

SEIA1301	DISCRETE ELECTRONIC CIRCUITS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- The objective of this course is to publicize the student with the design and analysis of Rectifiers and power supplies, Transistor biasing circuits, Small signal analysis of FET and MOSFET amplifiers, Frequency Response and Multistage amplifiers and Large Signal Amplifiers.

UNIT 1 SMALL SIGNAL AMPLIFIERS**9 Hrs.**

BJT amplifiers : CE, CB and CC amplifiers - multistage amplifiers - differential amplifier - designing BJT amplifier networks (analysis using hybrid π model) FET amplifiers : CS, CG and CD amplifiers - designing FET amplifier networks
Frequency response : low frequency response of BJT and FET amplifiers - Miller effect capacitance - high frequency response of BJT and FET amplifiers.

UNIT 2 LARGE SIGNAL AMPLIFIERS**9 Hrs.**

Class A, B, C, AB and D type of operation - efficiency of class A amplifier with resistive and transformer coupled load, efficiency class B, complementary symmetry amplifiers - distortion in power amplifiers - Thermal stability of power amplifier.

UNIT 3 FEEDBACK AMPLIFIERS & OSCILLATORS**9 Hrs.**

Block diagram, Four types of negative feedback connections - voltage series feedback, voltage shunt feedback, current series feedback and current shunt feedback, Oscillators - Classification, Barkhausen Criterion - Analysis of LC oscillators - Hartley, Colpitts, Clapp, RC oscillators - phase shift - Wien bridge - Frequency range of RC and LC Oscillators, Miller and Pierce Crystal oscillators.

UNIT 4 TUNED AMPLIFIERS**9 Hrs.**

Small signal tuned amplifiers - Analysis of capacitor coupled single tuned amplifier & inductively coupled single tuned amplifier - double tuned amplifier - effect of cascading single tuned and double tuned amplifiers on bandwidth - Stagger tuned amplifiers - large signal tuned amplifiers - Class C tuned amplifier - Efficiency and applications of Class C tuned amplifier.

UNIT 5 WAVE SHAPING AND MULTI VIBRATOR CIRCUITS**9 Hrs.**

High Pass and Low Pass RC Circuits and their Response for Sine, Step, Pulse, Square, Ramp and Exponential Input. Multivibrators – Astable Multivibrators - Emitter and Collector Coupled - Monostable, Bistable Multivibrators, and Schmitt Trigger Circuits, Blocking oscillator – Monostable & Astable blocking oscillator.

Max. 45 Hrs.**COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1 - Understand the working of different types of Amplifiers.
- CO2 - Analyze the Hybrid Model of BJT Amplifiers.
- CO3 - Design Small Signal Model of FET and MOSFET Amplifiers.
- CO4 - Explain Frequency response and Multistage Amplifiers.
- CO5 - Explain working of Multivibrators.
- CO6 - Design Large Signal Amplifiers.

TEXT / REFERENCE BOOKS

1. S. Salivahanan, N. Suresh Kumar and A. Vallavaraj, "Electronic Devices and Circuits", 2nd Edition, TMH, 2007.
2. G.K, "Electronic Devices and Circuits", Khanna Publishers, 23rd Edition, 2004.
3. David A., Bell, "Solid State Pulse Circuits", PHI, 2002.
4. Venkatraman R., "Pulse, Digital Circuits and Computer Fundamentals", Dhanpat Rai, (Paper Back), 2013.
5. Jacob Millman and C. Halkias, "Integrated Electronics, Analog and Digital Circuits and Systems", McGraw Hill, 1997.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN**Max. Marks : 100****Exam Duration : 3 Hrs.****PART A:** 10 Questions of 2 marks each-No choice**20 Marks****PART B:** 2 Questions from each unit of internal choice, each carrying 16 marks**80 Marks**

SEEA1304	ELECTRICAL CIRCUITS AND NETWORKS ANALYSIS	L	T	P	Credits	Total Marks
		3	*	0	3	100

COURSE OBJECTIVES

- To impart knowledge on the fundamental principles on analysis of Electrical circuits.
- To Understand and Analyze Network Functions and Various Parameters.
- To Familiarize about Resonance Circuits.

UNIT 1 D.C. AND AC CIRCUITS**9 Hrs.**

Electrical Quantities, Ohm's Law, Resistors - Series and parallel Combinations, Kirchhoff's Laws, Node and Mesh Analysis - Sinusoidal Functions - RMS(effective) and Average Values - Phasor Representation - J operator - Sinusoidal Excitation Applied to Purely Resistive - Inductive and Capacitive Circuits - RL - RC and RLC Series and Parallel Circuits.

UNIT 2 NETWORK THEOREMS (BOTH DC & AC)**9 Hrs.**

Superposition Theorem - Reciprocity Theorem - Thevenin's Theorem - Norton's Theorem - Maximum power transfer Theorem.

UNIT 3 NETWORK TOPOLOGY**9 Hrs.**

Network Topology - Basic concepts of Graph theory, Network Graph, Tree, Incidence & Reduced Incidence Matrices, Cut sets, Tie sets, Cut set schedule, Tie set schedule - Application to network solutions - Duality and Dual Networks.

UNIT 4 NETWORK FUNCTION AND ITS PARAMETERS**9 Hrs.**

Network Functions - Driving point Impedance - Transfer Functions- Network Parameters - Z, Y, h and ABCD- Parameter Conversion Parameters of Important Networks - Lattice Network - T Network and π Network - Twin Network - Bartlett's Bisection Theorem and its Application - Interconnection of Two Port Networks.

UNIT 5 TRANSIENTS AND RESONANCE CIRCUITS**9 Hrs.**

Time Domain Analysis - Transient Response of RL, RC & RLC networks with DC Input and Sinusoidal AC Input- Series and Parallel Resonance - Frequency Response - Quality Factor and Bandwidth.

Max.45 Hrs.**COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1 - Analyze and find various Electrical Quantities for D.C and A.C. Circuits.
- CO2 - Study and Apply the Network Theorems.
- CO3 - Design different Circuits based on its Topology.
- CO4 - Design and Convert the two port networks based on its application.
- CO5 - Describe the Transient Circuits with respect to its Switching Conditions.
- CO6 - Design Circuits based on Resonance Conditions.

TEXT / REFERENCE BOOKS

1. Sudhakar and Shyam Mohan Palli, "Circuits and Networks: Analysis and Synthesis", 3rd Edition, Tata McGraw Hill, 2008.
2. John.D.Ryder, "Networks Lines and Fields", 2nd Edition, PHI Publications, 2003.
3. Hayt W. H, Jack Kemmerly, Steven Durbin, "Engineering Circuit Analysis", Tata McGraw Hill, 8th illustrated edition, 2011.
4. Kuo, "Network Analysis and Synthesis", John Wiley & Sons Inc, 2014.
5. Umesh Sinha, "Network Analysis and Synthesis", 5th Edition, Sathya Prakashan Publishers, 2010.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN**Max. Marks: 100****Exam Duration: 3 Hrs****PART A:** 10 Questions of 2 marks each-No choice**20 Marks****PART B:** 2 Questions from each unit of internal choice, each carrying 16 marks**80 Marks**

SECA2306	DEVICES AND ELECTRIC CIRCUITS LAB	L	T	P	Credits	Total Marks
		0	0	4	2	100

COURSE OBJECTIVES

- To understand the characteristics of diodes, transistors, LDRs, SCR, DIAC, Triac.
- To understand the theorems for electrical circuit analysis.

SUGGESTED LIST OF EXPERIMENTS**DEVICES LAB**

1. Characteristics of semiconductor diode & Zener diode.
2. Characteristics of CE & CB Configuration.
3. Characteristics of JFET & UJT.
4. Characteristics of LDR & Phototransistor.
5. Characteristics of SCR.
6. Characteristics of Diac & Triac.

ELECTRIC CIRCUITS LAB

1. Verification of Thevenin's Theorem.
2. Verification of Superposition Theorem.
3. Verification of Reciprocity Theorem.
4. Verification of Compensation Theorem.
5. Verification of Maximum Power Transfer Theorem.

COURSE OUTCOMES

On completion of the course, students are able to

- CO1 - Acquire basic knowledge on the working of semiconductor devices.
- CO2 - Understand the basic electric circuit concepts.
- CO3 - Simulate the electric circuit using PSPICE.
- CO4 - Analyse the characteristics of semiconductor diode & Zener diode, transistor, JFET, UJT, LDR, Phototransistor, SCR, Diac & Triac.
- CO5 - Analyse and verify the circuit using Thevenin's, Superposition, Reciprocity, Compensation & Maximum Power Transfer Theorem.
- CO6 - Design various application circuits using diodes.

SEIA1401	ELECTRICAL AND ELECTRONIC MEASUREMENTS AND INSTRUMENTATION	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To give an overview of current, voltage, power and energy measuring electrical, electronics and digital instruments.
- To expose the students to the design of bridges for the measurement of resistance, capacitance and inductance.
- To give an overview of test and measuring instruments.
- To give an idea about Oscilloscopes, Recorders and Waveform generators and analyzers.

UNIT 1 ELECTRICAL MEASUREMENTS**9 Hrs.**

General features and Classification of electro mechanical instruments. Principles of Moving coil, moving iron, dynamometer type, rectifier type, thermal instruments. Errors and compensation, Extension of instrument range: shunt and multipliers, calibration of voltmeter and ammeters, CT and PT.

UNIT 2 MEASUREMENT OF POWER AND ENERGY**9 Hrs.**

Electro-dynamic wattmeter's, Low Power Factor (LPF) wattmeter, errors, Single and three phase power measurement, Hall effect wattmeter, thermal type wattmeter. Energy measurement - Single phase and poly phase induction type energy meter - theory and adjustments - Testing of energy meters - Calibration of wattmeter and energy meter.

