P. and Jain, S., Handbook on Energy Audit and Environment Management, Teri Bookstore
2. Diwan, P., Energy Conservation, Pentagon Press (2008).
3. Younger, W., Handbook of Energy Audits, CRC Press (2008)
4. Sawhney and Maheshwari, Solar Energy and Energy Conservation, Prentice Hall (India)
5. Rao S. and B. B. Parulkar, Energy Technology, Khanna Publishers
6. Sukhatme S. P., Solar Energy, Tata McGraw Hill
7. David S., Hand Book of Industrial Energy Conservation, Van Nostrand Reinhold Publishing Company.

Note for Examiner(s): Question paper will comprise three sections,

1. Section-A will be compulsory and comprise 4-short answer type questions uniformly spread to the entire syllabus.
2. Section-B will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on concepts, definitions, derivations, principles, construction and working etc.
3. Section-C will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on derivations, numerical and applications of the various topics covered therein.

Note for Students:

1. Section – A is compulsory and attempt/answer all the four questions carrying 12 marks in total.
2. Attempt/answer two questions each out of the Section – B and Section – C. All questions will carry 12 marks.

Program Name: M. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-PE-101	Course Name: Program Elective-I ENERGY EFFICIENT MACHENES(vi)	L 3	T -	P -	C 3
Year and Semester	**1st Yr.** **1st Semester**	**Contact hours per week: (3Hrs)** Exam: (3 Hrs)			
Pre-requisite of course	**Electrical Machines**	**Evaluation**			
		CIE: 40		**SEE: 60**	

Course Objectives:

1. To introduce the concept of energy management and energy audit system.
2. To introduce the concept and Economics of Power factor improvements.
3. To study the concept of Energy efficient machines Energy efficient and Economics of Energy power generation.
4. To study the concept of economics of electrical energy distribution and electrical drives.

Course Outcomes: On completion of the course, student would be able to:

CO1	To Familiarize withthe concept of the concept of energy management and energy audit system
CO2	To understand the concept of Energy efficient machines and Economics of Power factor improvements.
CO3	To Familiarize with the concept of Energy efficient machines and Economics of Energy power generation.
CO4	To understand the concept of economics of electrical energy distribution and electrical drives.

Module No	COURSE SYLLABUS CONTENTS OF MODULE	Hrs	COs
1	INTRODUCTION: Need for energy efficient machines, energy cost and two part tariff, energy conservation in industries and farms -a necessity, introduction to energy management and energy audit system. Review of induction motor characteristics.	**7**	**CO1**
2	POWER FACTOR: The power factor in sinusoidal systems, power factor improvement, power factor with nonlinear loads, Harmonics and the power factor.	**7**	**CO2**
3	ENERGY EFFICIENT MOTORS: Standard motor efficiency, why more efficient motors? An energy efficient motor, efficiency determination methods, Direct Measurement method, Loss segregation method, Comparison, motor efficiency labelling, energy efficient motor standards. Motor life cycle.	**8**	**CO3**
4	INDUCTION MOTORS AND ADJUSTABLE DRIVE SYSTEMS: Energy Conservation, adjustable speed systems, Application of adjustable speed systems to fans, pumps and constant torque loads.	**8**	**CO4**

TEXT /REFERENCE BOOKS:

1. Andreas John C., Energy efficient electric motors, Marcel Dekker Inc. 1992.
2. Thuman Albert, Introduction to Efficient Electric System Design, The Fairmount Press Prentice Hall.
3. Tripathi S.C. , Electric Energy Utilization and Conservation, Tata McGraw-Hill 1991.

4. Belove Charles, Handbook of Modem Electronics and Electrical Engineering, John Wiley & Sons.

Note for Examiner(s): Question paper will comprise three sections,

1. Section-A will be compulsory and comprise 4-short answer type questions uniformly spread to the entire syllabus.
2. Section-B will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on concepts, definitions, derivations, principles, construction and working etc.
3. Section-C will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on derivations, numerical and applications of the various topics covered therein.

Note for Students:

1. Section – A is compulsory and attempt/answer all the four questions carrying 12 marks in total.
2. Attempt/answer two questions each out of the Section – B and Section – C. All questions will carry 12 marks.

Program Name: M. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-PC-103	**Course Name: BIO-MEDICAL INSTRUMENTATION**	**L**	**T**	**P**	**C**
		3	**-**	**-**	**3**
Year and Semester	**1st Yr. 1stSemester**	**Contact hours per week: (3Hrs)** Exam: (3 Hrs)			
Pre-requisite of course	Physics, Basic Electrical Engineering.	**Evaluation**			
		CIE: 40	**SEE: 60**		

Course Objectives:	
1. To introduce the concept of Bio Instrumentation like Medical Bio Potential Electrodes and Biomedical Recorders.	
2. To studycardiac and Respiratory measurementssystem	
3. To studyInstrumentation for Measuring Nervous Function.	
4. To study Recent Trends in Biomedical Engineering.	
Course Outcomes: On completion of the course, student would be able to:	
CO1	To Familiarize with Bio Medical Instrumentation.
CO2	To understand cardiac and Respiratory measurementssystem.
CO3	To understand Instrumentation for Measuring Nervous Function.
CO4	To understand the Recent Biomedical devices instrumentation.

Module No	**COURSE SYLLABUS CONTENTS OF MODULE**	**Hrs**	**COs**
1	Characteristics of Transducers and Electrodes for Biological Measurement: Introduction to human body; block diagram, classification, characteristics, various physiological events and suitable transducer for their recording, bioelectric potentials	**5**	**CO1**
2	Cardiac & System: Cardiac musculature, Electro cardiography, ECG recording, Phonocardiography, holter recoding ECG lead system, Heart rate meter, vector cardiography, Pacemakers, Defibrillators. Blood Pressure and Blood Flow Measurement: Invasive and non-invasive methods of Blood	**7**	**CO1, CO2**

	pressure, Characteristics of blood flow and heart sound, Cardiac output measurement, Plethysmography. Respiratatory System: Mechanics of breathing, Parameters of respiration, Respiratory system measurements, Respiratory therapy instruments		
3	Instrumentation for Measuring Nervous Function: EEG signal, frequency band classification, Lead systems, EEG recording, Clinical applications of EEG signal, X-ray CT scan, MRI, PET. Muscoskeletal systems: EMG, Clinical applications, and Muscles stimulator. Clinical Laboratory Instrumentation: Test on blood cell, Blood cell counter, Blood glucose monitors, auto analyzer, Pulse-oximeter.	**7**	**CO3**
4	Recent Trends in Biomedical Engg.: Patient care and monitoring, Non-invasive diagnostic instrumentation, Biotelemetry, Telemedicine, Prosthetic devices, Lie detector test, Application of lasers and ultrasonic in biomedical field. Troubleshooting & Electrical Safety of Biomedical Instruments: Physiological effect of current and safety measurement.	**7**	**CO4**

TEXT/REFERENCE BOOKS:

1. Medical instrumentation application & design, John G Webster, John wiley, 1998.
2. Review of medical physiology, W.F. Ganong, Medical publisher, 1977
3. Biomedical instrument and measurement, Cromwell, PHI, 2000
4. Handbook of biomedical instrument, R S Khandpur, TMH

Note for Examiner(s): Question paper will comprise three sections,

1. Section-A will be compulsory and comprise 4-short answer type questions uniformly spread to the entire syllabus.
2. Section-B will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on concepts, definitions, derivations, principles, construction and working etc.
3. Section-C will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on derivations, numerical and applications of the various topics covered therein.

Note for Students:

1. Section – A is compulsory and attempt/answer all the four questions carrying 12 marks in total.
2. Attempt/answer two questions each out of the Section – B and Section – C. All questions will carry 12 marks.

Program Name: M. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-PC-105	**Course Name: ADVACED ELECTRIC DRIVE**	**L**	**T**	**P**	**C**
		3	**-**	**-**	**3**
Year and Semester	**1st Yr. 1stSemester**	**Contact hours per week:** (3Hrs) Exam: (3 Hrs)			
Pre-requisite of course	**Electrical Machines, Power Electronics**	**Evaluation**			
		CIE: 40	**SEE: 60**		
Course Objectives:					
1. To introduce the concept of types of Electric Drives.					

2. To introduce the DC Motor Drives.			
3. To introduce the AC Motor Drives.			
4. To study the Motor power rating.			
5. To implement Traction Drives.			
Course Outcomes: On completion of the course, student would be able to:			
CO1	To Familiarize with Dynamics and Control of Electric Drives.		
CO2	To understand efficient speed control techniques in DC Motor Drives.		
CO3	To understand efficient speed control techniques in AC Motor Drives.		
CO4	To understand the significance and selection of power rating.		
CO5	To familiarization of Load and choice of traction for suitable load.		
Module No	**COURSE SYLLABUS CONTENTS OF MODULE**	**Hrs**	**COs**
1	Electric Drive: Concept, classification, parts and advantages of electrical dives. Types of Loads, Components of load toques, Fundamental torque equations, Equivalent value of drive parameters for loads with rotational and translational motion. Determination of moment of inertia, Steady state stability, Transient stability. Multiquadrant operation of drives. Load equalization.	**8**	**CO1**
2	Motor power rating: Thermal model of motor for heating and cooling, classes of motor duty, determination ofmotor rating for continuous, short time and intermittent duty, equivalent current, torque and power methods of determination of rating for fluctuating and intermittent loads. Effect of load inertia & environmental factors. Starting of Electric Drives: Effect of starting on Power supply, motor and load. Methods of stating of electric motors. Acceleration time Energy relation during stating, methods to reduce the Energy loss during starting. Braking of Electric Drives: Types of braking, braking of DC motor, Induction motor and Synchronous motor, Energy loss during braking.	**8**	**CO1, CO2,**
3	DC motor drives: Modeling of DC motors, State space modeling, block diagram & Transfer function, Single phase, three phases fully controlled and half controlled DC drives. Dual converter control of DC drives. Power factor, supply harmonics and ripple in motor current chopper controlled DC motor drives. Induction motor drives: Stator voltage variation by three phase controllers, Speed control using chopper resistance in the rotor circuit, slip power recovery scheme. Pulse width modulated inverter fed and current source inverter fed induction motor drive. Volts/Hertz Control, Vector or Field oriented control.	**8**	**CO2, CO3**
4	Synchronous motor drives: Variable frequency control, Self-Control, Voltage source inverter fed synchronous motor drive, Vector control. Introduction to Solar and Battery Powered Drive, Stepper motor, Switched Reluctance motor drive. Industrial application: Drive consideration for Textile mills, Steel rolling mills, Cement mills, Paper mills, Machine tools. Cranes & hoist drives.	**8**	**CO4, CO5**

TEXT/REFERENCE BOOKS:

1. Fundamental of Electrical Drives, G.K. Dubey, New Age International Publication.

2. Electric Drives, VedamSubrahmanyam, TMH
3. A first course on Electrical Drives, S.K. Pillai, , New Age International Publication.
4. Electric motor drives, R. Krishnan, PHI
5. Modern Power Electronics & Ac drives, B.K. Bose, Pearson Education.
6. Electric Motor & Drives. Austin Hughes, Newnes.

Note for Examiner(s): Question paper will comprise three sections,

1. Section-A will be compulsory and comprise 4-short answer type questions uniformly spread to the entire syllabus.
2. Section-B will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on concepts, definitions, derivations, principles, construction and working etc.
3. Section-C will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on derivations, numerical and applications of the various topics covered therein.

