B. Tech Instrumentation Engineering

**Syllabi for Examinations**

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

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| **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. | | | | | | | |
| 1. To understand social responsibility of an engineer. | | | | | | | |
| 1. 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.

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B. Tech Instrumentation Engineering

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

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| **Course no:**  **IN-PC-303** | | | **Course title: Power Electronics-II** | | | | |
| **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 introduce the concept of Choppers. | | | | | | | |
| 1. To introduce the concept of Inverters and types of inverters. | | | | | | | |
| 1. To study the modulation & harmonics and techniques to remove harmonics. | | | | | | | |
| 1. 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-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 1800 Mode VSI and Three –Phase 1200 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.

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B. Tech Instrumentation Engineering

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

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| **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. | | | | | | | | |
| 1. To make the students understand the instructions sets of basic microprocessors and various assembly language programs. | | | | | | | | |
| 1. To impart the knowledge of various programmable interfacing chips. | | | | | | | | |
| 1. 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)**

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| **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.

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

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| **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 | | | | | | | | |
| 1. Study the Stability analysis of Linear system, Analyze and interpret stability of the system through Root Locus, Bode plot and Nyquist plot. | | | | | | | | |
| 1. Study Lag, Lead, Lead-Lag compensators and verify experimental results using MATLAB. | | | | | | | | |
| 1. 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.

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

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| **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 | | | | | | | | |
| 1. to develop knowledge about system characteristics and performance attributes | | | | | | | | |
| 1. To elaborate relevant issues of physical, architecture design at printed circuits board level of complex electronic systems | | | | | | | | |
| 1. To understand the fundamentals circuit layout | | | | | | | | |
| 1. 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)**

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| **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. | | | | | | | |
| 1. To familiarize with digital modulation and its formats. | | | | | | | |
| 1. To have understanding of angle modulation and its types. | | | | | | | |
| 1. To have knowledge of pulse modulation and digital modulation. | | | | | | | |
| 1. To gain analytical skills based information theory. | | | | | | | |
| 1. 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.

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

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| **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

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**3RDYEAR (SEMESTER–VI) (w.e.f.2020-21)**

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| **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. | | | | | | | | |
| 1. To study the Discrete linear Time Invariant systems in Z domain and in frequency domain. | | | | | | | | |
| 1. To study different structure realization of Finite Impulse Response systems and Finite Impulse Response systems. | | | | | | | | |
| 1. To study the basic of Discrete-Fourier Transform (DFT), Fast Fourier Transform (FFT) algorithms and its application. | | | | | | | | |
| 1. 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

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**3RDYEAR (SEMESTER–VI) (w.e.f.2020-21)**

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| **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. | | | | | | | | |
| 1. Use of assembler directives and programming in assembly language using Assembler | | | | | | | | |
| 1. This course concerns with Embedded systems basic knowledge: embedded architectures: | | | | | | | | |
| 1. 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

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B. Tech Instrumentation Engineering

**Syllabi for Examinations**

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

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| **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. | | | | | | | |
| 1. To gain knowledge on blind and heuristic search in AI. | | | | | | | |
| 1. To create an understanding of the basic issues of knowledge representation and Logic. | | | | | | | |
| 1. 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.

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

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| --- | --- | --- | --- | --- | --- | --- | --- |
| **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. | | | | | | | |
| 1. To introduce Bio Potential Electrodes and Biomedical Recorders. | | | | | | | |
| 1. To introduce the Heart Sound and Ultrasound. | | | | | | | |
| 1. 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)**

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| **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. | | | | | | | | |
| 1. 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 | | | | | | | | |
| 1. To further the acquired knowledge to utilize it in different research works on Pattern Recognition and Image Processing. | | | | | | | | |
| 1. 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)**

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| **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 | | | | | | |
| 1. To understand the multiloop systems | | | | | | |
| 1. To develop knowledge about controller tuning | | | | | | |
| 1. To develop understanding about PI diagrams | | | | | | |
| 1. 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)**

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| **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. | | | | | | | | |
| 1. To develop student’s skills in performing spatial transformations associated with rigid body motions. | | | | | | | | |
| 1. To develop student’s skills in perform kinematics analysis of robot systems. | | | | | | | | |
| 1. To provide the student with knowledge of the singularity issues associated with the operation of robotic systems. | | | | | | | | |
| 1. To provide the student with some knowledge and analysis skills associated with trajectory planning. | | | | | | | | |
| 1. 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)**

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| **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 | | | | | | | | |
| 1. To Understand the concepts of spectroscopy | | | | | | | | |
| 1. To study the various methods of instrumental analysis | | | | | | | | |
| 1. 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

1. Introduction To Instrumental Analysis By Robert D. Braun
2. Essentials of Instrumental analysis by Skoog, Holler & Nieman, Thomson Publ.

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

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| --- | --- | --- | --- | --- | --- | --- | --- |
| **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 | | | | | | | |
| 1. Study control Valve noise, its calculation & reduction techniques and Design & Construction of Globe Valve. | | | | | | | |
| 1. Study the characteristic function of PLC, its Architecture and various PLC programming languages and Demonstrate various PLC programming skill for industrial applications. | | | | | | | |
| 1. Detail study and applications of Distributed process control system and Understanding of various automotive standards and Protocols used in PLC network and DCS | | | | | | | |
| 1. 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

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