UNIT 3 MEASUREMENT OF RESISTANCE, INDUCTANCE AND CAPACITANCE**9 Hrs.**

Low, high and precise resistance measurement, Megger, Ohmmeters, Classical AC bridges: Measurement of Self-Inductance and capacitance. Detectors in bridge measurement, bridge screening, Wagner earth, transformer ratio bridges

UNIT 4 ELECTRONIC AND DIGITAL MEASUREMENTS**9 Hrs.**

Electronic voltmeter and Digital voltmeter, current measurement with electronic instruments, Analog and digital multi-meters, Digital frequency meters, Time interval measurement. Digital LCR meter, Q-Meter, Digital wattmeter and energy meters

UNIT 5 DISPLAY DEVICES, WAVEFORM GENERATORS AND ANALYZERS**9 Hrs.**

DSO, DPO, MSO, Analog Recorders – Strip Chart and X-Y recorders, Digital Recorders Function generators, Signal generators, Waveform analyzers, Spectrum analyzers, Distortion analyzers,

Max.45 Hrs.**COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1 - Understand the principle, construction, operations and applications of electrical and electronic measuring instruments.
- CO2 - Develop the knowledge to measure parameters like voltage, current, power, energy, resistance, inductance, capacitance, magnetic flux, iron loss, frequency, time interval; etc.
- CO3 - Apply the knowledge to use an instrument to measure the parameter.
- CO4 - Evaluate the performance of instruments under various operating conditions.
- CO5 - Select instruments suitable for specific measurement application.
- CO6 - Design electrical and electronic instruments through the principles learnt.

TEXT / REFERENCE BOOKS

1. Golding, E.W. and Widdis, F.C., "Electrical Measurements and Measuring Instruments", A.H.Wheeler and Co, 5th Edn, 2011.
2. David A. Bell, "Electronic Instrumentation and Measurements", Oxford University Press, 3rd Edition, 2013.
3. Shawney A K, "A course in Electrical and Electronic Measurements and Instrumentation", Dhanpat Rai and Sons. 19th revised edition, 2014.
4. Cooper, W.D. and Helfric, A.D., "Electronic Instrumentation and Measurement Techniques", PHIL, 1st Edition, 2009.
5. Kalsi.H.S, "Electronic Instrumentation", Tata McGraw Hill Education Private Limited, 3rd Edition, 2012.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN**Max. Marks: 100****Exam Duration: 3 Hrs.****PART A:** 10 Questions of 2 marks each-No choice**20 Marks****PART B:** 2 Questions from each unit of internal choice, each carrying 16 marks**80 Marks**

SEIA1402	INDUSTRIAL UNIT OPERATIONS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To impart knowledge pertaining to overview of unit operations.
- To give an idea about distillation and unit operations in transport of solids, liquids & gases and also various unit operations involved in chemical reactors, steam boilers, furnaces, pumps, compressors, extruders, blowers and centrifuges.

UNIT 1 OVERVIEW OF UNIT OPERATIONS**9 Hrs.**

Introduction to industrial processes - Concepts of unit operations and unit processes - Material balance and energy balance -Types of reactions - General idea of controlling operations.

UNIT 2 TRANSPORT OF SOLIDS, LIQUIDS AND GASES**9 Hrs.**

Study of Unit operation in Transport of Solids, liquids and gases - Different crushers and grinders - Adjusting of particle size, Mixing- Separation- Leaching and extraction.

UNIT 3 DISTILLATION, CHEMICAL REACTORS, STEAM BOILERS, FURNACES**9 Hrs.**

Study of Unit operation in Distillation: Flash distillation - Batch distillation- Continuous distillation- Operational features- construction and working principle of Chemical reactors- Steam boilers- Furnaces.

UNIT 4 DRYERS, CRYSTALLIZERS, EVAPORATORS**9 Hrs.**

Study of Unit operation in Dryers, Crystallization, Evaporators, Heat exchangers, Humidification, De-humidification - Different types - operational features, construction and working principle.

UNIT 5 PUMPS, COMPRESSORS, EXTRUDERS, BLOWERS, CENTRIFUGES**9 Hrs.**

Study of Unit operation in Pumps, Compressors, Extruders, Blowers, Centrifuges - operational features, construction and working principle.

Max.45 Hrs.**COURSE OUTCOMES**

On completion of the course, student will be able to

CO1 - Define unit operations, unit process and types of reactions involved in different industries.

CO2 - Explain the unit operations in transportation of solids, liquids and gases.

CO3 - Explain the unit operations in different processes.

CO4 - Discuss the working principle and operation of different processes.

CO5 - Compare the unit operations of distillation columns, chemical reactors, steam boilers and furnaces, in pumps, compressors, extruders, blowers and centrifuges , pumps, compressors, extruders.

CO6 - Understand the various unit operations in different processes.

TEXT / REFERENCE BOOKS

- McCabe W.L.Smith, J.C.PeterHarriot, "Unit operation of chemical engineering", McGraw Hill Inc., 1993.
- Levenspiel O, "Chemical Reaction Engineering", Wiley, 1972.
- Robert H.Perry and Don Green Perry, "Perry's Chemical Engineers' Handbook", 8th Edition, 2007.
- B.G.Liptak, "Instrumentation Engineers Hand book: Process Measurement and Process control", 4th Edition, CRC Press, 2003.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN**Max. Marks: 100****Exam Duration: 3 Hrs.****PART A** : 10 Questions of 2 marks each-No choice**20 Marks****PART B** : 2 Questions from each unit of internal choice, each carrying 16 marks**80 Marks**

SEIA1502	ANALYTICAL INSTRUMENTATION	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- The subject aims to provide the basic principles of various instrument analysis and its applications.
- This subject brings comprehensive analysis of various gas analyser and chromatography.
- It aims in thorough study of spectro photometers analysis and applications.

UNIT 1 SPECTRO PHOTOMETERS**9 Hrs.**

Spectral methods of analysis – Beer's law UV – visible spectrophotometers – single beam and double beam instruments – source and detectors – IR spectrophotometers – sources and detectors – FTIR spectrometers –Atomic absorption spectrophotometer – flame emission spectrophotometers – sources of flame photometry –applications - ESR, EPR spectroscopy - TOF spectrometer -Introduction to x-ray spectroscopy.

UNIT 2 PRINCIPLE of NUCLEAR MAGNETIC RESONANCE**9 Hrs.**

NMR – basic principle – NMR spectrometers – applications – introduction to mass spectrophotometers –nuclear radiation detectors – GM counter – proportional counter – solid state detectors.

UNIT 3 CHROMATOGRAPHY**9 Hrs.**

Gas chromatography – liquid chromatography — high-pressure liquid chromatography – principles, types and applications detectors.

UNIT 4 pH CONDUCTIVITY & DISSOLVED COMPONENT ANALYSER**9 Hrs.**

Conductivity meters – pH meters - dissolved oxygen hydrogen analyser –sodium analyser – silica analyser and Sampling systems.

UNIT 5 GAS ANALYSER**9 Hrs.**

Thermal conductivity - thermal analyser – types of Oxygen analyser – CO monitor – NOx analyser – H₂S analyser – dust and smoke measurement

Max. 45 Hrs.**COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1 - Understand the working of different types of Analysers.
- CO2 - Analyze the techniques of chromatography.
- CO3 - Understand working of different Spectrophotometers.
- CO4 - Explain NMR.
- CO5 - Analyze the applications of Analyzers, Chromatography.
- CO6 - Explain the operating principle of analyzers, chromatography, Spectrophotometers.

TEXT/ REFERENCE BOOKS

- Hobart H. Willard, Lynne.L. Merrit, John A. Dean, Frank A.Settle, "Instrumental Methods of Analysis", 7th Edition, CBS Publishing & Distribution, 1986.
- Jain R.K, "Mechanical &Industrial Measurements", Khanna Publishers, 11th Edition, 2004.
- Khandpur R.S, "Handbook of Analytical Instruments", II Edition, Tata McGrawHill, New Delhi, 2006.
- Gurdeep R. Chatwal, Sham.K. Anand, "Instrumental methods of Chemical Analysis" Himalaya Publishing house, Reprint 2006.
- Robert D. Braun, "Introduction to Instrumental Analysis", Pharma Book Syndicate, Hyderabad, Reprint 2006.
- Douglas.A. Skoog, F.James Holker, Stanley R.Gouch, "Instrumental Analysis", Engage Learning India, India Edn.2008.

END SEMESTER EXAM QUESTION PAPER PATTERN**Max. Marks: 100****Exam Duration: 3 Hrs.****PART A:** 10 Questions of 2 marks each-No choice**20 Marks****PART B:** 2 Questions from each unit of internal choice, each carrying 16 marks**80 Marks**

SEEA1502	CONTROL SYSTEMS	L	T	P	Credits	Total Marks
		3	*	0	3	100

COURSE OBJECTIVES

- To impart knowledge regarding the various types of system and different transfer function analyzing techniques associated with control systems.
- To analyze the response and error of various types of system in time domain.
- To understand the stability analysis of frequency domain systems.
- To analyze the open loop system in frequency domain.
- To implement the design of controllers and compensators.

UNIT 1 SYSTEM CONCEPTS**10 Hrs.**

Types of System - Open Loop Systems, Closed Loop Systems, Basic Elements in Control System - Mathematical Models of Physical System: Differential Equation- Transfer Functions of Single Input, Single Output and Multi Variable Systems - Simple Electrical Networks, Electrical Analogous of Mechanical Translational and Rotational System - D.C and A.C Servomotor - Mechanical System- Translational and Rotational System - Block Diagram Reduction Techniques - Signal Flow Graphs - Mason's Gain Formula.

UNIT 2 TIME RESPONSE ANALYSIS OF CONTROL SYSTEMS**9 Hrs.**

Standard Test Signals - Time Response of First and Second Order System, Time Domain- Specifications - Generalized Error Series - Steady State Error - Static and Dynamic Error Constants.

UNIT 3 STABILITY OF CONTROL SYSTEM**9 Hrs.**

Characteristics Equation - Location of Roots in S Plane for Stability - Routh Hurwitz Criterion - Root Locus Analysis - Effect of Pole Zero Additions on Root Locus - Nyquist Stability Criterion.

UNIT 4 FREQUENCY RESPONSE ANALYSIS**9 Hrs.**

Frequency Response of the System - Correlation between Time and Frequency Response - Gain and Phase Margin - Bode Plot - Nyquist Plot (Polar Plot).

UNIT 5 COMPENSATION AND CONTROLLERS**8 Hrs.**

Introduction to compensation networks - Lag, Lead and Lag Lead networks - Effect of providing Lag, Lead and Lag-Lead compensation on system performance and design using bode plot - P, PI, PID Controllers design.

Max. 45 Hrs.**COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1 - Understand the types of control systems in different domains.
- CO2 - Analyse the response of any linear time invariant system.
- CO3 - Identify the type of errors and obtaining their constants.
- CO4 - Determine and analyse the stability of the system.
- CO5 - Perform the analysis of the control system in both time and frequency domains.
- CO6 - Design a controller and a compensator in frequency domain.