Note for Students:

1. Section – A is compulsory and attempt/answer all the four questions carrying 12 marks in total.
2. Attempt/answer two questions each out of the Section – B and Section – C. All questions will carry 12 marks.

Program Name: M. Tech.-Electrical and Instrumentation Engineering

<table>
<tr><td>Course Code:
EI-PC-107</td><td colspan="2">Course Name: ADVANCE PROCESS CONTROL</td><td>L
3</td><td>T
-</td><td>P
-</td><td>C
3</td></tr>
<tr><td>Year and Semester</td><td>1st Yr.
1st Semester</td><td colspan="4">Contact hours per week: (3Hrs)
Exam: (3 Hrs)</td></tr>
<tr><td rowspan="2">Pre-requisite of course</td><td rowspan="2">Control System</td><td colspan="4">Evaluation</td></tr>
<tr><td colspan="2">CIE: 40</td><td colspan="2">SEE: 60</td></tr>
<tr><td colspan="7">Course Objectives:</td></tr>
<tr><td colspan="7">1. Study the techniques used for PID controller tuning</td></tr>
<tr><td colspan="7">2. Development and synthesis the feedback controllers for specified close loop response</td></tr>
<tr><td colspan="7">3. Concept and Study of FC and FO type control valve and their applications with examples, Gain of valve and concept of control valve sizing for liquid, Gas, vapour and steam. (Special reference to Masoneillian&Fisher Equation) and study control valve cavitation and flashing phenomenon</td></tr>
<tr><td colspan="7">4. Study and development of advance control techniques for process control and automation</td></tr>
<tr><td colspan="7">5. Development of control techniques for safe design of process control and automation</td></tr>
<tr><td colspan="7">6. Study and development of Predictive control, Statistical control, Adaptive and Inferential control system</td></tr>
<tr><td colspan="7">Course Outcomes: On completion of the course, student would be able to:</td></tr>
<tr><td>CO1</td><td colspan="6">Able to Analyze the effect of P, PI, PD and PID controllers on a control system and design suitable controller for a typical process</td></tr>
<tr><td>CO2</td><td colspan="6">Able to understand FC and FO type control valve and Able to learn and analyze the various principles & concepts involved in valve sizing for liquid, Gas, vapor and steam and control valve cavitation and flashing phenomenon</td></tr>
<tr><td>CO3</td><td colspan="6">Ability to understand analysis and development of advance control techniques for process control and automation</td></tr>
</table>

CO4	Ability to understand analysis and development of Predictive control, Statistical control, Adaptive and Inferential control system techniques for process control and automation

Module No	COURSE SYLLABUS CONTENTS OF MODULE	Hrs	COs
1	PID controller tuning procedures: Close loop oscillation based tuning, Ziegler-Nichol close-loop method. Tuning rules for first order + dead time processes: step testing quarter decay ratio response, Ziegler-Nichol open loop method, Cohen-Coon parameters. Synthesis of feedback controllers: Development of the controller synthesis formula, specifications of close loop response, direct synthesis for minimum and non-minimum phase processes, controller modes and tuning parameters derivative mode for dead time process. Dead Time Compensation (Algorithms for Smith Predictor), & effect of process modeling error.	**10**	**CO1**
2	Control Valve Design: Control valve flow characteristics, Valve & process characteristics, range availability of control valve, control valve sizing for gas, liquid, vapors and steam, Control valve cavitation and flashing, flow control cavitation index, vibration curve cavitation index, calculation of flash fraction, Control valve gain, sequencing of control valve . Valve application, selection, valve capacity testing.	**8**	**CO2**
3	Additional control techniques: Cascade control,. Selective control & Split range control, Cascade control for various processes , dynamic characteristics of Cascade control system and its tuning. Override and Auctioneering control system for various processes, Feedforward control system, Feedforward control of various processes. Design of Feedforward controllers, Feedforward –Feedback control & their relative advantages & disadvantages.	**10**	**CO3**
4	Ratio control system, Predictive control, Statistical control Adaptive and Inferential control system: Programmed Adaptive control, gain scheduling Adaptive control, Self tuning regulator (STR), MRAC, Multivariable Process Control.	**9**	**CO4**

TEXT BOOKS/REFERENCE BOOKS:

1. Principles and Practice of Automatic Process Control by Carlos A Smith, John wiley& sons
2. Computer Aided Process control by S.K. Singh PHI
3. Process Control Modeling, Design, and Simulation by B.WayaneBequette PHI
4. Chemical Process control by Stephanopolous PHI

Note for Examiner(s): Question paper will comprise three sections,

1. Section-A will be compulsory and comprise 4-short answer type questions uniformly spread to the entire syllabus.
2. Section-B will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on concepts, definitions, derivations, principles, construction and working etc.
3. Section-C will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on derivations, numerical and applications of the various topics covered therein.

Note for Students:

1. Section – A is compulsory and attempt/answer all the four questions carrying 12 marks in total.
2. Attempt/answer two questions each out of the Section – B and Section – C. All questions will carry 12 marks.

Program Name: M. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-RM-109	**Course Name: Research Methodology and IPR**	**L**	**T**	**P**	**C**
		2	**-**	**-**	**2**
Year and Semester	**1st Yr. 1stSemester**	**Contact hours per week: (2Hrs)** Exam: (3 Hrs)			
Pre-requisite of course	**Nil**	**Evaluation**			
		CIE: 20		**SEE: 30**	

Course Objectives	
1. To study the ideas of research methods.	
2. To study about statistical analysis and sampling.	
3. To study about regression and correlation analysis.	
4. To study about edition, tabulation and testing of hypotheses.	
Course Outcomes	
CO1	To formulate a route map for a particular problem or topic of research
CO2	How to test and validate the data through statistical techniques
CO3	To implement the suitable methods of sampling for individual problems
CO4	To compare and evaluate the results with others
CO5	To present the results with more informative details

Module No	**COURSE SYLLABUS CONTENTS OF MODULE**	**Hrs**	**COs**
1	Nature and objective of the research: Methods of Research: Historical, descriptive and experimental. Alternative approaches to the study of the research problem and problem formulation. Formulation of hypotheses: Feasibility, preparation and presentation of proposal.	**8**	**CO1, CO5**
2	Introduction to statistical analysis: Probability and probability distributions, binomial, Poisson, exponential and normal distributions, and their applications. Sampling: Primary and secondary data, their collection and validation, methods of sampling, stratified random sampling, and systematic sampling.	**8**	**CO2 CO3**
3	Regression and correlation analysis: Tests of significance based on normal, t and chi square distributions, analysis of variance. Basic Principles of design of experiments, completely randomized and randomized block designs.	**8**	**CO2 CO3 CO4**
4	Edition, tabulation, & testing of hypotheses, Interpolation of results, presentation, styles for figures, tables, text, quoting of reference and bibliography. Use of software for statistical analysis like SPSS, Mini tab or MAT lab, Report writing, preparation of thesis.	**8**	**CO4 CO5**

TEXT BOOKS/REFERENCE BOOKS:

1. Research Methodology by C.R Kothari, VishwaPrakashan
2. Research Methodology by P.G .Tripathi
3. Research Methodology in Social Science by Sadhu Singh, Himalya Publishers
4. Business Research Methods, Donald cooper, Tata McGraw Hill
5. Statistical analysis for Engineers & Scientists, J. W. Barnes, McGraw Hill

Note for Examiner(s): Question paper will comprise three sections,

1. Section-A will be compulsory and comprise 4-short answer type questions uniformly spread to the entire syllabus.
2. Section-B will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on concepts, definitions, derivations, principles, construction and working etc.
3. Section-C will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on derivations, numerical and applications of the various topics covered therein.

Note for Students:

1. Section – A is compulsory and attempt/answer all the four questions carrying 12 marks in total.
2. Attempt/answer two questions each out of the Section – B and Section – C. All questions will carry 12 marks.

Program Name: M. Tech.-Electrical and Instrumentation Engineering

Course Code:EI-PRPC-101	**Course Name:** Process Control Lab	**L**	**T**	**P**	**C**
		0	**0**	**3**	**1.5**
Year and Semester	**1st Year** **1stSemester**	**Contact hours per week:** (3Hrs) Exam**:** (3hrs.)			
Pre-requisite of course	**Control Engineering Lab.**	**Evaluation**			
		CIE: 20		**SEE: 30**	

Course Objectives:	
1. To Familiarization of PLC Ladder Programming Instructions Set	
2. To compile and execute programs in Ladder Programming	
3. To study the PC and PLC based control systems	
4. To study and write PLC program for the multiple process control systems	
5. To study and write PLC program for different strategies of control system such as feedback, feed forward, cascade, ratio control etc.	
6. To write PLC programs to solve the different control problems	
Course Outcomes: On completion of the course, student would be able to:	
CO1	Ability to understand PC and PLC based control system and their implementation
CO2	Ability to develop PLC Ladder Programming skill
CO3	Analyse and implement PLC Ladder Programming for different type of process control system.
CO4	Ability to design and develop PLC program for different strategies of control system such as feedback, feed forward, cascade, ratio control for control of process variables

Expt. No	**COURSE SYLLABUS CONTENTS OF MODULE**	**COs**
1	Familiarization of PLC Ladder Programming Instructions Set	**CO1,**

2	**To Study** PC Based Traffic Light Control :- • Basic Traffic Light Sequence	**CO2, CO3, CO4**
3	PLC Based Traffic Light Control: • PLC Connection Details • Dual Traffic Light Sequence • Traffic Counting • Green Time Alteration According to Traffic Flow • The Pedestrian Crossing • Complete System Control	
4	To Study Process Control – Ratio, feedback control flow & level	
5	To Study Rotary Transfer Unit :- • Movement of Rotary Table • Initialization • Station Counting • Dispensing • A Production Line System • Follow a Set Routine	
6	To Study Industrial Control Trainer	
7	To Study Multi-process Control Trainer : Feedback, feedforward cascade and ration Control system for flow , temperature and level control	
8	To study of Pressure Control Unit :-Proportional Control : Run a loop experiments using 'proportional only control' with the following sets of SP and PG values. Record the eventual 'steady state' rate values in the table below, once the initial oscillations have decayed. • Proportional and Integral Control	
9	To design, Level Control PC :- • Proportional Control • Proportional and Integral Control	
10	To Study .Flow control PC & PLC :- • Proportional Control • Proportional and Integral Control • Saturation and Integral Windup • Three Term or PID Control • Zeigler / Nichols Tuning	
11	To Study The System Rig :- • Proportional Control • Proportional and Integral Control • Saturation and Integral Windup • Three Term or PID Control • Ziegler / Nichols Tuning • Temperature Control • Batch Volume Control • Fluid Level Control	

	• Open Loop Control • Bode Plots • Flow Loop Model using Caldwell's Method • Flo Loop Model using Sundaresan's Method • Design of Controller for PCU Flow Loop • PRT Signal Conditioning • Flowmeter Signal Conditioning	
12	Process Control Experiment :- • Proportional Control • Proportional and Integral Control • Saturation and Integral Windup • Three Term or PID Control • Ziegler / Nichols Tuning • Temperature Control • Batch Volume Control • Fluid Level Control • Open Loop Control • Bode Plots	

Program Name: M. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-PE-102	**Course Name: Program Elective-II Renewable & Non-Conventional Energy(i)**	**L**	**T**	**P**	**C**
		3	**0**	**-**	**3**
Year and Semester	**1st year 2nd Semester**	**Contact hours per week:** (3Hrs) **Exam:** (3hrs.)			
Pre-requisite of course	**Basic Electrical Engineering and Engineering Science**	**Evaluation**			
		CIE: 40	**SEE: 60**		

Course Objectives:

1. To familiarize the energy scenario and the consequent growth of the power generation from renewable energy and non-conventional energy sources.
2. To study the basic engineering science of renewable and non-conventional energies sources.
3. To study the wind and solar energy conversion systems for electrical system.
4. To study the energy conversion techniques for nonconventional sources and applications.

Course Outcomes: On completion of the course, student would be able to:

CO1	Understand the energy scenario and the consequent growth of the power generation from renewable energy and non-conventional energy sources.
CO2	Understand the basic engineering science of renewable and non-conventional energies sources.
CO3	Understand the wind and solar energy conversion systems for electrical power system.
CO4	To understand the energy conversion techniques for nonconventional sources and applications.

Module No	**COURSE SYLLABUS CONTENTS OF MODULE**	**Hrs**	**COs**

1	**Introduction to Energy sources:** Renewable and non-renewable energy sources, energy consumption as a measure of Nation's development; strategy for meeting the future energy requirements Global and National scenarios, Prospects of renewable energy sources. Impact of renewable energy generation on environment, Kyoto Protocol.	**7**	**CO1**
2	**Solar Energy:** Solar radiation - beam and diffuse radiation, solar constant, earth sun angles, attenuation and measurement of solar radiation, local solar time, derived solar angles, sunrise, sunset and day length. flat plate collectors, concentrating collectors, Solar air heaters-types, solar driers, storage of solar energy-thermal storage, solar pond , solar water heaters, solar distillation, solar still, solar cooker, solar heating & cooling of buildings, photo voltaic - solar cells, different types of PV Cells, Mono-poly Crystalline and amorphous Silicon solar cells. Design of PV array. Efficiency and cost of PV systems & its applications. PV hybrid systems.	**8**	**CO2, CO3**
3	**Wind Energy:** Principle of wind energy conversion; Basic components of wind energy conversion systems; wind mill components, various types and their constructional features; design considerations of horizontal and vertical axis wind machines: analysis of aerodynamic forces acting on wind mill blades and estimation of power output; wind data and site selection considerations.	**7**	**CO2, CO3**
4	**Energy from Biomass:** Biomass conversion technologies, Biogas generation plants, classification, advantages and disadvantages, constructional details, site selection, digester design consideration, filling a digester for starting, maintaining biogas production, Fuel properties of bio gas, utilization of biogas. **Hydrogen Energy and Fuel cell:** Introduction, Hydrogen Production methods, Hydrogen storage, hydrogen transportation, utilization of hydrogen gas, hydrogen as alternative fuel for vehicles. Introduction, Design principle and operation of fuel cell, Types of fuel cells, conversion efficiency of fuel cell, and application of fuel cells.	**9**	**CO2, CO4**

Reference Books:

1. G.D. Rai, "Non-conventional Energy sources", Khanna Publishers.
2. Bansal Keemann and Meliss, "Renewable energy sources and conversion technology", Tata Mc-Graw Hill.
3. Ashok V. Desai, "Non conventional Energy", New Age International Publishers Ltd.
4. D.P. Kothari, "Renewable energy resources and emerging technologies", Prentice Hall of India Pvt. Ltd.

Note for Examiner(s): Question paper will comprise three sections,

1. Section-A will be compulsory and comprise 4-short answer type questions uniformly spread to the entire syllabus.
2. Section-B will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on concepts, definitions, derivations, principles, construction and working etc.
3. Section-C will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on derivations, numerical and applications of the various topics covered therein.

Note for Students:

1. Section – A is compulsory and attempt/answer all the four questions carrying 12 marks in total.
2. Attempt/answer two questions each out of the Section – B and Section – C. All questions will carry 12 marks.

Program Name: M. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-PE-102	**Course Name: Program Elective-II THEORY AND DESIGN OF NEURO – FUZZY CONTROLLERS(ii)**	**L**	**T**	**P**	**C**
		3	**0**	**-**	**3**
Year and Semester	**1st Year 2nd Semester**	**Contact hours per week:** (3Hrs) **Exam:** (3hrs.)			
Pre-requisite of course	**Basic Engineering Mathematics**	**Evaluation**			
		CIE: 40	**SEE: 60**		

Course Objectives:	
1. To study and acquire the basic knowledge of neural network and fuzzy logic.	
2. To study the basic architecture and modeling of neural network control and Fuzzy logic control.	
3. To study various types of fuzzy logic and neural network controllers.	
4. To identify, formulate and solve the neuro fuzzy logic based problems.	
Course Outcomes: On completion of the course, student would be able to:	
CO1	To understand basic concept and working of neural network and fuzzy logic system.
CO2	To understand the basic architecture and modeling of neural network control and Fuzzy logic control.
CO3	Able to neural network and fuzzy logic techniques in different field, which involve perception, reasoning and learning.
CO4	Analyze and design a real world problem for implementation and understand the dynamic behavior of a system.

Module No	**COURSE SYLLABUS CONTENTS OF MODULE**	**Hrs**	**COs**
1	**NEURAL NETWORK THEORY:** Introduction, Biological neurons and their artificial models, Learning, adaptation and neural networks learning rules types of neural networks, Single layer, multiplayer, Feed forward, feedback networks; back propagation, Learning and training, Hop field network.	**8**	**CO1, CO2**
2	**NEURAL NETWORKS BASED CONTROL:** Neural network for non-linear systems, Schemes of neuro control, System identification forward model and inverse model, Indirect learning neural network control applications, Case studies.	**8**	**CO2, CO3, CO4**
3	**FUZZY LOGIC THEORY :** Fuzzy sets ,Fuzzy operation , Fuzzy arithmetic, Fuzzy relations ,Fuzzy relational equations, Fuzzy measure, Fuzzy functions , Approximate reasoning ,Fuzzy propositions ,Fuzzy quantifiers , If–then rules.	**8**	**CO1**
4	**FUZZY LOGICBASED CONTROL:**Structure of fuzzy logic controller,Fuzzification models, Database,Rule base Inference engine,defuzzification, Module ,Non-linear fuzzy control, PID like FLC,	**8**	**CO2, CO3, CO4**

	Sliding mode FLC,Sugeno FLC, Adaptive fuzzy control , Fuzzy control applications case studies.		

REFERENCE BOOKS

1. Jacek. M. Zurada, "Introduction to Artificial Neural Systems", Jaico Publishing House, 1999.
2. Kosko, B. "Neural Networks and Fuzzy Systems", Prentice Hall of India Pvt. Ltd., 1994.
3. Klir G.J. & Folger T.A. "Fuzzy sets, uncertainty and information", Prentice Hall of India Pvt. Ltd., 1993.
4. Zimmerman H.J., "Fuzzy set theory and its application" Kluwer Academic Publishers, 1994. 5. Driankov, Hellendroon, "Introduction to Fuzzy Control", Narosa Publishers.
5. FarinWah S.S., Filev, D. Langari, R. "Fuzzy control synthesis and analysis", John Wiley and Sons, 2000.

Note for Examiner(s): Question paper will comprise three sections,

1. Section-A will be compulsory and comprise 4-short answer type questions uniformly spread to the entire syllabus.
2. Section-B will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on concepts, definitions, derivations, principles, construction and working etc.
3. Section-C will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on derivations, numerical and applications of the various topics covered therein.

Note for Students:

1. Section – A is compulsory and attempt/answer all the four questions carrying 12 marks in total.
2. Attempt/answer two questions each out of the Section – B and Section – C. All questions will carry 12 marks.

Program Name: M. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-PE-102	**Course Name: Program Elective-II DIGITAL CONTROL SYSTEM(iii)**	**L**	**T**	**P**	**C**
		3	**-**	**-**	**3**
Year and Semester	**1st Yr. 2nd Semester**	**Contact hours per week: (3Hrs)** Exam: (3 Hrs)			
Pre-requisite of course	**Control System**	**Evaluation**			
		CIE: 40	**SEE: 60**		
Course Objectives:					
1. Study the digital control system details: Signal flow graph, Time domain analysis, correlation between time response & root location in S & Z transform and stability in Z-plane					
2. Study the digital control system design by various methods in Z-plane					
3. Study of techniques for analysis of nonlinear system, concept of local, global, asymptotic and total stability of nonlinear system, Liapunov's stability criterion.					
4. Study of Tuning procedure for PID controllers and Design considerations for Robust control.					
5. Study the concept, analysis and design of Adaptive and Learning system.					
Course Outcomes: On completion of the course, student would be able to:					

CO1	Ability to understand the concept, analyze the Digital control system and their stability
CO2	Ability to understand the digital control system design by various methods in Z-plane
CO3	Ability to understand the techniques for analysis of nonlinear system and their stability criterion
CO4	Ability to understand and skill of the Tuning procedure for PID controllers and Designing of Robust control.
CO5	Ability to understand the concept, analysis and design of Adaptive and Learning system

Module No	COURSE SYLLABUS CONTENTS OF MODULE	Hrs	COs
1	DIGITAL CONTROL: Introduction to digital control, sampling, Data reconstruction principles, Pulse transfer functions, Block diagram & signal flow graph, Digital Control Techniques-PID, Deadbeat. Time domain analysis, correlation between time response & root location in S & Z transform, effect of pole-zero configuration in Z-plane on maximum overshoot & peak time transient response, Stability in Z-plane using modified Rouths criteria, Jury's criteria.	**10**	**CO1**
2	Digital control system design : Design by Emulation, Direct design by root locus in z-plane, Frequency response method, Direct design method by Ragazzini. NON LINEAR CONTROL SYSTEM: Introduction to nonlinear feedback control system, special features of linear system; limit cycle, jump response, sub harmonics etc., describing function and phase plane techniques for analysis of nonlinear system, concept of local, global, asymptotic and total stability of nonlinear system, Liapunov's stability criterion.	**11**	**CO2** **CO3**
3	PID CONTROL AND ROBUST CONTROL: Tuning procedure for PID controllers, modification of PID control schemes, two degrees of freedom control. Design considerations for Robust control.	**8**	**CO4**
4	ADAPTIVE AND LEARNING CONTROL SYSTEMS: Basic Principles of Adaptive and Learning Control Systems, Model Reference Adaptive Control, Types of Learning-Supervised and Unsupervised Learning Control Systems, On-line and Off-line Learning Control Systems.	**8**	**CO5**

TEXT BOOKS/ REFERENCE BOOKS:

1. Digital control system By B. C. Kuo (PHI)
2. Modern control engineering By Ogata (PHI)
3. Control System Engineering By Nagrath& Gopal (Wiley Eastern)
4. Control System Engineering By Phillips and Nagle (PHI Publications)
5. Control System Engineering by Norman S Nise, Wile
6. Modern Control System by R C Dorf, R H Bishop, Addision Wesley
7. Systems, Modeling & Analysis by I J Nagrath, M Gopal, TMH
8. Digital Control & State Variable Methods by M Gopal, TMH

Note for Examiner(s): Question paper will comprise three sections,

1. Section-A will be compulsory and comprise 4-short answer type questions uniformly spread to the entire syllabus.
2. Section-B will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on concepts, definitions, derivations, principles, construction and working etc.
3. Section-C will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on derivations, numerical and applications of the various topics covered therein.