TEXT / REFERENCE BOOKS

1. I.J.Nagarath and M.Gopal, "Control System Engineering" New Age International(p)Limited Publishers, 2nd edition., 2009.
2. Kausuhio Ogata, "Modern Control Engineering", Prentice Hall of India PVT. Ltd, 5th edition, 2010.
3. Richard Dorf, "Modern Control Systems", Pearson Education Ltd, 11th Edition 2009.
4. M.N. Bandyopadhyay, "Control Engineering, Theory and Practice" PHI, 4th print, 2006.
5. N.K.Sinha, "Control Systems", New Age International Private Limited Publishers, 3rd Edition, reprint 2008.
6. A.Nagoorkani, "Control System", RBA Publications, 3rd edition, reprint 2012.
7. U.A.Bakshi and S.C.Goyal, "Control System Engineering", Technical Publication, 2nd Revised reprint 2007.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN**Max. Marks: 100****PART A:** 10 Questions of 2 marks each - No choice**PART B:** 2 Questions from each unit of internal choice; each carrying 16 marks**Exam Duration: 3 Hrs.****20 Marks****80 Marks**

SEIA1503	SOFTWARE TOOLS FOR INSTRUMENTATION ENGINEERS	L	T	P	Credits	Total Marks
		3	*	0	3	100

COURSE OBJECTIVES

- To get the strong knowledge in Control System applications using Matlab, Labview, PLC, SCADA and DCS.
- To design simulink block for various Engineering Application.
- To understand the main challenges related with human machine interaction and solve it with various software tools.

UNIT 1 MATLAB PROGRAMMING**9 Hrs.**

Introduction to MATLAB Software: MATLAB Command window - Workspace - Working with the MATLAB- user interface - Basic commands- Assigning variables Operations with variables-programming with different loops and conditional statements-Applications in Biomedical and Control engineering (signal & image).

UNIT 2 SIMULINK**9 Hrs,**

Introduction-Introduction to simulink libraries-graphical user interface - selection of objects- blocks-lines- simulation-application programs-limitations- Steps for creating fuzzy logic tool box -GUI editor-rule viewer -membership function editor-rule editor.

UNIT 3 PROGRAMMABLE LOGIC CONTROLLERS**9 Hrs.**

Programmable logic controllers: Organization- Hardware details- I/O- Power supply- CPU Standards- Programming aspects- Ladder programming- Sequential function charts- Human-machine interface (HMI) - Case study on Lubrication System.

UNIT 4 LARGE SCALE CONTROL SYSTEM**10 Hrs.**

SCADA: SCADA Architecture, Different Communication Protocols, Common System Components, Supervision and Control- HMI- RTU and Supervisory Stations - DCS: DCS Architecture, Local Control (LCU) architecture- LCU languages, LCU Process interfacing issues - communication facilities- configuration of DCS- displays- redundancy concept - case study on thermal power station.

UNIT 5 VIRTUAL INSTRUMENTATION**8 Hrs.**

Virtual instrumentation - Definition, flexibility - Block diagram and architecture of virtual instruments - Virtual instruments versus traditional instruments -LabVIEW software and interfacing with Hardware, VI programming techniques - VI, sub VI, loops and charts, arrays, clusters and graphs, interfacing LabView with Matlab .-LabVIEW applications in Instrumentation.

Max.45 Hrs.**COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1 - Ability to utilize experimental, statistical and computational methods and tools necessary for engineering practice.
- CO2 - Explain the fundamental concepts of PLC, SCADA, DCS and VI.
- CO3 - Get an idea of advanced process control blocks and apply suitable software tools for different case studies.
- CO4 - Elucidate the concept of programming to solve various Control System Problems in Industries.
- CO5 - Knowledge and skills in modeling simulation, optimization and design of industrial automation systems.
- CO6 - Understand the main functioning of various instrumentation industries through case studies.

TEXT / REFERENCE BOOKS

- Gordon Clarke, Deon Reynders, "Practical Modern SCADA Protocols: DNP3, 60870.5 and Related Systems", Newnes Publications, Oxford, UK, 2004.
- John Essick, "Hands-On Introduction to Lab VIEW for Scientists and Engineers", Oxford University Press (November 12, 2008).
- Efim Rosenwasser, Bernhard P. Lampe, "Multivariable Computer-Controlled Systems: A Transfer Function Approach", Springer, 2006.
- Chapman, S J Thomson, "Matlab Programming for Engineers", Bookware Companion Series, 5th edition, 2016.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN**Max. Marks: 100****Exam Duration: 3 Hrs.****PART A:** 10 Questions of 2 marks each - No choice**20 Marks****PART B:** 2 Questions from each unit of internal choice; each carrying 16 marks**80 Marks**

SEIA1403	INDUSTRIAL INSTRUMENTATION	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To provide knowledge in the basic measurements in industries such as roughness, flatness, roundness and straightness.
- To make the student understand measurement of industrial parameters such as force, torque acceleration and speed.
- To make the students familiar with the temperature standards, ranges, calibration and various techniques in temperature and pressure measurement.
- To provide adequate knowledge on the measurement of flow, level, humidity, viscosity and density.

UNIT 1 INDUSTRIAL MEASUREMENTS**10 Hrs.**

Measurement of straightness, flatness, roundness and roughness. Force Measurement - Load cell, different types of load cells - elastic load cell-strain gauge load cell. Torque measurement-Using strain gauge and magneto elastic principle, Speed Measurement - Revolution counter-capacitive tachometer, D.C and A.C tachometer generators - stroboscopic methods. Acceleration Measurement- Elementary accelerometer, Seismic accelerometer, Practical accelerometers.

UNIT 2 TEMPERATURE MEASUREMENT & APPLICATION**9 Hrs.**

Definition & Standards, Temperature scales, Calibration of thermometers, Bimetallic thermometer, filled- in Thermometers, Vapour pressure thermometers, Resistance thermometers, Thermistors- color testing and installation procedure, Thermostat, Thermocouples - types and ranges, characteristics, laws of thermocouples, cold junction compensation, IC temperature sensors AD 590, Pyrometers - radiation and optical pyrometers.

UNIT 3 PRESSURE MEASUREMENT**9 Hrs.**

Manometers - different types of manometers, Elastic pressure transducers, Dead weight Tester, Electrical types, Vacuum gauges - McLeod gauge, Knudsen gauge, Thermocouple gauge, Ionization gauge, Differential pressure Transmitter - electrical & pneumatic types, Complete air supply system for pneumatic control equipment and the different components and their function.

UNIT 4 MEASUREMENT OF FLOW & LEVEL**9 Hrs.**

Orifice, Venturi, Pitot tube, flow nozzle rotameter, Doherty tube, Positive displacement meter, Turbine flow meter, Electromagnetic flow meter, Ultrasonic flow meter, Open channel flow measurement, Solid flow measurement. Level: Sight glass, float gauge, displacer, torque tube, bubbler tube, diaphragm box, Differential Pressure methods, electrical methods- resistance type, capacitance type, ultrasonic level gauging.

UNIT 5 MEASUREMENT OF DENSITY, VISCOSITY, HUMIDITY**8 Hrs.**

Hydrometer - continuous weight measurement, liquid densitometer - float principle, air pressure balanced method, using gamma rays - gas density measurements - gas specific gravity measurements - Viscosity terms, saybolt viscometer, rotometer type viscometer, Industrial consistency meters. Humidity terms - dry & wet bulb psychrometers - hot wire electrode type hygrometer, electrolytic hygrometer, Dew point hygrometer.

Max.45 Hrs.**COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1 - Identify the parameters to be measured in industries.
- CO2 - Explain measuring techniques of the process parameters.
- CO3 - Choose the appropriate instrument based on the ranges of parameters to be measured.
- CO4 - Differentiate between different types of measuring technique for a parameter.
- CO5 - Demonstrate few instruments in measurement of process parameters.
- CO6 - Apply the proper technique for measurement.

TEXT / REFERENCE BOOKS

1. Patranabis D., "Principles of Industrial Instrumentation", Tata McGraw Hill, 3rd Edition, New Delhi, Reprint 2010.
2. Singh. S.K., "Industrial Instrumentation & Control" 3rd Edition, Tata McGraw Hill, Reprint 2009.
3. Krishnaswamy. K & Vijayachitra. S, "Industrial Instrumentation" New age International, Reprint 2008.
4. Ernest O. Doebelin, Dhanish. N. Manik, "Measurement Systems Application & Design", TMH, 6th Edition, 2011.
5. A.K. Sawhney and PuneetSawhney, "A Course in Electrical and Electronics Measurements and Instrumentation", 18th Edition, Dhanpat Rai and Co, New Delhi, 2010.
6. Tattamangalam R. Padmanabhan, "Industrial Instrumentation: Principles and Design, Springer Science & Business Media", 2012.
7. Jain R.K, "Mechanical & Industrial Measurements", Khanna Publishers, 11th Edition, 2004.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN**Max. Marks: 100****Exam Duration: 3 Hrs.****PART A:** 10 Questions of 2 marks each-No choice**20 Marks****PART B:** 2 Questions from each unit of internal choice, each carrying 16 marks**80 Marks**

SEIA3001	MEASUREMENTS AND INSTRUMENTATION	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To learn about various measurement concepts.
- To learn about signal generators and signal analysers.
- To know about the data acquisition systems.
- To know about the measurement in optical domain.

UNIT 1 BASIC MEASUREMENT**9 Hrs.**

Measurement systems – Static and dynamic characteristics – units and standards of measurements – error, accuracy and precision, types, statistical analysis – moving coil, moving iron meters – Electrodynamometer type wattmeter- Energy meter multimeters – Bridge measurements : – Maxwell, Hay, Schering, Anderson and Wien bridge.

UNIT 2 BASIC ELECTRONIC MEASUREMENTS**9 Hrs.**

Electronic multimeters – Cathode ray oscilloscopes – block schematic – applications – special oscilloscopes - delayed time base oscilloscopes, analog and digital storage oscilloscope, sampling oscilloscope – Q meters – Vector meters – RF voltage and power measurements – True RMS meters.