Note for Students:

1. Section – A is compulsory and attempt/answer all the four questions carrying 12 marks in total.
2. Attempt/answer two questions each out of the Section – B and Section – C. All questions will carry 12 marks.

Program Name: M. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-PE-102	**Course Name: Program Elective-II HVDC TRANSMISSION SYSTEM(iv)**	**L**	**T**	**P**	**C**
		3	**0**	**-**	**3**
Year and Semester	**1st year 2nd Semester**	**Contact hours per week:** (3Hrs) **Exam:** (3hrs.)			
Pre-requisite of course	**Power Electronics and Power System Engineering**	**Evaluation**			
		CIE: 40	**SEE: 60**		

Course Objectives:	
1. To study the basic concept, working theory and constructional detail of Direct Current (DC) power transmission line.	
2. To study the power converter interface and analysis in HVDC transmission line.	
3. To study the power converter controller in HVDC transmission line	
4. To study the effect of reactor and protection of DC line.	
Course Outcomes: On completion of the course, student would be able to:	
CO1	To understand the basic concept, working theory and constructional detail of Direct Current (DC) power transmission line.
CO2	To impart technical knowledge of power converter interface and analysis in HVDC transmission line.
CO3	To apprise with power converter control system in HVDC transmission line
CO4	To understand the effect of reactor and protection of DC line.

Module No	**COURSE SYLLABUS CONTENTS OF MODULE**	**Hrs**	**COs**
1	**Direct Current (DC) power transmission technology:** Introduction, comparison of Alternating Current (AC) and Direct Current (DC) transmission, application of DC transmission, application of DC transmission, description of DC transmission system, Configurations, planning for High Voltage Direct Current (HVDC) transmission, modern trends in DC transmission. Introduction to Device: Thyristor valve, valve tests, recent trends.	**6**	**CO1**
2	**Analysis of High Voltage Direct Current (HVDC) converters:** Pulse number, choice of converter configuration, simplified analysis of	**8**	**CO1, CO2**

	Graetzcircuit, converter bridge characteristics, and characteristics of a twelve-pulse converter, detailed analysis of converters with and without overlap.		
3	**Converter and HVDC system control:** General, principles of DC link control, converter control characteristics, system control hierarchy, firing angle control, current and extinction angle control, starting and stopping of DC link, power control, higher level controllers, telecommunication requirements. **Converter faults and protection:** Introduction, converter faults, protection against over-currents, over-voltages in a converter station, surge arresters, protection against over-voltages.	**8**	**CO2, CO3**
4	**Smoothing reactor and DC line:** Introduction, smoothing reactors, DC line, transient over voltages in DC line, protection of DC line, DC breakers, Mono-polar operation, effects of proximity of AC and DC transmission lines.	**6**	**CO4**

RECOMMENDED BOOKS:

1. E.W. Kimbark, "High Voltage DC Transmission", Wiley-Interscience.
2. V. Kamaraju and M.S. Naidu, "High Voltage Engineering", Tata McGraw-Hill Education.
3. R.S.Jha,"High Voltage Engineering", Dhanpat Rai sons.
4. E. Kuffel and M. Abdullah, "High Voltage Engineering", Pergamon Press.
5. C. L. Wadhwa, "High Voltage Engineering", New Age Publications.
6. K.R. Padiyar, "HVDC Power Transmission Systems: Technology and System Interactions", New Age International Publications.

Note for Examiner(s): Question paper will comprise three sections,

1. Section-A will be compulsory and comprise 4-short answer type questions uniformly spread to the entire syllabus.
2. Section-B will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on concepts, definitions, derivations, principles, construction and working etc.
3. Section-C will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on derivations, numerical and applications of the various topics covered therein.

Note for Students:

1. Section – A is compulsory and attempt/answer all the four questions carrying 12 marks in total.
2. Attempt/answer two questions each out of the Section – B and Section – C. All questions will carry 12 marks.

Program Name: M. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-PE-102	**Course Name: Program Elective-II ENERGY MANAGEMENT(v)**	**L**	**T**	**P**	**C**
		3	**-**	**-**	**3**
Year and Semester	**1st Yr. 2nd Semester**	**Contact hours per week: (3Hrs)** Exam: (3 Hrs)			
Pre-requisite of course	**Electrical Machine, Electrical Measurements and Instruments**	**Evaluation**			
		CIE: 40		**SEE: 60**	
Course Objectives:					
1. To introduce the various energy systems.					
2. To study the basics theory, and operation of renewable system.					
3. To study the concept ofenergy conservation and management.					

4. To study various techniques for energy conservationand its management.	
Course Outcomes: On completion of the course, student would be able to:	
CO1	To familiarize with the various energy systems.
CO2	To understand the basics theory, operation renewable system.
CO3	To impart basic technical knowledge theenergy conservation system and management.
CO4	To learn the role of various techniques used for energy conservationsystem and its management.

Module No	COURSE SYLLABUS CONTENTS OF MODULE	Hrs	COs
1	INTRODUCTION: Various Sources of Energy, Conventional and non-Conventional energy, Concept and Classification of Renewable energy, Concept of Energy Conservation and Energy Management, Present Energy Scenario in India (Conventional and non- Conventional energy).	**7**	**CO1**
2	RENEWABLE ENERGY SOURCES: Potential and Utilization status of Renewable Energy in India, Solar Energy: Solar Water Heater Systems, Solar Air dryer Systems, Solar Photo-voltaic Systems, Solar Cookers and Solar ponds, Wind Energy: Selection Criteria for Wind farms, Wind Mills, Bio Gas Plants-Construction and Operation, Bio Mass Gasification, Bio Mass Briquetting; Mini and Micro Hydel Power Plants, Geo-Thermal Energy, Ocean Energy.	**8**	**CO2**
3	ENERGY CONSERVATION AND MANAGEMENT: Actual energy requirement assessment techniques of any industry and energy consumption status, possibility of reduction of energy consumption by using various energy conservation techniques or equipments e.g. variable speed drives, constant voltage transformers, electronic chokes, CFLs etc.	**7**	**CO3**
4	ENERGY CONSERVATION INSTRUMENTATION:Importance of instrumentation and control techniques in the energy conservation and management, SCADA systems, Instruments required to carry out energy audit exercise, optimal mixing of renewable energy sources and load rationalization for reducing load on conventional energy sources.	**7**	**CO4**

TEXT/REFERENCE BOOKS:

1. Hand Book of Industrial Energy Conservation by S David; Van Nostrand Reinhold Publishing Company.
2. Energy Technology by S Rao & B. B. Parulkar; Khanna Publishers
3. Solar Energy by S. P. Sukhatme; TMH publications
4. Solar Energy & Energy Conservation by Sawhney&Maheshwari; PHI publication.

Note for Examiner(s): Question paper will comprise three sections,

1. Section-A will be compulsory and comprise 4-short answer type questions uniformly spread to the entire syllabus.
2. Section-B will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on concepts, definitions, derivations, principles, construction and working etc.
3. Section-C will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on derivations, numerical and applications of the various topics covered therein.

Note for Students:

1. Section – A is compulsory and attempt/answer all the four questions carrying 12 marks in total.
2. Attempt/answer two questions each out of the Section – B and Section – C. All questions will carry 12 marks.

Program Name: M. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-PE-102	**Course Name: Program Elective-II PROCESS MODELLING AND CONTROL(vi)**	**L**	**T**	**P**	**C**
		3	**-**	**-**	**3**
Year and Semester	**1st Yr. 2nd Semester**	**Contact hours per week: (3Hrs)** Exam: (3 Hrs)			
Pre-requisite of course	**Mathematics,Control System**	**Evaluation**			
		CIE: 40	**SEE: 60**		

Course Objectives:	
1. Study the Mathematical Modelling, Process dynamic of various type of processes.	
2. Simulation and Modelling of different process control system	
3. Study of various control system Models and Design of cross controllers and selection of loop using RGA.	
4. Study the concept, analysis and design of Adaptive and Learning system.	
5. Study the concept, analysis and design of Real time control system	
6. Study of Distributed computing systems, Software Process models	
Course Outcomes: On completion of the course, student would be able to:	
CO1	Ability to understand and to derive Modelling, Process dynamic of various type of processes.
CO2	Ability to understand the various control system Models and Design of cross controllers and selection of loop using RGA.
CO3	Ability to understand concept, analysis and design of Adaptive and Learning system.
CO4	Ability to understand concept, analysis and design of Real time control system
CO5	Ability to implement new and emerging technologies to analyze, design, maintain reliable, safe, and cost effective solution for industry problems.

Module No	**COURSE SYLLABUS CONTENTS OF MODULE**	**Hrs**	**COs**
1	Simulation and Modelling: Importance of Simulation, Mathematical Modelling, Process dynamic of fluid flow and heat transfer system, Mass transfer dynamics and distillation column, Reaction kinetics of chemical processes. Process control aim and objectives classification of process control system, techniques for process control. Modelling and simulation for plant Automation-case studies.	**8**	**CO1**
2	Predictive control system: Model based control system (Internal mode control, Model Predictive control and Process Model based control), Plant wide Control, Inferential control, Multiple-loop (Multivariable) control system. Interaction and Decoupling of control loops. Design of cross controllers and selection of loop using RGA. Prosperities and application of RGA.	**10**	**CO2**
3	ADAPTIVE AND LEARNING CONTROL SYSTEM: Basic principles of Adaptive and learning systems, MRAC & STAC, Adaptive control	**10**	**CO3 CO5**

	techniques, Types of Learning- Supervised and Unsupervised Learning control system, On-line and Off-line Learning control system.		
4	Real time control system: Characteristics and classes of real time systems, program classification: Sequential, multitasking real time, concurrency and synchronization. Design strategies, Reability, fault detection, fault tolerance real time operating system, Distributed computing systems, Software Process models (Build and mix model, waterfall, rapid prototyping, Incremental and Spiral model) Design techniques and tools	**10**	**CO4 CO5**

TEXT BOOKS:

REFERENCE BOOKS:

1. Techniques of Process Modelling, Simulation and Control for Engineer by Astrom, Luyben, McGraw Hill.
2. Computer Controlled System by Astrom, K.J and B. Wittenmark PHI
3. Chemical Process Control by Stephanopolous PHI
4. Process Control Modeling ,Design and Simulation by B.WayaneBequette, PHI

Note for Examiner(s): Question paper will comprise three sections,

1. Section-A will be compulsory and comprise 4-short answer type questions uniformly spread to the entire syllabus.
2. Section-B will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on concepts, definitions, derivations, principles, construction and working etc.
3. Section-C will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on derivations, numerical and applications of the various topics covered therein.

Note for Students:

1. Section – A is compulsory and attempt/answer all the four questions carrying 12 marks in total.
2. Attempt/answer two questions each out of the Section – B and Section – C. All questions will carry 12 marks.

Program Name: M.Tech.-Electrical and Instrumentation Engineering

Course Code: EI-PC-104	**Course Name: Power Quality Monitoring and Conditioning**	**L**	**T**	**P**	**C**
		3	**-**	**-**	**3**
Year and Semester	**1st Year. 2nd Semester**	**Contact hours per week:** (3Hrs) Exam: (3 Hrs)			
Pre-requisite of course	**Power System, Electrical Machines**	**Evaluation**			
		CIE: 40	**SEE: 60**		
Course Objectives:					
1. To familiarize the students about different power quality issues to be resolved.					
2. To understand the convention codes /guidelines issues by bodies like IEEE, IEC etc related to voltage, frequency and harmonics.					
3. To mentor the students about methods of power quality assessment.					
4. To monitor the power quality in the power system.					
5. To model a system for power quality enhancement.					
Course Outcomes: On completion of the course, student would be able to:					

CO1	Have the knowledge of various power quality issues in power system.
CO2	Work with international standards/guidelines related to power quality issues.
CO3	Quantitative analysis of power quality in system.
CO4	Monitor the power quality through measurement of various system parameters.
CO5	Decide the compensators and filters to keep the power quality indices within the standards.