UNIT 3 SIGNAL GENERATORS AND ANALYZERS**9 Hrs.**

Function generators – pulse and square wave generators, RF signal generators –Sweep generators – Frequency synthesizer – wave analyzer – Harmonic distortion analyzer–spectrum analyzer :- digital spectrum analyzer, Vector Network Analyzer – Digital L,C,R measurements, Digital RLC meters.

UNIT 4 DIGITAL INSTRUMENTS**9 Hrs.**

Comparison of analog and digital techniques – digital voltmeter – multimeters – frequency counters – measurement of frequency and time interval – extension of frequency range – Automation in digital instruments, Automatic polarity indication, automatic ranging, automatic zeroing, fully automatic digital instruments, Computer controlled test systems, Virtual instruments.

UNIT 5 ACQUISITION MEASUREMENT SYSTEMS AND FIBER OPTIC DATA**9 Hrs.**

Elements of a digital data acquisition system – interfacing of transducers – multiplexing – data loggers –computer controlled instrumentation – IEEE 488 bus – fiber optic measurements for power and system loss – optical time domains reflectometer.

Max. 45 Hrs.**COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1 - Understand the basics of measurement system.
- CO2 - Design a measuring instrument and study about various oscilloscopes.
- CO3 - Choose proper method for analysing the signals using signal generators.
- CO4 - Identify the latest technology for modern digital instruments.
- CO5 - Evaluate the various digital measurement techniques.
- CO6 - Develop a data acquisition system and measurement system.

TEXT / REFERENCE BOOKS

1. Albert D.Helfrick and William D.Cooper, " Modern Electronic Instrumentation and Measurement Techniques", Pearson / Prentice Hall of India, 2007.
2. Ernest O. Doebelin, "Measurement Systems- Application and Design", TMH, 2007.
3. Joseph J.Carr, "Elements of Electronics Instrumentation and Measurement", Pearson Education, 2003.
4. Alan. S. Morris, "Principles of Measurements and Instrumentation", 2nd Edition, Prentice Hall of India, 2003.
5. David A. Bell, "Electronic Instrumentation and measurements", Prentice Hall of India Pvt Ltd, 2003.
6. B.C. Nakra and K.K. Choudhry, "Instrumentation, Measurement and Analysis", 2nd Edition, TMH, 2004.
7. James W. Dally, William F. Riley, Kenneth G. McConnell, "Instrumentation for Engineering Measurements", 2nd Edition, John Wiley, 2003.

END SEMESTER EXAM QUESTION PAPER PATTERN**Max. Marks: 100****Exam Duration: 3 Hrs.****PART A:** 10 Questions of 2 marks each-No choice**20 Marks****PART B:** 2 Questions from each unit of internal choice, each carrying 16 marks**80 Marks**

SEIA3002	PROCESS CONTROL SYSTEM COMPONENTS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- To introduce the principles and design concepts of various control and instrumentation components applied to process control system.

UNIT 1 FLOW AND TEMPERATURE SYSTEM**9 Hrs.**

Orifice meter – design of orifice for given flow condition – rotameter - design of rotameter - Transmitters – Pneumatic transmitter, Electronic transmitter, intelligent transmitter - signal conditioning for RTD – Zero and span adjustment in D/P transmitters and temperature transmitters.

UNIT 2 PRESSURE AND LEVEL SYSTEM**9 Hrs.**

Pressure Relieving devices Functions - Relief valve - safety valves - safety relief valves - Pilot operated relief valves - Bourdon gauges – design of Bourdon tube – Design of Air purge system for level measurement. Electronic P + I + D controllers – design – adjustment of set point, bias and controller settings.

UNIT 3 CONTROL VALVES**9 Hrs.**

Control valves –Necessity-Comparison with other final control elements– valve characteristics – Control valve parameters control valve capacity-valve range ability-valve size-valve gain –Selection criteria- Control valve sizing Procedure-Cavitation & flashing in control valve.

UNIT 4 PUMPS**9 Hrs.**

Types of pumps – pump – performance – pipe work calculation – characteristics of different pumps – pump operation maintenance – instruments used in pumping practice pump noise and vibration – selection of pumps.

UNIT 5 LOGIC CIRCUIT**9 Hrs.**

Design of logic circuits for alarm and annunciator circuits, interlocks – design of microprocessor based P + I + D controller.

Max.45 Hrs.**COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1 - Understand the working of flow, level, pressure and temperature systems.
- CO2 - Analyze the working of devices for measurement of Flow, level, pressure and temperature systems.
- CO3 - Select an appropriate control valve.
- CO4 - Explain the characteristics of Pumps.
- CO5 - Design Logic circuit for alarms and annunciator circuits.
- CO6 - Design of devices for measurement of Flow, level, pressure and temperature.

TEXT / REFERENCE BOOKS

1. N.A. Anderson, "Instrumentation for Process Measurement and Control", Chilton Company, 3rd Edition, 1997, ebook 2017, CRC Press.
2. Brian Nesbitt, "Handbook of Pumps and Pumping: Pumping Manual International", Elsevier, 1st Edition, 2006.
3. C.D. Johnson, "Process Control Instrumentation Technology", Prentice Hall Inc. 8th Edition, 2015.
4. Terry Bartelt, "Instrumentation and Process Control", Nov.28, 2006, Delmar Cengage Learning.
5. Donald.P. Eckman, "Automatic Process Control", Wiley India Pvt Ltd., 2009.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN**Max. Marks: 100****PART A** : 10 Questions of 2 marks each-No choice**PART B** : 2 Questions from each unit of internal choice, each carrying 16 marks**Exam Duration: 3 Hrs.****20 Marks****80 Marks**

SEIA3003	MODERN CONTROL SYSTEMS	L	T	P	Credits	Total Marks
		3	*	0	3	100

COURSE OBJECTIVES

- To Provide Knowledge on Design in State Variable Form.
- To Provide Knowledge in Phase Plane Analysis.
- To Give Basic Knowledge in Describing Function Analysis.
- To Study the Design of Optimal Controller.
- To Study the Design of Optimal Estimator including Kalman Filter

UNIT 1 STATE SPACE ANALYSIS**9 Hrs.**

State space analysis – state space formulation – state space representation of control systems described by scalar differential equation – state variable – transformation of state space equation, physical, phase & canonical variable, state space models – state space representation for discrete time systems.

UNIT 2 PHASE PLANE ANALYSIS**9 Hrs.**

Features of Linear and Non-Linear Systems – Common Physical Non-Linearities – Methods of Linearization- Concept of Phase Portraits – Singular Points – Limit Cycles – Construction of Phase Portraits – Phase Plane Analysis of Linear and Non Linear Systems – Isocline Method.

UNIT 3 DESCRIBING FUNCTION ANALYSIS**9 Hrs.**

Basic Concepts, Derivation of Describing Functions for Common Non-Linearities : on/off, dead zone and saturation – Describing Function Analysis of Non-Linear Systems – Limit Cycles – Stability Of Oscillations.

UNIT 4 PHASE VARIABLE MATRIX**9 Hrs.**

Jordan and canonical forms, controllability and observability – condition for controllability and observability, Gilbert method and Kalman decomposition – design of state feedback by pole placement. Controllable phase variable form, observable phase variable form, reduced order observer – full order observer – reducibility, irreducibility, transfer function matrix, impulse response functions.

UNIT 5 DESIGN OF DISCRETE TIME CONTROL SYSTEM**9 Hrs.**

Sampled data theory – sampling process – sampling theorem, sample and hold circuits – zero order hold, discrete systems and solution of difference equation using z transform, pulse transfer function – response of sampled data system to step and ramp input, stability studies – jury's test.

Max.45 Hrs.**COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1 - Understand State Variable Form, Phase Plane Analysis.
- CO2 - Understand the analysis of describing functions.
- CO3 - Analyze the functions in state variable form and in Phase plane.
- CO4 - Analyze the describing functions.
- CO5 - Solve for observability and controllability.
- CO6 - Compute stability test and analysis.

TEXT / REFERENCE BOOKS

1. K. P. Mohandas, "Modern Control Engineering", Sanguine Technical Publishers, 2006.
2. G. J. Thaler, "Automatic Control Systems", Jaico Publishing House, 1993.
3. M.Gopal, "Modern Control System Theory", New Age International Publishers, 2002.
4. William S Levine, "Control System Fundamentals: The Control Handbook", CRC Press, Taylor and Francis Group, 2011.
5. AshishTewari, "Modern Control Design with Matlab and Simulink", John Wiley, New Delhi, 2002.
6. K. Ogata, "Modern Control Engineering", 4th Edition, PHI, New Delhi, 2002.
7. T. Glad and L. Ljung, "Control Theory –Multivariable and Non-Linear Methods", Taylor & Francis, 2002.
8. D.S.Naidu, "Optimal Control Systems", First Indian Reprint, CRC Press, 2009.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN**Max. Marks: 100****Exam Duration: 3 Hrs.****PART A:** 10 Questions of 2 marks each-No choice**20 Marks****PART B:** 2 Questions from each unit of internal choice, each carrying 16 marks**80 Marks**

SEIA3004	SOFT COMPUTING TECHNIQUES	L	T	P	Credits	Total Marks
		3	*	0	3	100

COURSE OBJECTIVES

- To learn the key aspects of Neural networks, Fuzzy logic components and building block hypothesis of Genetic algorithm.
- To adopt these techniques in solving problems in the real world.

UNIT 1 INTRODUCTION TO SOFT COMPUTING AND ARTIFICIAL NEURAL NETWORKS**9 Hrs.**

Evolution of Computing - Soft Computing Constituents - From Conventional AI to Computational Intelligence - Machine Learning Basics, Fundamentals of ANN - Biological Neurons and Their Artificial Models - Types of ANN - Properties - Different Learning Rules - Types of Activation Functions - Training of ANN - Hebb learning - Perceptron Model (Both Single & Multi Layer) - Training Algorithm - Problems Solving Using Learning Rules and Algorithms - Linear Separability – Limitation.

UNIT 2 DETERMINISTIC AND STATISTICAL NETWORKS**9 Hrs.**

Back Propagation Training Algorithm - Practical Difficulties - Counter Propagation Network - Structure & Operation - Training of Kohonen and Grossberg Layer - Applications of BPN & CPN - Statistical Method – Training Application - Boltzman Training - Cauchy Training - Hop Field Network and Boltzman Machine - Speed Energy Function - Network Capacity - RBF Network, BAM, Architecture of SOM, ANN based water level controller.

UNIT 3 FUZZY LOGIC**9 Hrs.**

Introduction to Fuzzy Set Theory - Basic Concepts of Fuzzy Sets - Classical Set Vs Fuzzy Set - Properties of Fuzzy Set - Fuzzy Logic Operation on Fuzzy Sets - Fuzzy Logic Control Principles - Fuzzy Relations - Fuzzy Rules - Defuzzification - Fuzzy Inference Systems - Fuzzy Expert Systems - Fuzzy Decision Making.

UNIT 4 FUZZY LOGIC CONTROLLER AND ITS APPLICATION**9 Hrs.**

Fuzzy Logic Controller - Fuzzification Interface - Knowledge Base- Decision Making Logic – Defuzzification Interface- Application of Fuzzy Logic to Water Level Controller - Temperature Controller - Control of Blood Pressure during Anaesthesia. Introduction to Neuro - Fuzzy Systems - Fuzzy System Design Procedures - Fuzzy Sets and Logic Background - Fuzzy / ANN Design and Implementation.

UNIT 5 GENETIC ALGORITHMS**9 Hrs.**

Introduction - Robustness of Traditional Optimization and Search Techniques - The goals of optimization - Survival of the Fittest - Fitness Computations - Cross over - Mutation - Reproduction- Rank method- Rank space method.

Max. 45 Hrs.**COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1 - Understand the concept of ANN, Fuzzy Logic, Genetic Algorithm.
- CO2 - Illustrate the types of ANN, fuzzification and defuzzification techniques.
- CO3 - Select the appropriate techniques for applications.
- CO4 - Compare the different techniques.
- CO5 - Judge the various techniques in different types of applications.
- CO6 - Plan for implementation of ANN, FL, GA based control.

TEXT / REFERENCE BOOKS

- Laurene Fausett, "Fundamentals of Neural Networks: Architectures, Algorithms and Applications", 2008.
- Timothy J. Ross, "Fuzzy Logic with Engineering Applications", McGraw - Hill International Editions, 2004.
- Jang J.S.R., Sun C.T. and Mizutani E, "Neuro-Fuzzy and soft computing", Pearson Education, 2003.
- Rajasekaran. S, Pai. G.A.V. "Neural Networks, Fuzzy Logic and Genetic Algorithms", Prentice Hall of India, 2003.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN**Max. Marks: 100****PART A:** 10 Questions of 2 marks each-No choice**PART B:** 2 Questions from each unit of internal choice, each carrying 16 marks**Exam Duration: 3 Hrs.****20 Marks****80 Marks**

SEIA3006	ROBOTICS AND AUTOMATION	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To introduce basic concepts of various dynamics processes.
- To educate on the effect of various power sources and sensors.
- To impart knowledge on the manipulators, grippers and robot dynamics.

UNIT 1 BASIC CONCEPTS**9 Hrs.**

Origin & various generation of Robots - Robot definition - Robotics system components - Robot classification Coordinate frames - Asimov's laws of robotics - degree of freedom - dynamic stabilization of robots.- work volume. Need for Automation - types of automation - fixed, programmable and flexible automation.

UNIT 2 POWER SOURCES AND SENSORS**9 Hrs.**

Hydraulic, pneumatic and electric drives - determination of HP of motor and gearing ratio - variable speed arrangements - path determination - micro machines in robotics - machine vision - ranging - laser - acoustic - magnetic, fiber optic and tactile sensors.

UNIT 3 MANIPULATORS, ACTUATORS, GRIPPERS AND ROBOT DYNAMICS**9 Hrs.**

Construction of manipulators - manipulator dynamics and force control - electronic and pneumatic manipulator control circuits - end effectors - various types of grippers - design considerations. Introduction to Robot Dynamics - Lagrange formulation - Newton Euler formulation - Properties of robot dynamic equations.

UNIT 4 KINEMATICS AND PATH PLANNING**9 Hrs.**

Forward Kinematics – Denavit Hartenberg Representation- multiple solution jacobian work envelop, Inverse Kinematics - Geometric approach- Hill climbing techniques.

UNIT 5 PROGRAMMING LANGUAGES AND APPLICATIONS**9 Hrs.**

Robot programming - Fixed instruction, sequence control, General programming language, Specific programming languages. Robots for welding, painting and assembly - Remote Controlled robots - robots in manufacturing and non-manufacturing applications - Robots for nuclear and chemical plants.

Max. 45 Hrs.**COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1 - Understand the concepts of Robotics.
- CO2 - Define the laws of robotics and identify the types.
- CO3 - Classify the different types of sensors and summarize the techniques of image processing.
- CO4 - Choose the type of gripper as per requirement and explain the dynamics of robots.
- CO5 - Compare the different kinematic techniques.
- CO6 - Develop a robot

TEXT / REFERENCE BOOKS

1. Mikell P. Weiss G.M., Nagel R.N., Odraj N.G., "Industrial Robotics", McGraw-Hill Singapore, 1996.
2. Ghosh, "Control in Robotics and Automation: Sensor Based Integration", Allied Publishers, Chennai, 1998.
3. Deb.S.R., "Robotics technology and flexible Automation", John Wiley, USA 1992.
4. Asfahl C.R., "Robots and Manufacturing Automation", John Wiley, USA 1992.
5. Klafter R.D., Chmielewski T.A., Negin M., "Robotic Engineering - An integrated approach", Prentice Hall of India, New Delhi, 1994.
6. McKerrow P.J. "Introduction to Robotics", Addison Wesley, USA, 1991.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN**Max. Marks: 100****Exam Duration: 3 Hrs.****PART A :** 10 Questions of 2 marks each-No choice**20 Marks****PART B :** 2 Questions from each unit of internal choice, each carrying 16 marks**80 Marks**

SEIA3007	INSTRUMENTATION IN AEROSPACE AND NAVIGATION	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To introduce the basics and technical aspects of aerospace and navigation.
- To describe the principle and working of aircraft and aerospace vehicle systems and instruments, their related sensors and navigation aids.
- To provide knowledge on flight simulation, instrumentation and control concepts with their major faults.

UNIT 1 AIR CRAFT AND AEROSPACE VEHICLE INSTRUMENTATION**9 Hrs.**

Air data instruments: altimeter, air speed rate of climb - gyroscopic instruments - turn and bank indicator - artificial horizon - directional Gyro Schuler Tuning, Stable Platform - Introduction to Auto pilots - integrated flight instruments - altitude compensation.

UNIT 2 GPS AND SENSORS**7 Hrs.**

GPS - propulsion controls - Sun sensors - Horizon sensors - Star tracker - Stabilization controls.

UNIT 3 RADIO NAVIGATION AIDS AND FLIGHT INSTRUMENTATION AND CONTROL**10 Hrs.**

Automatic direction finder - distance measuring equipments - instruments landing system - visual omni range - radar - optical instruments - engine instruments and control - pressure measurements - thermal meter control tachometer - accelerometer - smoke and fire detection - propeller controls - twin blade control - cabin pressure and temperature.

UNIT 4 AIR CRAFT FLIGHT SIMULATION INSTRUMENTATION**9 Hrs.**

Basic description of a flight simulator - Solution of Aerodynamics equations- simulation of abnormal conditions - Jet engine power plant troubles - Flight controls and auto pilot troubles, Simulation - Simulation of difficult conditions-- Weapons System trainer- Need for realism – Instrumentation.

UNIT 5 FAULTS IN AEROSPACE VEHICLE**10 Hrs.**

Hydraulic systems troubles - landing gear troubles - cabin conditioning troubles - indication of unsafe canopy - Boeing condition - Radio troubles - Separate generator - System troubles - Trouble indicator light - Advantages of instrumented flight - Black box and its use.

Max. 45 Hrs.**COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1 - Know about the various aircraft instruments.
- CO2 - Understand GPS and Sensors.
- CO3 - Implementing various Radio Navigation aids.
- CO4 - Find faults in aerospace vehicle.
- CO5 - Realize the flight simulation and instrumentation concepts.
- CO6 - Formulate the design for flight instrumentation and control.

TEXT / REFERENCE BOOKS

1. Chris Binnis, "Aircraft Systems: Instruments, Communications, Navigation and Control", John Wiley & Sons, 2018.
2. Mike Tooley and David Wyatt, "Aircraft communication and Navigation systems", Routledge, Second edition, 2017.
3. Pallett E.G.H., "Aircraft Instrumentation and Integrated Systems", Longman Scientific and Technical, 1992.
4. Nagaraja N.S., "Elements of Electronic Navigation", Tata McGraw Hill Publishing Ltd., New Delhi, 1975.
5. Douglas M. Considine and Ross. S.D. "Handbook of Applied Instrumentation", McGraw Hill, 1965.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN**Max. Marks: 100****Exam Duration: 3 Hrs.****PART A:** 10 Questions of 2 marks each-No choice**20 Marks****PART B:** 2 Questions from each unit of internal choice, each carrying 16 marks**80 Marks**

SIC1311	BIOMEDICAL INSTRUMENTATION	L	T	P	Credits	Total Marks
		3	0	0	3	100

UNIT 1 ELECTROPHYSIOLOGY**8 hrs**

Cell and Its Structure – Electrical, Mechanical and Chemical Activities – Action and Resting Potential- Organization of Nervous System – CNS – PNS – Neurons – Axons- Synapse – Propagation of Electrical Impulses along the Nerve- Sodium Pump – Cardio Pulmonary System- Physiology of Heart, Lung, Kidney

UNIT 2 BIO POTENTIAL ELECTRODES AND TRANSDUCERS**8 hrs**

Design of Medical Instruments – Components of Biomedical Instrument System – Electrodes: Micro Electrodes, Needle Electrodes, Surface Electrodes – Instrumentation amplifier - Biomedical Measurements like PH, PCO₂, PO₂ of Blood, Isolation Amplifier, Preamplifier, Current Amplifier, Chopper Amplifier

UNIT 3 INSTRUMENTS USED FOR DIAGNOSIS**10 hrs**

ECG, Einthoven Triangle, Leads, Electrodes, Vector Cardiograph, Measurement of Cardiac Output, EEG, EMG, Plethysmography, Blood Flow Measurements, Holter Monitor- Respiratory Rate Measurement – Oximeter, Patient Monitoring System, ICCU