Module No	**COURSE SYLLABUS CONTENTS OF MODULE**	**Hrs**	**Cos**
1	UNIT I - POWER QUALITY - AN OVERVIEW: Power Quality definition, PQ characterization: Transients, short duration and long duration voltage variations, Voltage imbalance, waveform distortion, Voltage fluctuations, Power frequency variation–Power acceptability curves: CBEMA, ITIC – Sources for Electric Power Quality problem in power system: poor load power factor, Nonlinear and unbalanced loads, DC offset in loads, Notching in load voltage, Disturbance in supply voltage – Power quality standards and Guidelines.	**6**	**CO1**
2	VOLTAGE VARIATIONS: Voltage Sags - Magnitude & duration-Types-Sources of sags - Estimation of Voltage sag performance: Transmission system and Utility distribution system, Effect of sag on AC Motor Drives, Single-Phase Domestic and Office Loads, Monitoring and mitigation of voltage sag. Origin of Long & Short interruption -influence on various equipment.	**7**	**CO2**
3	POWER QUALITY ANALYSIS: Measurements of Voltage, Current, Power, Energy, power factor- Time domain methods and Frequency domain methods: Laplace's, Fourier and Hartley transform – The Walsh Transform – Wavelet Transform. Harmonic Distortion, Voltage versus Current Distortion, Harmonics versus Transients, Harmonic Indexes, Harmonic Sources from Commercial Loads, Harmonic Sources from Industrial Loads.	**7**	**CO3**
4	POWER QUALITY MONITORING: Monitoring considerations: Power line disturbance analyser, power quality measurement equipment, harmonic / spectrum analyser, flicker meters, disturbance analyser. Analysis of power outages, Analysis of unbalance: Symmetrical components of phasor quantities, Instantaneous symmetrical components, Instantaneous real and reactive powers, Analysis of distortion: On–line extraction of fundamental sequence components from measured samples	**8**	**CO4**
5	POWER QUALITY ENHANCEMENT: Harmonic filters: passive, Active and hybrid filters – Custom power devices: Load compensation using DSTATCOM, Voltage regulation using DSTATCOM, protecting sensitive loads using DVR, UPQC –control strategies: P-Q theory, Synchronous detection method – Custom power park.	**8**	**CO5**

Text Books:

1. Understanding Power Quality Problems-Voltage sag & Interruptions, Math Bollen H.J., IEEE Press, 2000.
2. Power Quality Enhancement Using Custom Power Devices, Arindam Ghosh , G. Ledwick, Kluwer Academic Publishers, 2002.

3. Electrical Power Systems Roger.C.Dugan, Mark.F.McGranagham, Surya Santoso, H.WayneBeaty, Quality", McGraw Hill, 2003.
4. HVDC and FACTS Controllers: Applications of Static Converters in Power Systems, Vijay K Sood, Springer
5. Facts Controllers in Power Transmission and Distribution, K R Padiyar, TunbridgeWells : Anshan, ©2009.

Reference Books:

1. Electric Power Quality, Heydt G.T., Stars in a Circle Publications, 1994(2nd edition).
2. Handbook of Power Quality, Angelo Baggini '– Wiley

Note for Examiner(s): Question paper will comprise three sections,

1. Section-A will be compulsory and comprise 4-short answer type questions uniformly spread to the entire syllabus.
2. Section-B will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on concepts, definitions, derivations, principles, construction and working etc.
3. Section-C will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on derivations, numerical and applications of the various topics covered therein.

Note for Students:

1. Section – A is compulsory and attempt/answer all the four questions carrying 12 marks in total.
2. Attempt/answer two questions each out of the Section – B and Section – C. All questions will carry 12 marks.

Program Name: M. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-PC-106	**Course Name: PLC & DCS**	**L**	**T**	**P**	**C**
		3	**-**	**-**	**3**
Year and Semester	**1st Yr. 2nd Semester**	**Contact hours per week: (3Hrs)** Exam: (3 Hrs)			
Pre-requisite of course	**Control System**	**Evaluation**			
		CIE: 40		**SEE: 60**	

Course Objectives:
1. Study the concept of Direct Digital Control
2. Study and development of position and velocity control algorithm and their applications in 3. different control schemes
4. Study the characteristic function of PLC, its Architecture and various PLC programming languages and Demonstratevarious PLC programming skill for industrial applications.
5. Detail study and applications of Distributed process control system and Understanding of various automotive standards and Protocols used in PLC network and DCS
6. Study DCS supervisory control techniques & considerations(Algorithms), Concept of field buses and their applications
7. Detail study and applications of Supervisory control and Data Acquisition system(SCADA)

Course Outcomes: On completion of the course, student would be able to:	
CO1	Ability to understand the concept of Direct digital control and able to development position and velocity control algorithm and their applications in different control schemes

CO2	Able to learn the various PLC programming languages and Demonstratevarious PLC programming skill for industrial applications.
CO3	Able to learn and analyze the various principles & concepts of Distributed process control system and Understanding of various automotive standards and Protocols used in PLC network and DCS
CO4	Acquire the knowledge of DCS supervisory control techniques, the concept of field buses and their Industrial applications.
CO5	To implement new and emerging technologies to analyze, design, maintain reliable, safe, and cost effective solution for industry problems.

Module No	COURSE SYLLABUS CONTENTS OF MODULE	Hrs	COs
1	Direct Digital Control – Structure and Software: The position algorithm (simplifying PID control equation, deriving position algorithm); the velocity algorithm (velocity algorithm, deriving the velocity algorithm); Multi variable control (Cascade control using velocity algorithm, radio control using velocity algorithm).	**8**	**CO1**
2	Discrete State Process Control System: Development and analysis of ladder diagram, logic diagram from ladder diagram, Function description of PLC, Programming fundamentals , hardware and system sizing and selection, PLC peripherals, programming, PLC networking, PLC programmable languages, ladder diagrams language, Boolean mnemonics language, functional block language, PLCs.	**10**	**CO2 CO3**
3	Distributed Process Control System: Functional requirement of DPCS, DCS configurations/ architecture, data highway cables, field buses, protocols used in DCS, Software configuration: controller function configuration, multiplexer and party line system.	**10**	**CO3 CO4 CO5**
4	Supervisory control and Data Acquisition system (Functions of SCADA, channel scanning, conversion to engineering units, data processing, distributed SCADA system, Remote terminal unit). DCS supervisory computer and configurations: supervisory computer function, supervisory control techniques and consideration, Supervisory control algorithm, DCS system integration with PLC and computer. Fiber optic local area networks – map and top.Popular Distributed Control Systems: CP 80 system.	**9**	**CO3 CO4 CO5**

TEXT BOOKS/REFERENCE BOOKS:

1. Computer Aided Process control by S.K. Singh PHI
2. Computer Based Industrial Control by Krishna Kant PHI
3. Instrument Engineers Handbook- Process Control by Bela G. Liiptak
4. Microprocessor in Process control by C.D. Johnson
5. Principles and Practice of Automatic Process Control by Carlos& A Smith

Note for Examiner(s): Question paper will comprise three sections,

1. Section-A will be compulsory and comprise 4-short answer type questions uniformly spread to the entire syllabus.
2. Section-B will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on concepts, definitions, derivations, principles, construction and working etc.

3. Section-C will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on derivations, numerical and applications of the various topics covered therein.

Note for Students:

1. Section – A is compulsory and attempt/answer all the four questions carrying 12 marks in total.
2. Attempt/answer two questions each out of the Section – B and Section – C. All questions will carry 12 marks.

Program Name: M. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-PC-108	**Course Name:** Embedded System Design	**L**	**T**	**P**	**C**
		3	**-**	**-**	**3**
Year and Semester	**1st Yr.** **2nd Semester**	**Contact hours per week:** (3 Hrs) Exam: (3 Hrs)			
Pre-requisite of course	Microprocessor and Microcontrollers	**Evaluation**			
		CIE: 40	**SEE: 60**		

Course Objectives:	
1. To provide an overview of Design Principles of Embedded System.	
2. To provide clear understanding about the role of firmware, operating systems in correlation with hardware systems.	
Course Outcomes: On completion of the course, student would be able to:	
CO1	Expected to understand the selection procedure of Processors in the Embedded domain.
CO2	Design Procedure for Embedded Firmware.
CO3	Expected to visualize the role of Real time Operating Systems in Embedded Systems
CO4	Expected to evaluate the Correlation between task synchronization and latency issues

Module No	**COURSE SYLLABUS CONTENTS OF MODULE**	**Hrs**	**COs**
1	**Introduction to Embedded Systems**: Definition of Embedded System, Embedded Systems Vs General Computing Systems, History of Embedded Systems, Classification, Major Application Areas, Purpose of Embedded Systems, Characteristics and Quality Attributes of Embedded Systems.	**7**	**CO1**
2	**Typical Embedded System:** Core of the Embedded System: General Purpose and Domain Specific Processors, ASICs, PLDs, Commercial Off-The-Shelf Components (COTS), Memory: ROM, RAM, Memory according to the type of Interface, Memory Shadowing, Memory selection for Embedded Systems, Sensors and Actuators, Communication Interface: Onboard and External Communication Interfaces.	**8**	**CO1 CO2**
3	**Embedded Firmware**: Reset Circuit, Brown-out Protection Circuit, Oscillator Unit, Real Time Clock, Watchdog Timer, Embedded Firmware Design Approaches and Development Languages.	**7**	**CO2 CO3**
4	**RTOS Based Embedded System Design:** Operating System Basics, Types of Operating Systems, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling.	**6**	**CO3**
5	**Task Communication:** Shared Memory, Message Passing, Remote Procedure Call and Sockets, Task Synchronization: Task Communication/Synchronization	**8**	**CO3 CO4**

	Issues, Task Synchronization Techniques, Device Drivers, How to Choose an RTOS.		

TEXT BOOKS:

1. Introduction to Embedded Systems - Shibu K.V, Mc Graw Hill.

REFERENCE BOOKS:

1. Embedded Systems - Raj Kamal, TMH.
2. Embedded System Design - Frank Vahid, Tony Givargis, John Wiley.
3. Embedded Systems – Lyla, Pearson, 2013
4. An Embedded Software Primer - David E. Simon, Pearson Education.

Note for Examiner(s): Question paper will comprise three sections,

1. Section-A will be compulsory and comprise 4-short answer type questions uniformly spread to the entire syllabus.
2. Section-B will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on concepts, definitions, derivations, principles, construction and working etc.
3. Section-C will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on derivations, numerical and applications of the various topics covered therein.

Note for Students:

1. Section – A is compulsory and attempt/answer all the four questions carrying 12 marks in total.
2. Attempt/answer two questions each out of the Section – B and Section – C. All questions will carry 12 marks.