UNIT 4 MODERN IMAGING SYSTEM**10 hrs**

Ultrasonic Diagnosis, Ultrasonic Scanning, Isotopes in Medical Diagnosis- Pace Makers, Defibrillators, Doppler Monitor(colour), Medical imaging-X-ray generation, Radiographic & Fluoroscopic Techniques – Image Intensifiers-Computer Aided Tomography, PET, SPECT- Laser Applications-Echocardiography-CT Scan-MRI/NMR- Endoscopy

UNIT 5 RECENT TRENDS & INSTRUMENTS FOR THERAPY**9 hrs**

Dialysers – Surgical Diathermy – Electro Anaesthetic and Surgical Techniques. Sources of Electric Hazards and Safety Techniques. Single Channel Telemetry, Multi channel Telemetry, Implantable Telemetry, Wireless Telemetry, Telemedicine, Telemedicine Applications

Max.45 Hrs**COURSE OUTCOMES:**

On completion of this course, students are able to

CO1	Recall the structure of cell, physiology of different biological systems and their functions
CO2	Interpret the types of electrodes and measurements of biological parameters
CO3	Analyze diagnostic instruments, therapeutic instruments and imaging systems

CO4	Compare and contrast suitable medical imaging equipments used for diagnostic purposes
CO5	Evaluate the working of modern therapeutic equipment's and telemedicine which would enable to create novel biomedical device
CO6	Design and develop novel therapeutic and diagnostic biomedical equipments

TEXT / REFERENCE BOOKS:

1. LeslieCromwell, FredJ. Werbell and Eruch A. Pfeigger, "Biomedical Instrumentation and Measurements" 2nd Edition, 2000.
2. Handbook of Biomedical Instrumentation by R. S. Khandpur, Tata McGraw Hill, 2003
3. M. Arumugam, "Biomedical Instrumentation", Anuradha Publications, Reprint 2009
4. J.G. Webster, "Medical Instrumentation Application and Design", John Wiley & Sons, 2010
5. R. Anandanatarajan, "Biomedical Instrumentation and Measurements", PHI Learning Pvt.Ltd- 2011

END SEMESTER EXAMINATION QUESTION PAPER PATTERN**Max. Marks: 100****Exam Duration: 3 hrs****Part A:** 10 questions of 2 marks each -No choice**20 Marks****Part B:** 2 questions from each unit with internal choice, each carrying 16 marks**80 Marks**

SIC1308	INDUSTRIAL UNIT OPERATIONS (For EIE)	L	T	P	Credits	Total Marks
		3	0	0	3	100

UNIT 1 OVERVIEW OF UNIT OPERATIONS 9 Hrs.

Introduction to industrial processes - Concepts of unit operations and unit processes - Material balance and energy balance - Types of reactions - General idea of controlling operations

UNIT 2 TRANSPORT OF SOLIDS, LIQUIDS AND GASES 9 Hrs.

Study of Unit operation in Transport of Solids, liquids and gases, Different crushers and grinders, Adjusting of particle size, Mixing, Separation, Leaching and extraction

UNIT 3 DISTILLATION, CHEMICAL REACTORS, STEAM BOILERS, FURNACES 9 Hrs.

Study of Unit operation in Distillation: Flash distillation, Batch distillation, Continuous distillation, Operational features, construction and working principle of Chemical reactors, Steam boilers, Furnaces.

UNIT 4 DRYERS, CRYSTALLIZERS, EVAPORATORS 9 Hrs.

Study of Unit operation in Dryers, Crystallization, Evaporators, Heat exchangers, Humidification, De-humidification - Different types - operational features, construction and working principle

UNIT 5 PUMPS, COMPRESSORS, EXTRUDERS, BLOWERS, CENTRIFUGES 9 Hrs.

Study of Unit operation in Pumps, Compressors, Extruders, Blowers, Centrifuges - operational features, construction and working principle

Max. 45 Hours**COURSE OUTCOMES:**

On completion of this course, students are able to

CO1.	Analyze the different controlling action
CO 2.	Analyze the unit operations in transportation of solids, liquids and gases
CO 3.	Analyze the unit operations in different processes
CO 4.	Demonstrate the working principle and operation of different processes
CO 5.	Compare the unit operations of distillation columns, reactors, boilers furnaces, compressors, etc
CO6	Design of the various unit operations in different processes

TEXT / REFERENCE BOOKS

- McCabe W.L.Smith, J.C.Peter Harriot, Unit operation of chemical engineering, McGraw Hill Inc., 1993
- Levenspiel O, Chemical Reaction Engineering. Wiley, 1972
- Robert H.Perry and Don Green Perry, Perry's Chemical Engineers' Handbook, 8th Edition, 2007
- B.G.Liptak, Instrumentation Engineers Hand book: Process Measurement and Process control,

END SEMESTER EXAM QUESTION PAPER PATTERN**Max. Marks: 100****PART A:** 10 Questions of 2 marks each-No choice**PART B:** 2 Questions from each unit of internal choice, each carrying 16 marks**Exam Duration: 3 Hrs.****20 Marks****80 Marks**

SIC1306	CONTROL ENGINEERING (For EIE)	L	T	P	Credits	Total Marks
		3	1	0	4	100

UNIT 1 REVIEW OF MATRICES**12 Hrs.**

Review of matrices - co-ordinate transformation - Concept of State equation of Dynamic Systems - Eigen values and Eigen vectors - matrix diagonalization - Cayley Hamilton theorem - state transition matrix - Eigen Values and State transitions matrix

UNIT 2 STATE SPACE ANALYSIS**12 Hrs.**

State space analysis - state space formulation - state space representation of control systems described by scalar differential equation - state variable - transformation of state space equation, physical, phase & canonical variable, state space models - state space representation for discrete time system.

UNIT 3 PHASE VARIABLE MATRIX.**12 Hrs.**

Jordan and canonical forms, controllability and observability - condition for controllability and observability, Gilbert method and Kalman decomposition - design of state feedback by pole placement. Controllable phase variable form, observable phase variable form, reduced order observer - full order observer - reducibility, irreducibility, transfer function matrix, impulse response functions, Matlab programming Controllability and observability

UNIT 4 NON-LINEAR SYSTEM ANALYSIS**12 Hrs.**

Non-linear systems - properties of non linear system - describing function for simple non linearity's like on-off, dead zone and saturation - describing function analysis of non linear systems - Limit cycles - phase plane method - basic concept - singular points - constructing phase plane trajectory for linear and nonlinear second order systems - Isocline method

UNIT 5 DESIGN OF DISCRETE TIME CONTROL SYSTEM (FOR DISCRETE SYSTEM)**12 Hrs.**

Sampled data theory - Sampling process - Sampling theorem, Sample and hold circuits - Zero Order Hold
Z-Transform - Theorems on Z-Transforms - Inverse Z-Transforms - Discrete systems and solution of difference equation using Z transform - Pulse transfer function - Response of sampled data system to step and ramp input, Stability studies - Jury's test, bilinear transformation, Schur Cohn Stability

Max. 60 Hours**COURSE OUTCOMES:**

On completion of the course, students are able to

CO1	Apply mathematical concepts of matrices to understand the state equation of dynamic systems
CO2	Analyze the state space representation and transformation of state space equation
CO3	Evaluate the observability & controllability and design the full order & reduced order observers
CO4	Analyze the non-linear systems & construct the phase trajectories

CO5	Analyze the response sampled data system for various inputs
CO6	Analyze the stability of the discrete systems

TEXT/ REFERENCE BOOKS

1. Gopal.M, “Modern Control Theory”, 2nd Edition, Wiley Eastern Publishers, 1993.
2. Tou.T.J. “Modern Control Theory”, McGraw Hill publications, 1964.
3. Ogata.K.H, “State Space Analysis of Control Systems”, Prentice Hall Publications, 1967.
4. Nagrath I.J. & Gopal.M, “Control Systems Engineering”, 2nd Edition, Wiley & Sons, 1985
5. Nagroor Kani “Advanced Control system”, McGraw Hill publications, 1964.
6. Deshpande P.B. & Ash R.H, “Elements of Computer Process Control”, Instrument Society of America 1981.

END SEMESTER EXAM QUESTION PAPER PATTERN**Max. Marks : 100****Exam Duration : 3 Hrs.****PART A :** 10 Questions of 2 marks each-No choice**20 Marks****PART B :** 2 Questions from each unit of internal choice, each carrying 16 marks**80 Marks**

SEC1309	MICROCONTROLLERS AND EMBEDDED SYSTEMS (For EIE)	L	T	P	Credits	Total Marks
		3	0	0	3	100

UNIT 1 ARCHITECTURE OF 8051**9****Hrs.**

Comparison of Microprocessor and Microcontroller - Block diagram of Microcontroller -Architecture of 8051- Pin details of 8051 - Memory Organization of 8051 - Special function registers - Interfacing of external Memory- I/O Ports- Oscillator and Clock - Timer - Interrupts - Serial Port.

UNIT 2 INSTRUCTION SET OF 8051**8 Hrs.**

Addressing modes of 8051- **Instruction set of 8051** - Classification of 8051 Instructions - Data transfer instructions - Arithmetic Instructions - Logical instructions -Branching instructions - Bit Manipulation Instructions - Simple programs with 8051.

UNIT 3 PIC MICROCONTROLLER**10 Hrs.**

PIC Microcontrollers and Instruction Set: PIC Micro-controllers - overview; features, PIC-18Fxxx architecture, file selection register, Memory organization, Addressing modes, Instruction set, Interrupt handling. PIC-18Fxxx - Reset, low power operations, oscillator connections, **I/O ports - serial; parallel, Timers, Interrupts, ADC.**

UNIT 4 INTRODUCTION TO EMBEDDED SYSTEM**10****Hrs.**

Embedded system- characteristics of embedded system- categories of embedded system- requirements of embedded systems- challenges and design issues of embedded system- trends in embedded system- system integration- hardware and software partition- applications of embedded system - control system and industrial automation-biomedical-data communication system-network information appliances- IVR systems- GPS systems.

UNIT 5 EMBEDDED SOFTWARE DEVELOPMENT AND TOOLS**8 Hrs.**

Software architectures, Round - Robin, Round-Robin with Interrupts, Function Queue Scheduling architecture, Introduction to assembler - Compiler -Cross compilers and Integrated Development Environment IDE, Linker/ Locators, Simulators, Getting Embedded software into target System- Debugging Strategies.