Program Name: M. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-PC-110	**Course Name: ADVACED POWER SYSTEM**	**L**	**T**	**P**	**C**
		3	**0**	**-**	**3**
Year and Semester	**1st year 2ndSemester**	**Contact hours per week:** (3Hrs) **Exam:** (3hrs.)			
Pre-requisite of course	**Basics of Power System**	**Evaluation**			
		CIE: 40		**SEE: 60**	

Course Objectives:

1. To study basics PU theory and modelling of electrical networks.
2. To study working of theory of load flow parameters and its methods.
3. To study the transient phenomena and type of faults in power system.
4. To introduce the concept of transient stability theory and its method.

Course Outcomes: On completion of the course, student would be able to:

CO1	To understand the basic concept of PU system for electrical circuits and its modellings.
CO2	To impart basic technical knowledge of load flow studies and its iteration solution methods.
CO3	To understand and analyze various types of faults for different electrical equipments.
CO4	To impart a technical knowledge of transient stability in electrical system and solution of its stability equations.

Module No	**COURSE SYLLABUS CONTENTS OF MODULE**	**Hrs**	**COs**
1	**SYSTEM MODELLING:** System modelling of synchronous machines, transformers, loads etc, per unit system, single line diagram of electrical	**8**	**CO1**

	networks, single phase impedance diagrams. Formulation of impedance and admittance matrices for the electrical networks.		
2	**LOAD FLOW STUDIES:** Data for the load flow studies, Swing Bus, Formulation of simultaneous equations, Iterative solutions by the Gauss-Seidal method and Newton Raphson Method.	**8**	**CO2**
3	**FAULT ANALYSIS:** Transients on transmission line, short circuit of synchronous machine, selection of circuit breakers, Algorithm for short circuit studies, Symmetrical Component transformation, and construction of sequence networks of power systems. Symmetrical Analysis of Unsymmetrical Line-to-ground (LG), Line-to line (LL), double line to ground (LLG) faults using symmetrical components.	**8**	**CO3**
4	**POWER SYSTEM STABILITY:** Steady state stability, Dynamics of a synchronous machine, Power angle equations, Transient stability, equal area criterion, Numerical solution of swing equation , factors effecting transient stability.	**8**	**CO4**

REFRENCE BOOKS RECOMMENDED:

1. O.I.Elgerd, "Electric Energy Systems Theory",Tata McGraw Hill
2. I.J Nagrath, D.P. Kolthari, "Modern Power System Analysis", Tata McGraw Hill
3. W.D.Stevenson, "Elements of Power System Analysis", McGraw Hill
4. I.J. Nagrath and D.P, Kothari, "Power System Engineering", Tata McGraw Hill
5. J. Arrillaga and C.P. Arnold, "Computer Analysis of Power Systems", John Wiley & Sons
6. W. Stagg Glenn and H. Ei-Abiad Ahmed "Computer Methods in Power System Analysis", Tata McGraw Hill
7. G.L. Kusic, "Computer Aided Power System analysis", Prentice Hall, India

Note for Examiner(s): Question paper will comprise three sections,

1. Section-A will be compulsory and comprise 4-short answer type questions uniformly spread to the entire syllabus.
2. Section-B will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on concepts, definitions, derivations, principles, construction and working etc.
3. Section-C will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on derivations, numerical and applications of the various topics covered therein.

Note for Students:

1. Section – A is compulsory and attempt/answer all the four questions carrying 12 marks in total.
2. Attempt/answer two questions each out of the Section – B and Section – C. All questions will carry 12 marks.

Program Name: M. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-PRPC -102	**Course Name: Advanced Power System Lab**	**L**	**T**	**P**	**C**
		0	**0**	**3**	**1.5**
Year and Semester	**1st Year 2nd Semester**	**Contact hours per week:** (3Hrs) **Exam:** (3hrs.)			

Pre-requisite of course	Basic of Power System	Evaluation	
		CIE: 20	SEE:30

Course Objectives:

1. To study the various parameters of power system like ABCD, Y-Bus, Z-Bus.
2. To learn different methods for load flow analysis.
3. To learn fault analysis methods
4. To learn transient stability methods

Course Outcomes: On completion of the course, student would be able to:

CO1	To apprise with the various parameters of power system like ABCD, Y-Bus, Z-Bus.
CO2	To develop a technical skill to analyze the load flow in power system
CO3	To develop a technical skill to analyze the transient stability of electrical system.
CO4	To analyze the performance of the transmission line system.

Expt. No	COURSE SYLLABUS CONTENTS OF MODULE	COs
1	To compute ABCD parameters and Regulation of a 3-Φ transmission line model.	CO1 CO2 CO3 CO4
2	To study Formation of Admittance Matrices (Y-BUS).	
3	To study Formation of Impedance Matrices (Z-BUS).	
4	To study Load Flow Analysis using GAUSS SEIDAL Method.	
5	To study Load Flow Analysis using NEWTON-RAPHSON Method.	
6	To perform Short circuit analysis of 3-Φ synchronous machine.	
7	To study Power circle diagrams of a 3-Φ transmission line model.	
8	To perform Transient Stability Analysis for Single Machine connected to Infinite Bus by Point by Point method.	
9	To study Load – Frequency Dynamics of Single Area Power Systems.	
10	To study Load – Frequency Dynamics of Two Area Power Systems.	

Program Name: M. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-PRPC-104	Course Name: Embedded Systems Lab	L	T	P	C
		-	-	3	1.5

Year and Semester	1st Yr. 2nd Semester	Contact hours per week: (3Hrs) Exam: (3 Hrs)	
Pre-requisite of course	Microprocessor and Microcontrollers	Evaluation	
		CIE: 20	SEE: 30

Course Objectives:

1. To provide an overview of Design Principles of Embedded System.
2. To provide clear understanding about the role of firmware, operating systems in correlation with hardware systems.

Course Outcomes: On completion of the course, student would be able to:

CO1	Expected to understand the selection procedure of Processors in the Embedded domain.
CO2	Design Procedure for Embedded Firmware.
CO3	Expected to visualize the role of Real time Operating Systems in Embedded Systems
CO4	Expected to evaluate the Correlation between task synchronization and latency issues

Expt. No	COURSE SYLLABUS CONTENTS OF MODULE	COs
1	**Functional Testing Of Devices:** Flashing the OS on to the device into a stable functional state by porting desktop environment with necessary packages.	**CO1** **CO2** **CO3** **CO4**
2	**Exporting Display On To Other Systems:** Making use of available laptop/desktop displays as a display for the device using SSH client & X11 display server.	
3	**GPIO Programming:** Programming of available GPIO pins of the corresponding device using native programming language. Interfacing of I/O devices like LED/Switch etc., and testing the functionality.	
4	**Interfacing Chronos eZ430:** Chronos device is a programmable texas instruments watch which can be used for multiple purposes like PPT control, Mouse operations etc., Exploit the features of the device by interfacing with devices.	
5	**ON/OFF Control Based On Light Intensity:** Using the light sensors, monitor the surrounding light intensity & automatically turn ON/OFF the high intensity LED's by taking some pre-defined threshold light intensity value.	
6	**Battery Voltage Range Indicator:** Monitor the voltage level of the battery and indicating the same using multiple LED's (for ex: for 3V battery and 3 LED's, turn on 3 LED's for 2-3V, 2 LED's for 1-2V, 1 led for 0.1-1V & turn off all for 0V)	
7	**Dice Game Simulation:** Instead of using the conventional dice, generate a random value similar to dice value and display the same using a 16X2 LCD. A possible extension could be to provide the user with option of selecting single or double dice game.	
8	**Displaying RSS News Feed On Display Interface:** Displaying the RSS news feed headlines on a LCD display connected to device. This can be adapted to other websites like twitter or other information websites. Python can be used to acquire data from the internet.	
9	**Porting Openwrt To the Device:** Attempt to use the device while connecting to a wifi network using a USB dongle and at the same time providing a wireless access point to the dongle.	
10	**Hosting a website on Board:** Building and hosting a simple website (static/dynamic) on the device and make it accessible online. There is a need to install server (eg: Apache) and thereby host the website.	
11	**Webcam Server:** Interfacing the regular usb webcam with the device and turn it into fully functional IP webcam & test the functionality.	
12	**FM Transmission:** Transforming the device into a regular fm transmitter capable of transmitting audio at desired frequency (generally 88-108 Mhz)	
	Note: Devices mentioned in the above lists include Arduino, Raspbery Pi, Beaglebone	
	Cycle 1: Programming in 8051	
1	Study of 8051 Evaluation Board Trainer kit and Keil IDE Software Tool.	
2	Serial Data Transmission	
3	Interface switches and LEDs	
4	Interface LCD	
5	Interface 4*4 matrix keyboard	
6	Interface stepper motor	
7	Interface 7 Segment Display using I2C	
8	ADC, DAC Interface	

	Cycle 2: Programming in PIC Processor	
9	Configure and Control General Purpose I/O Pins	
10	Interfacing LED & Switch Interface	
11	2*16 LCD Display	
12	Serial Communication	
13	I2C Interface & EEPROM Interface	
14	Buzzer Interface	
15	SD-MMC Card Interface	
Note: all the experiments are to be carried out independently by each student with different specifications. At least 12 experiments are to be carried out.		

Text Books:

1. Use the IDE tool effectively for developing and executing the programs using 8051.
2. Comprehend the usage of on-chip timers and serial communication of 8051 and their interrupts using programs
3. Interface devices like ADC, DAC, LCD, and Stepper Motor to 8051 and develop real time projects.
4. Use the keil software for the development of logic, proteus software for hardware simulation and flash magic for downloading the code on to the target system.
5. Develop the logic to interface devices like temp sensor, stepper motor, Buzzer to ARM microcontroller and analyse the working of GPIO, on-chip peripherals of ARM

Program Name: M. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-PC-201	**Course Name:** Smart & Micro Sensor Design	**L**	**T**	**P**	**C**
		3	**-**	**-**	**3**
Year and Semester	**2nd Yr.** **3rd Semester**	**Contact hours per week:** (3 Hrs) Exam: (3 Hrs)			
Pre-requisite of course	**VLSI Design**	**Evaluation**			
		CIE: 40		**SEE: 60**	

Course Objectives:	
3. It aims to equip the students with MEMS fabrication	
4. To provide adequate knowledge about tools at an intermediate to advanced level.	
5. To provide exposure to students towards advanced level of sensors	
Course Outcomes: On completion of the course, student would be able to:	
CO1	Understand of MEMS fabrication
CO2	Apply various fabrication procedures
CO3	Analyze the design of sensors
CO4	Design and develop smart and intelligent systems

Module No	**COURSE SYLLABUS CONTENTS OF MODULE**	**Hrs**	**COs**
1	MEMS: Introduction, principle of MEMS, Example of Mems, small and large scaling, fabrication technology, micromachining: photolithography, thin film deposition and doping, wet chemical etching, waferbonding, plasma etching, surface micromachining.	**8**	**CO1, CO2**

2	Mechanics of Membrane and beams: dynamics, string, beams, diaphragms and membrane Transduction of Deformation: Metal strain gauges, Semiconductor Strain Gauges, Capacitive Transducers, Force and Pressure sensors: Force Sensors, Pressure sensors, Thermocouples Semi conducting Thermo resistors, Fiber Optical sensors, concept of smart and intelligent sensor, bio sensors.	**8**	**CO3, CO4**
3	Acceleration Sensors: introduction, Bulk Michromachined Accelerometers, surface Michromachined accelerometers, force feedback, angular rate sensors, Flow Sensors: The laminar boundary layer, Heat Transport in the limit of very small Reynolds Numbers, Thermal Flow Sensors, Skin Friction Sensors, Dry fluid Flow Sensors, wet fluid flow sensors, Resonant Sensors: Basic principle and physics.	**8**	**CO3**
4	Definition of intelligence and of intelligent instrumentation system: Features characterizing intelligence and Features intelligent instrumentation, component of intelligent instrumentation. Design of intelligent instrumentation systems. Smart and Intelligent transmitters, smart features standard for smart sensing, setting standards for smart sensors and system, IEEE 1451.1, IEEE 1451.2, STIM, IEEE P1451.3, IEEEP 1451.4, Field buses systems.	**8**	**CO4**

Text Books:

1. E.O. Doeblin Measurement System Application and Design, McGraw Hill
2. Beeweth and Buck- Mechanical Measurement, Nares Puti
3. Nortan- Hand Book of transducers, PHI
4. Conside-Process and industrial instrumentation, McGraw Hill
5. Mechanical Microsensors, M.Elwenspoek, R. Wiegerink, Springer

Note for Examiner(s): Question paper will comprise three sections,

4. Section-A will be compulsory and comprise 4-short answer type questions uniformly spread to the entire syllabus.
5. Section-B will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on concepts, definitions, derivations, principles, construction and working etc.
6. Section-C will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on derivations, numerical and applications of the various topics covered therein.

Note for Students:

3. Section – A is compulsory and attempt/answer all the four questions carrying 12 marks in total.
4. Attempt/answer two questions each out of the Section – B and Section – C. All questions will carry 12 marks.

Program Name: M. Tech.-Electrical and Instrumentation Engineering

Course Code:	**Course Name: Program Elective-III**	**L**	**T**	**P**	**C**
EI-PE-203	**DIGITAL SIGNAL PROCESSING(i)**	**3**	**0**	**-**	**3**

Year and Semester	**2nd year** **3rd Semester**	**Contact hours per week:** (3Hrs) **Exam:** (3hrs.)	
Pre-requisite of course	**Basic Engineering Mathematics**	**Evaluation**	
		CIE: 40	**SEE: 60**

Course Objectives:

1. To study the discrete linear Time Invariant systems in Z domain and in frequency domain.
2. To study the basic of Discrete-Fourier Transform (DFT), Fast Fourier Transform (FFT) algorithms and its application.
3. To study different structure realization of Finite Impulse Response systems and Finite Impulse Response systems.
4. To study the digital filters for filtering applications.
5. To study the Multi-rate digital Signal Processing techniques and its applications

Course Outcomes: On completion of the course, student would be able to:

CO1	To analyze the Discrete linear Time Invariant systems in Z domain and in frequency domain.
CO2	To understand the different structure realization of Finite Impulse Response systems and Finite Impulse Response systems.
CO3	To learn the basic of Discrete-Fourier Transform (DFT), Fast Fourier Transform (FFT) algorithms and its applications.
CO4	To Design digital filters for filtering applications.
CO5	To apprise with Multi-rate Signal Processing techniques.

Module No	COURSE SYLLABUS CONTENTS OF MODULE	Hrs	COs
1	**Introduction of Discrete Time Signals and Systems:** Discrete time systems, Analysis of discrete time linear time-invariant systems, Discrete time systems described by difference equations, Implementation of discrete system, Correlation of discrete time signals, Z-transform and properties of Z-transform, Rational Z-transformation, Inverse Z-transform, Analysis of linear time invariant systems in Z-domain. **Frequency Analysis of Signals and Systems:** Frequency analysis of continuous time signals, Frequency analysis of discrete time signals, Properties of Fourier Transform for discrete time signals, Frequency domain characteristics of linear time invariant systems, linear invariant systems as frequency selective filters.	**8**	**CO1**
2	**The Discrete Fourier Transform:** Frequency domain sampling, Properties of Discrete Fourier Transform (DFT), discrete Frequency analysis of signals using the DFT.FFTalgorithm : Decimation-in-time (DIT) algorithm andDecimation-in-frequency(DIF) algorithm, Linear filtering methods based on DFT. **Realization of digital systems**: Structure realizationsmethods of FIR and IIR system.	**8**	**CO2,CO3**
3	**Design of Digital Filters:** Generalized characteristics of discrete filters, Design of Finite Impulse Response (FIR) filters, FIR digital filter design using Fourier series method, window design techniques. Optimal equi-ripple design techniques, frequency sampling design techniques. Design of Infinite Impulse Response (IIR) filters from analog filters, Comparison of IIR and FIR filters.	**8**	**CO4**

4	**Multirate Digital Signal Processing:** Introduction, decimation by a factor D, Interpolation by a factor I, sampling rate conversion by a rational factor I/D, implementation of sampling rate conversion, multistage implementation of sampling rate conversion, sampling rate conversion of Band pass signals, sampling rate conversion by an arbitrary factor, applications of multi rate signal processing.	**8**	**CO5**

Suggested Text / Reference Books:

1. John G. Proakisand Dimitris G. Manolakis,"Digital Signal Processing", PHI Pub.
2. Allan Y. Oppenhein& Ronald W. Schater , "Digital Signal Processing", PHI, 2004.
3. J. R. Jhohnson, "Intorduction to Digital Signal Processing", PHI, 2000.
4. B. Somanthan Nair, "Digital Signal Processing: Theory, Analysis & Digital Filter Design", PHI, 2004
5. Sanjit K. Mitra, "DSP a Computer based approach", TMH, 2nd Ed., 2001.
6. S. Salivahanan, C. Gnanapriya, "Digital Signal Processing", McGraw Hill.

Note for Examiner(s): Question paper will comprise three sections,

1. Section-A will be compulsory and comprise 4-short answer type questions uniformly spread to the entire syllabus.
2. Section-B will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on concepts, definitions, derivations, principles, construction and working etc.
3. Section-C will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on derivations, numerical and applications of the various topics covered therein.

Note for Students:

1. Section – A is compulsory and attempt/answer all the four questions carrying 12 marks in total.
2. Attempt/answer two questions each out of the Section – B and Section – C. All questions will carry 12 marks.

Program Name: M. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-PE-203	**Course Name:Program Elective-III Reliability Engineering(iii)**	**L**	**T**	**P**	**C**
		3	**0**	**-**	**3**
Year and Semester	**2nd Year 3rdSemester**	**Contact hours per week: (3Hrs) Exam: (3hrs.)**			
Pre-requisite of course	**Basic Engineering Mathematics**	**Evaluation**			
		CIE: 40	**SEE: 60**		

Course Objectives:	
1. To study the basic concept of reliability, maintainability and availability engineering.	
2. To study the evaluation techniques of engineering models and reliability improvement methods.	
3. To study the concept of fault tree analysis and optimization techniques.	
4. To study evaluation model for reliability, maintainability, availability testing.	
5. To study the applications of fuzzy theory and neural networks to reliability engineering,	
Course Outcomes: On completion of the course, student would be able to:	
CO1	To understand the basic concept of reliability, maintainability and availability engineering.

CO2	To understand the evaluation techniques of engineering models and reliability improvement methods.
CO3	To learn the fault tree analysis and optimization techniques.
CO4	Ability to do testing and evaluate the reliability, maintainability, availability of engineering models.
CO5	To study the applications of fuzzy theory and neural networks to reliability engineering,

Module No	**COURSE SYLLABUS CONTENTS OF MODULE**	**Hrs**	**COs**
1	Review of basic concepts in reliability engineering, reliability function, different reliability models etc., and reliability evaluation techniques for complex system: Non path set and cutest approaches, path set and cut set approaches, different reliability measures and performance indices, modeling and reliability evaluation of system subjected to common cause failures.	7	CO1
2	Reliability improvement, Reliability allocation/apportionment and redundancy optimization techniques,Fault tree analysis.	7	CO2, CO3
3	Maintainability Analysis: measure of system performance, types of maintenance, reliability centered maintenance, reliability and availability evaluation of engineering systems using Markov models. Reliability testing,Design for reliability and maintainability.	7	CO1, CO4
4	Applications of fuzzy theory and neural networks to reliability engineering,Typical reliability case studies.	7	CO5

Suggested Text / Reference Books:

1. M.L Shooman, “Probabilistic reliability- an engineering approach” RE Krieger Pub, 1990.
2. K.K Aggarwal, “Reliability Engineering” Springer Pub, 1993.
3. E. Balaguruswamy, “Reliability Engineering” McGraw hill, 2002.
4. R. Ramakumar, “Engineering Reliability” Prentice, NJ, 1993.

Note for Examiner(s): Question paper will comprise three sections,

1. Section-A will be compulsory and comprise 4-short answer type questions uniformly spread to the entire syllabus.

2. Section-B will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on concepts, definitions, derivations, principles, construction and working etc.

3. Section-C will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on derivations, numerical and applications of the various topics covered therein.

Note for Students:

1. Section – A is compulsory and attempt/answer all the four questions carrying 12 marks in total.

2. Attempt/answer two questions each out of the Section – B and Section – C. All questions will carry 12 marks.

Program Name: M. Tech.-Electrical and Instrumentation Engineering

Course Code:	**Course Name: Program Elective-III,**	**L**	**T**	**P**	**C**
EI-PE-203	Electrical Vehicle Engineering (iv)	**3**	**0**	**-**	**3**
Year and Semester	**2nd Year 3rd Semester**	**Contact hours per week:** (3Hrs) **Exam:** (3hrs.)			

Pre-requisite of course	Electrical Machines, Power Electronics, Basic Science Engineering	Evaluation	
		CIE: 40	SEE: 60

Course Objectives:

1. To introduce the upcoming technology of electric and hybrid system
2. To study the basics theory, operation and modeling of electric Hybrid system.
3. To study different topologies of electric Hybrid system
4. To study electric propulsion system in electric hybrid system

Course Outcomes: On completion of the course, student would be able to:

CO1	To familiarize with upcoming technology of electric and hybrid system
CO2	To understand the basics theory, operation and modeling of electric Hybrid system.
CO3	To understand and analyze different drive train topologies electric of Hybrid system.
CO4	To learn the role of electric propulsion system in electric hybrid system andits application.
CO5	To impart basic technical knowledge of electric hybrid vehicle system and apply it to technological fields.

Module No	COURSE SYLLABUS CONTENTS OF MODULE	Hrs	COs
1	**Introduction:**Introduction to hybrid electric vehicles: history of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies. Conventional vehicles: basics of vehicle performance, vehicle power source characterization, transmission characteristics, and mathematical models to describe vehicle performance.	7	CO1,CO2
2	**Hybrid Electric Drive:**Hybrid electric drive-trains: basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.	7	CO3
3	**Electric Propulsion Unit:**Introduction to electric components used in hybrid and electric vehicles, configuration and control of DC motor drives, configuration and control of induction motor drives, configuration and control of permanent magnet motor drives, configuration and control of switch reluctance motor drives, drive system efficiency.	7	CO4
4	**Case Studies:**Design of a hybrid electric vehicle (HEV), design of a battery electric vehicle (BEV).	5	CO5

Suggested Text / Reference Books:

1. Iqbal Hussein, *"Electric and Hybrid Vehicles, Design Fundamentals"*, CRC Press, 2003.
2. MehrdadEhsani, YimiGao, E Sebastian Gay, Ali Emadi, *"Modern Electric, Hybrid Electric and Fuel Cell VehiclesFundamentals", Theory and Design*, CRC Press, 2004.
3. James Larminie, John Lowry, *"Electric Vehicle Technology Explained"*, Wiley, 2003.