Max. 45 Hours**COURSE OUTCOMES:**

On completion of the course, students are able to

CO1	Analyze the internal architecture and operations of microcontroller related to industrial and performance-oriented logics and techniques
CO2	Analyze various addressing modes and instruction set of microcontrollers to structure the programming skills
CO3	Examine the various microcontrollers and to select appropriate controller, based on the performance requirements and implementation
CO4	Demonstrate various software development tools used to design embedded systems
CO5	Develop embedded system for real time applications

CO6	Evaluate various assembly language programs based on computation complexity to address Real-World Problems
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TEXT / REFERENCE BOOKS

1. Mazidi & McKinlay, "The 8051 Microcontroller and Embedded Systems using Assembly and C", PHI.
2. Myke Predko, "Programming and Customizing the 8051 Micro-controller", Tata McGraw-Hill edition.
3. R A Gaonkar, "Fundamentals of Microcontrollers and Applications in Embedded Systems (with the PIC18 Microcontroller Family)", Penram Publishing India.
4. Kenneth Ayala, "The 8051 Microcontroller", 3rd Edition, Thomson Delmar Learning, 2004.
5. Kenneth J. Ayala, Dhananjay V. Gadre, "The 8051 Microcontroller & Embedded Systems Using Assembly and C", Cengage Learning India Publication.
6. Ajay V Deshmukh, "Microcontrollers: Theory and Applications", Tata McGraw-Hill, 2005.
7. K.V. Shibu, "Introduction To Embedded Systems", Tata McGraw, 2009.
8. Raj Kamal, "Embedded Systems Architecture, Programming, and Design". (2/e), Tata McGraw Hill, 2008.
9. Technical references on www.mikroe.com.
10. Technical references on www.microchip.com.

END SEMESTER EXAM QUESTION PAPER PATTERN**Max. Marks : 100****Exam Duration : 3 Hrs.****PART A :** 10 Questions of 2 marks each-No choice**20 Marks****PART B :** 2 Questions from each unit with internal choice, each carrying 16 marks**80 Marks**

SIC1307	PROCESS CONTROL INSTRUMENTATION TECHNOLOGY (For EIE)	L	T	P	Credits	Total Marks
		3	0	0	3	100

UNIT 1 MATHEMATICAL MODELING OF PROCESSES**9 Hrs.**

Introduction of Process control - Need for Process Control, Elements of process control system, Process variables, Degrees of Freedom, Process Lag - Mathematical model of first order Liquid level, pressure and thermal processes - Higher order process - Response of Interacting and Non-Interacting liquid level systems - Dynamic system with dead time and Inverse response - Concept of servo and regulator operation.

UNIT 2 CHARACTERISTICS OF PROCESS CONTROLLERS**9 Hrs.**

Basic control modes - Characteristics and Response of On-Off, Proportional, Integral, Derivative control modes - Composite control modes - Characteristics and Response of P+I, P+D and P+I+D control modes - Pneumatic and Electronic controllers to realize various control actions - Integral windup - Control Lag - Selection of Control modes for Different processes.

UNIT 3 CONTROLLER TUNING & ADVANCED CONTROL LOOP SCHEMES**9 Hrs.**

Evaluation criteria - IAE, ISE, ITAE and 1/4 Decay ratio - Types of Controller tuning - Process reaction curve method, Ziegler Nichols I and II method

Control loop Schemes - Feed forward control, Cascade control, Ratio control, Split-range control, Adaptive control, Inferential control and Multivariable control - Interaction of control loops, Non interacting control loops, Relative gain array, Concepts of De-coupler.

UNIT 4 PROCESS CONTROL INSTRUMENTS AND ITS CHARACTERISTICS**9 Hrs.**

I/P and P/I Converter - Final control element - Pneumatic, electric and hydraulic actuator - Valve positioner, Control valves - Characteristics of control valve - Inherent and installed characteristics - Types of control valve Globe, Butterfly valves, Diaphragm and Ball valve - Control valves sizing - Cavitations and flashing in control valves, Selection criteria.

UNIT 5: DIGITAL CONTROL ALGORITHMS FOR PROCESS CONTROL**9 Hrs.**

Design of Deadbeat Algorithm, Dahlin's Algorithm, Kalman's Estimation - Predictive Controller - MPC - Linear and Nonlinear - Smith Predictor Algorithm.

**Max. 45
Hours**

COURSE OUTCOMES:

On completion of the course, students are able to

CO1	Formulate the mathematical of first order and second order process
CO2	Evaluate the proper mode and type of controllers for major processes
CO3	Apply Tuning techniques to tune PID parameters and to provide control schemes to a process.
CO4	Analyze the characteristics of control valves and actuators
CO5	Design the controller for the process using Deadbeat and Dahlin's Algorithm
CO6	Develop digital controller for linear and nonlinear problems for various applications

TEXT / REFERENCE BOOKS

1. Stephanopoulos C, "Chemical Process Control", Prentice Hall of India Pvt Ltd, 2005
2. Eckman. D.P, "Automatic Process Control", Wiley Eastern Ltd, 1972.
3. Curtis D Johnson, "Process Control Instrumentation Technology", John Wilsey & Sons, 2004.
4. Deshpande P.B. & Ash R.H, "Elements of Computer Process Control", Instrument Society of America 1981.
5. Shanthi Sasidharan, "Computer Control of Process", CBA Publishers, 2011. 6
- Harriot. P., "Process Control", Tata McGraw Hill, 1984.
7. B.G.Liptak, "Instrumentation in Process Industries", Vol. 1 & 2, Chilton Book & Co. 1974.
8. Coughanowr. D.R., "Process System Analysis and Control", 2nd Edition, John Wiley & Sons, 1991.
9. Shinskey. F.G., "Process Control System", 3rd Edition, McGraw Hill, 1991.
10. Liptak. B.G., "Process Control", Chilton Book & Co, 2001

END SEMESTER EXAM QUESTION PAPER PATTERN**Max.Marks :100****Exam Duration : 3 Hrs.****PART A :** 10 Questions of 2 marks each-No choice**20 Marks****PART B :** 2 Questions from each unit of internal choice, each carrying 16marks**80 Marks**

SIC4053	PROCESS CONTROL LAB (For EIE)	L	T	P	Credits	Total Marks
		0	0	4	2	100

SUGGESTED LIST OF EXPERIMENTS

1. Characteristics of I/P converter and P/I converter.
2. Characteristics of Control valve.
3. Study and control of a Level process using ON-OFF, P, PI, PD, PID controllers.
4. Study and control of a Pressure process using ON-OFF, P, PI, PD, PID controllers.
5. Study and control of a Flow process using ON-OFF, P, PI, PD, PID controllers.
6. Study and control of a Temperature process using ON-OFF, P, PI, PD, PID controllers.
7. Verification of logic gates using PLC.
8. Study of DCS.
9. Cascade Control.
10. Ratio Control.
11. Interacting and Non-Interacting System.
12. Tuning of Controller using Ziegler- Nicholas Method.

COURSE OUTCOMES:

On completion of the course, student will be able to

CO1	Apply the basic principle in control valve and I/P to determine its characteristics
CO2	Test for interfacing techniques using PID level and pressure process
CO3	Test for interfacing techniques using PID based Temperature and flow process
CO4	Analyze various modes of operations using PLC and DCS in real world applications
CO5	Determine transfer function and predict the response of Cascade and Ratio control using MATLAB
CO6	Develop Tuning of Parameters for real word application and determine the transfer function for Interacting and non-interacting system

SIC1404	INSTRUMENTATION IN INDUSTRIES (For EIE)	L	T	P	Credits	Total Marks
		3	0	0	3	100

UNIT 1 OVERVIEW DESCRIPTION OF INDUSTRIAL PROCESSES**11 Hrs.**

Description of process in Paper Industries Description of process in petrochemical industries: Description of process in iron and steel and mining industries - Description of process in pharmaceutical and nuclear industries.

UNIT 2 INSTRUMENTATION IN PAPER INDUSTRIES**7 Hrs.**

Measurement of Basic weight, thickness, density, Porosity, smoothness, softness, hardness and compressibility; selection of suitable measurement hardware for flow, pressure, level, temperature, density, solids, consistency - moisture analyzers oxidation - reduction potential and pH.

UNIT 3 INSTRUMENTATION IN PETROCHEMICAL INDUSTRIES**7 Hrs.**

P & I diagram of petroleum refinery, measurement and control of absolute pressure, density, conductivity, differential pressure and flow of evaporators. Measurement and control of column pressure, liquid distillate, vapour distillate.

UNIT 4 INSTRUMENTATION IN IRON AND STEEL AND MINING INDUSTRIES 11 Hrs. Iron and steel:

Selection of suitable measurement hardware for temperature, pressure, level, flow, weighing and proportioning - special gauges for measurement of thickness and shape

Mining Industry: Weighing - conveyor belts - metal detectors - level sensors - nuclear density detectors - flow meters, Coal analyzer - thermogravimetry - gross calorific value - total sulphur analysis - ash analyser - online monitor- air quality monitoring- Sampling of ambient air - general air sampling system - Flue gas oxygen analyzer - analysis of impurities in feed water and steam - dissolved oxygen analyzer - chromatography - pH Meter - pollution monitoring instruments

UNIT 5 INSTRUMENTATION IN PHARMACEUTICAL, NUCLEAR & POWER PLANT INDUSTRIES 9 Hrs.