Note for Examiner(s): Question paper will comprise three sections,

1. Section-A will be compulsory and comprise 4-short answer type questions uniformly spread to the entire syllabus.
2. Section-B will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on concepts, definitions, derivations, principles, construction and working etc.
3. Section-C will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on derivations, numerical and applications of the various topics covered therein.

Note for Students:

1. Section – A is compulsory and attempt/answer all the four questions carrying 12 marks in total.
2. Attempt/answer two questions each out of the Section – B and Section – C. All questions will carry 12 marks.

Program Name: M. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-PE-203	**Course Name:** Program Elective III System Theory(v)	**L**	**T**	**P**	**C**
		3	**-**	**-**	**3**
Year and Semester	**2nd Yr. 3rd Semester**	**Contact hours per week:** (3 Hrs) Exam: (3 Hrs)			
Pre-requisite of course	**Control Systems**	**Evaluation**			
		CIE: 40	**SEE: 60**		

Course Objectives:

1. It aims to equip the students with advanced concepts of control
2. To provide adequate knowledge about tools at an intermediate to advanced level.
3. To provide students to serve them well towards tackling more advanced level of control systems problems.
4. To provide knowledge about different aspects like stability, controllability and observability.

Course Outcomes: On completion of the course, student would be able to:

CO1	Develop various models of control systems
CO2	Evaluate controllability of the systems
CO3	Evaluate observabilty of the systems
CO4	Evaluate stability of the systems
CO5	Develop state models of the systems

Module No	**COURSE SYLLABUS CONTENTS OF MODULE**	**Hrs**	**COs**
1	Controllability & Observability: Introduction, general concept of controllability, general concept of observability, controllability tests for continuous time systems, observability tests for continuous time systems, controllability & observability for discrete time systems, controllability & observability of state model in Jordan canonical form, loss of controllability & observability due to sampling, controllability & observability canonical forms of state model.	**8**	**CO1, CO2, CO3**
2	State variables and input output descriptions: introduction, input output maps from state models, LTI continuous time systems, LTI discrete time systems, linear time varying systems, output controllability, reducibility, state model from input output maps realization of scalar transfer functions, phase variable canonical forms, realization of transfer function matrices, realization of pulse transfer functions.	**8**	**CO1,CO5**
3	Stability: Introduction, equilibrium points, stability concepts and definitions, stability of linear time invariant systems, equilibrium stability of non-linear continuous time autonomous systems, direct method of Lyapunov and the linear continuous time autonomous systems, aids to find	**8**	**CO1, CO4**

	Lyapunov functions for non-linear continuous time autonomous systems, use of Lyapunovfunctions to estimate transients, the direct method of Lyapunov and discrete time autonomous systems.		
4	Model control: Introduction, controllable and observable companion forms for single input/single output systems & multi-input/multi-output systems, the effect of state feedback on controllability & observability, pole placement by state feedback, full order observers, the separation principle, reduced order observers, deadbeat control by state feedback, deadbeat observers.	**8**	**CO1,CO5**

Text Books:

1. Modern control system theory by M. Gopal (New age international)
2. Modern control systems – a manual of design methods by John A Borrie (Prentice hall international)
3. Digital control and state variable methods by M. Gopal (Tata McGraw Hill)

Note for Examiner(s): Question paper will comprise three sections,

1. Section-A will be compulsory and comprise 4-short answer type questions uniformly spread to the entire syllabus.
2. Section-B will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on concepts, definitions, derivations, principles, construction and working etc.
3. Section-C will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on derivations, numerical and applications of the various topics covered therein.

Note for Students:

1. Section – A is compulsory and attempt/answer all the four questions carrying 12 marks in total.
2. Attempt/answer two questions each out of the Section – B and Section – C. All questions will carry 12 marks.

Program Name: M. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-PC-203	**Course Name: Program Elective-III Intelligent Instrumentation (vi)**	**L**	**T**	**P**	**C**
		3	**-**	**-**	**3**
Year and Semester	**2nd Year. 3rd Semester**	**Contact hours per week: (3Hrs)** Exam: (3 Hrs)			
Pre-requisite of course	**Measurements and Instrumentations**	**Evaluation**			
		CIE: 40		**SEE: 60**	
Course Objectives:					
1. Study the concept of intelligent instrumentation system					
2. Study of intelligent instrumentation components					
3. Study the characteristic function of **Smart Sensors**					
4. Detail study of Standards for smart sensors					
5. Study and development of data acquisition system for smart sensor system					
6. Detail study and applications of Microelectro-mechanical systems					

Course Outcomes: On completion of the course, student would be able to:	
CO1	Ability to understand the concept of intelligent instrumentation system
CO2	Able to learn characteristic function of **Smart Sensors**
CO3	Acquire the knowledge of Standards for smart sensors and their Industrial applications.
CO4	Able to learn and analyze the various principles & concepts of data acquisition system for smart sensor system.
CO5	To implement new and emerging technologies to analyze, design, maintain reliable, safe, and cost effective solution Smart sensors development including Microelectro-mechanical systems

Module No	**COURSE SYLLABUS CONTENTS OF MODULE**	**Hrs**	**COs**
1	Definition of intelligence and of an intelligent instrumentation system; features characterizing intelligence and features of intelligent instrumentation; components of intelligent instrumentation; Block diagram of an intelligent instrumentation system.	**8**	**CO1 CO2**
2	**Smart Sensors:** Primary sensors**;** Excitation**;** Amplification; Filters**;** Converters; Compensation (Nonlinearty**:** look up table method**,** polygon interpolation, polynomial interpolation**,** cubic spline interpolation, Approximation & regression; Noise & interference**;** Response time**;** Drift; Cross-sensitivity)**;** Information Coding/ Processing**;** Data Communication**;** Standards for smart sensor interface**;** The automation.	**10**	**CO2 CO3**
3	**Interfacing Instruments & Computers:** Basic issues of interfacing; Address decoding; Data transfer control; A/D converter; D/A converter; Other interface considerations.	**10**	**CO4**
4	**Software Filters(Digital Filters)** : Description of Spike Filter**,** Low pass filter, High pass filter etc. **Recent Trends in Sensor Technologies:** Introduction**;** Film sensors (Thick film sensors, Thin film sensors)**;** Semiconductor IC technology –standard methods; Microelectro-mechanical systems (Micro-machining, some application examples)**;** Nano-sensors**.**	**9**	**CO4 CO5**

TEXT BOOKS:

REFERENCE BOOKS:

1. Alan S. Morris, 'Principles of measurement & Instrumentation', PHI.
2. Wai-Kai Chen, 'Passive and Active Filters: Theory and Implementations', John Willey & Sons (Asia) Ptr. Ltd., New Delhi.
3. D. Patranabis, 'Sensors & Transducers', PHI, 2003.
4. Roman Kuc, 'Introduction to Digital Signal Processing', Mc Graw Hill Introduction Edition N.York.

Note for Examiner(s): Question paper will comprise three sections,

1. Section-A will be compulsory and comprise 4-short answer type questions uniformly spread to the entire syllabus.
2. Section-B will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on concepts, definitions, derivations, principles, construction and working etc.

3. Section-C will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on derivations, numerical and applications of the various topics covered therein.

Note for Students:

1. Section – A is compulsory and attempt/answer all the four questions carrying 12 marks in total.
2. Attempt/answer two questions each out of the Section – B and Section – C. All questions will carry 12 marks.

Program Name: M. Tech.-Electrical and Instrumentation Engineering

Course Code: EI-PE-203	**Course Name: Program Elective-III, INDUSTRIAL POWER ELECTRONICS(vii)**	**L**	**T**	**P**	**C**
		3	**-**	**-**	**3**
Year and Semester	**2nd Yr. 3rdSemester**	**Contact hours per week: (3Hrs)** Exam: (3 Hrs)			
Pre-requisite of course	**Power Electronics**	**Evaluation**			
		CIE: 40	**SEE: 60**		

Course Objectives:

1. To study the basic working theory of different power electrons devices.
2. To study the control of DC drive with the help of power electrons devices.
3. To study different industrial application of power electronic devices.
4. To study the control of AC electric drive with the help of power electrons devices.

Course Outcomes: On completion of the course, student would be able to:

CO1	To apprise with the basic working theory of different power electrons devices.
CO2	To understand the control of DC drive with the help of power electrons devices.
CO3	To understand different industrial application of power electronic devices.
CO4	To understand the control of AC electric drive with the help of power electrons devices.

Module No	**COURSE SYLLABUS CONTENTS OF MODULE**	**Hrs**	**COs**
1	INTRODUCTION: Review of semiconductor power devices (Power diodes, Power Transistors, MOSFETS, IGBT, SCR, GTO, MCT, DIAC, TRAIC, PUT, SUS, SCS), Review of choppers, converters, inverters, cyclo-converters. CLOSED LOOP CONTROL OF DC DRIVES: Single Quadrant variable speed drives; Four Quadrant variable speed drives, Armature voltage control at constant field, field weakening, details of various blocks of closed loop drives; drive employing armature reversal by a contractor, drive employing a dual converter with non- simultaneous and simultaneous control.	**8**	**CO1, CO2**
2	INDUSTRIAL APPLICATION OF POWER ELECTRONIC DEVICES: Control of electric drives used in manufacturing and process industries, protection of electric drives using solid state devices and controllers, analysis of drive systems. Testing for drive controllers: Design and testing if microprocessor based drive controllers, analysis of solid state control of industrial drives, design and testing of thyristor based controllers for electric drives.	**8**	**CO2, CO3**
3	FREQUENCY CONTROLLED INDUCTION MOTOR DRIVES: Control of IM by VSI-3 phase VSI, six step inverter voltage control, PWM inverter,	**8**	**CO4**

	breaking and multi-quadrant control, VSI variable frequency drives; control of IM by CSI- 3 phase CSI, current sources, Braking, PWM in a thyristor CSI, PWM GTO CSI, CSI variable frequency drives.		
4	SELF -CONTROLLED SYNCHRONOUS MOTOR DRIVES: Self-control, brushless &commutator less, DC & AC motors synchronous motor control-operation of a wound field and permanent magnet synchronous motor from a variable frequency current source; source, permanent magnet, operation of a permanent magnet motor at the maximum torque to armature current ratio and at the maximum torque to flux ratio; operation of self-controlled synchronous motor drives- CSI drives, VSI drives, cyclo-converters drives, brush-less and commutator-less AC & DC motor drives and their applications.	**8**	**CO4**

TEXT BOOKS:

REFERENCE BOOKS:

1. Industrial Electronics by Frank D. Petruzella (Mc Graw- Hill)
2. Industrial Electronics by Morris (McGraw-Hill)
3. Power semiconductor drives by G.K.Dubey, Prentice Hall Inc, New Jersey

Note for Examiner(s): Question paper will comprise three sections,

1. Section-A will be compulsory and comprise 4-short answer type questions uniformly spread to the entire syllabus.
2. Section-B will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on concepts, definitions, derivations, principles, construction and working etc.
3. Section-C will comprise 4-questions uniformly spread to the entire syllabus and questions will be based on derivations, numerical and applications of the various topics covered therein.

Note for Students:

1. Section – A is compulsory and attempt/answer all the four questions carrying 12 marks in total.
2. Attempt/answer two questions each out of the Section – B and Section – C. All questions will carry 12 marks.