Pharmaceutical Industries: Flow measurement - pressure measurement - smoke detector

Nuclear Industries: Radiation detection instruments - Area monitors and in-place detectors - Temperature measuring devices - level sensors

Power Plant Industries: Metal temperature measurements, flow of feed water - fuel, air, steam with correction factor for temperature and pressure

Max. 45 Hours**COURSE OUTCOMES:**

On completion of the course, student will be able to

CO1	Analyze various basic operations in various industrial processes.
CO2	Evaluate several measurements of the process parameters of Paper Industries
CO3	Analyze the measurements of the process parameters of petrochemical Industries
CO4	Develop a process parameters of Steel and Mining Industries
CO5	Analyze the characteristics measurements of the process parameters of Pharmaceutical Industries

CO6	Develop solutions of the process parameters of Nuclear and Power Plant Industries
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TEXT / REFERENCE BOOKS

1. Liptak B G, "Instrumentation in the processing industries", Chilton book Company, 1973.
2. Considine D. M., "Process/Industrial Instruments and control Handbook", McGraw Hill, 5th edition 1999.
3. Hower P. Kallen, "Hand Book of Instrumentation and Control", Tata McGraw Hill, 1961.
4. Liptak B G, "Instrument Engineer's Handbook, Vol. 2: Process Control and Optimization", CRC Press, 2006.
5. Baskara Rao, "Petrochemicals", Khanna Publishers, New Delhi, 1987.
6. Liptak B.G, "Process Measurement and Analysis", Third Edition, Chilton Book Co., 2003
7. Considine D.M, "Hand Book of Applied Instrumentation", Tata McGraw Hill, 1984

END SEMESTER EXAM QUESTION PAPER PATTERN**Max. Marks : 100****Exam Duration : 3 Hrs.****PART A :** 10 Questions of 2 marks each-No choice**20 Marks****PART B :** 2 Questions from each unit of internal choice, each carrying 16 marks**80 Marks**

SIC1406	PROCESS CONTROL SYSTEM COMPONENTS (For EIE)	L	T	P	Credits	Total Marks
		3	1	0	4	100

UNIT 1 FLOW AND TEMPERATURE SYSTEM**12 Hrs.**

Orifice meter - design of orifice for given flow condition - rotameter - design of rotameter - Transmitters
Pneumatic transmitter, Electronic transmitter, intelligent transmitter - signal conditioning for RTD - Zero and span adjustment in D/P transmitters and temperature transmitters

UNIT 2 PRESSURE AND LEVEL SYSTEM**12 Hrs.**

Pressure Relieving devices Functions - Relief valve - safety valves - safety relief valves - Pilot operated relief valves - Bourdon gauges - design of Bourdon tube - Design of Air purge system for level measurement. Electronic P
+ I + D controllers - design - adjustment of set point, bias and controller settings.

UNIT 3 CONTROL VALVES**12 Hrs.**

Control valves -Necessity-Comparison with other final control elements- valve characteristics - Control valve parameters control valve capacity-valve range ability-valve size-valve gain - Selection criteria - Control valve sizing Procedure-Cavitations& flashing in control valve.

UNIT 4 PUMPS**12 Hrs.**

Types of pumps - pump - performance - pipe work calculation - characteristics of different pumps - pump operation maintenance - instruments used in pumping practice pump noise and vibration - selection of pumps.

UNIT 5 LOGIC CIRCUIT**12 Hrs.**

Design of logic circuits for alarm and annunciator circuits, interlocks - design of microprocessor based PID controller.

Max. 60 Hours**COURSE OUTCOMES:**

On completion of the course, student will be able to

CO1	Apply various PLC systems on controller.
CO2	Analyze the various application of PLC system and function.
CO3	Evaluate the Distributed control system and PLC architectures
CO4	Evaluate the communication facilities and application and operator interfaces
CO5	Analyze the characteristics Basic building blocks of Computer controlled systems.
CO6	Develop solutions SCADA and data acquisition System various applications.

TEXT / REFERENCE BOOKS

1. Anderson. N.A., "Instrumentation for Process Measurement and Control", Chilton Company, 1980, 3rd Edition, 1997, CRC Press
2. Considine D.M., "Process Instruments and Controls Handbook", McGraw Hill Book Co. 1985, McGraw Hill Professional, 5th Edition, 1999
3. Warring. R.H., "Pumping Manual", Gulf Publishing Co., 1984.
4. Johnson. C.D., "Process Control Instrumentation Technology", Prentice Hall Inc. 7th Edition, 2002.
5. Terry Bartelt, "Instrumentation and Process Control", Nov.28, 2006, Delmar Cengage Learning.
6. Donald. P. Eckman, "Automatic Process Control", Wiley Eastern Ltd., New Delhi, 1993.
7. www.amiestudy.com, www.loremate.com

END SEMESTER EXAM QUESTION PAPER PATTERN**Max. Marks : 100****Exam Duration : 3 Hrs.****PART A :** 10 Questions of 2 marks each-No choice**20 Marks****PART B :** 2 Questions from each unit of internal choice, each carrying 16 marks**80 Marks**

SIC4056	INDUSTRIAL INSTRUMENTATION LAB (For EIE)	L	T	P	Credits	Total Marks
		0	0	4	2	100

SUGGESTED LIST OF EXPERIMENTS

1. Level Measurement using DPT.
2. Flow Measurement using Orifice and Venturimeter.
3. Calibration of Thermocouple.
4. Calibration of Pressure Transmitter.
5. Torque Measurement.
6. Viscosity Measurement.
7. UV Visible Spectrophotometer.
8. IR Spectrophotometer.
9. Vacuum Pressure Measurement.
10. Conductivity Meter Calibration and Measurements of conductivity of test solutions.
11. pH meter standardization and measurement of pH Values of test solutions.
12. Radiation Pyrometer and IR Thermometer.

COURSE OUTCOMES:

On completion of the course, student will be able to

CO1	Apply the various application of the rheology of fluids
CO2	Evaluate the industrial process parameters such as flow, level, temperature, pressure and viscosity.
CO3	Analyze PH, conductivity, UV absorbance and transmittance.
CO4	Evaluate the problems of regarding sensors and transmitter.
CO5	Develop a concept of Spectrophotometer
CO6	Design suitable of standardization and measurement of pH Values of test solutions

SEC4082	LINEAR AND DIGITAL INTEGRATED CIRCUITS LAB (For EIE)	L	T	P	Credits	Total Marks
		0	0	4	2	100

SUGGESTED LIST OF EXPERIMENTS

LINEAR INTEGRATED CIRCUITS

1. Characteristics of Operational amplifier
2. Applications of Operational amplifier: Integrator and Differentiator.
3. Design and testing of square and triangular waveform generators using Op-amps
4. Design and testing of Precision Rectifier.
5. Design and testing of Low pass and high Pass Filters.
6. Design and testing of a 4 bit D/A Converter.

DIGITAL INTEGRATED CIRCUITS

1. Design and testing of an half adder and fulladder
2. Design and testing of 1 bit comparator using logic gates.
3. Design and testing of 4 bit shift register
4. Design and testing of 4 : 2 Encoder and 2 :4 decoder
5. Design and testing of binary to gray and gray to binary code converter.

COURSE OUTCOMES:

On completion of the course, students are able to

CO1	Apply mathematical concepts for understanding the behavior of Operational amplifier
CO2	Analyze the functioning of various analog circuits
CO3	Design filter circuits using Op Amp for Real World applications
CO4	Implement the D/A converters using IC741
CO5	Design and test the combinational logic circuits.
CO6	Design the digital circuits for various applications

SIC4052	MEASUREMENTS AND TRANSDUCERS LAB (For EIE)	L	T	P	Credits	Total Marks
		0	0	4	2	100

SUGGESTED LIST OF EXPERIMENTS

1. Measurement of Medium Resistance Using Wheatstone's Bridge
2. Measurement of Low Resistance Using Kelvin's Double Bridge
3. Measurement of Capacitance Using Schering's Bridge
4. Measurement of Inductance Using Anderson's Bridge
5. Characteristics of Potentiometric transducer.
6. Strain Gauge characteristics Load
7. cell characteristics Characteristics of
8. LVDT Characteristics of Thermocouple
9. Temperature measurement using resistive principle Hall
10. Effect Transducer
11. Measurement of speed by using stroboscope

COURSE OUTCOMES:

On completion of the course, students are able to

CO1	Apply mathematical concepts for understanding the various bridges
CO2	Analyze the functioning of various bridges
CO3	Implement the passive transducers for the measurement of displacement and temperature
CO4	Implement the active transducers for the measurement of temperature
CO5	Develop the active & passive transducers various measurements.
CO6	Design the transducers for real world applications

SIC4057	SYSTEM DESIGN LAB (For EIE)	L	T	P	Credits	Total Marks
		0	0	4	2	100

SUGGESTED LIST OF EXPERIMENTS**MATLAB**

1. Design of Digital Controller using Deadbeat Algorithm.
2. Design of Digital Controller using Dahlin's Algorithm.
3. Design of Digital Controller using Kalman's Algorithm.
4. Design of Fuzzy logic Controller .
5. Design of Neural Network .
6. Design of Model Predictive Controller.

LABVIEW

7. Building VI to demonstrate conversion of Centigrade to Fahrenheit and
8. Building VI to create a subroutine for conversion of Centigrade to Fahrenheit.
9. Building VI for analyzing and logging of data.
10. Building VI to demonstrate waveform generator.
11. Building VI to demonstrate error clusters and handling.
12. Building VI to design multimeter.
13. Building VI to demonstrate ON-OFF controller.

COURSE OUTCOMES:

On completion of the course, student will be able to

CO1	Apply the concept of Digital Controller Algorithm
CO2	Apply MATLAB conventions and "good" programming practices
CO3	Design a control hardware in team-based design projects
CO4	Evaluate the basic VI to demonstrate conversion of Centigrade to Fahrenheit
CO5	Evaluate the logging of data and waveform generator
CO6	Apply various VI ON-OFF controller

SIC1405	LOGIC AND DISTRIBUTED CONTROL SYSTEMS (For EIE and E&C)	L	T	P	Credits	Total Marks
		3	0	0	3	100

UNIT 1 BASICS OF PROGRAMMABLE LOGIC CONTROLLER (PLC)**9 Hrs.**

Definition- overview of PLC systems - Input/ Output modules - Power supplies - I/O slots, General PLC programming procedures - programming on-off outputs, Auxiliary commands and functions - creating ladder diagrams from process control descriptions - Ladder logic for traffic light control system. PLC basic programming - digital logic Gates - Boolean algebra. Basic PLC functions - register basics - timer functions - counter functions.

UNIT 2 PLC INTERMEDIATE FUNCTIONS**11 Hrs.**

Arithmetic functions - number comparison functions - skip and MCR functions - data move systems. PLC Advanced intermediate functions - utilizing digital bits - sequencer functions - PLC Advanced functions: alternate programming languages - operation. PLC-PID functions - PLC installation - trouble shooting and maintenance - controlling a robot - processes with PLC - design of inter locks and alarms using PLC. Use of PC as PLC - Application of PLC - Case Study of Bottle Filling System, Field Bus and HART Protocol

UNIT 3 DISTRIBUTED CONTROL SYSTEMS (DCS)**9 Hrs.**

Evolution of DCS - building blocks - different architectures - comparison of architectures - detailed descriptions and functions of local control units - basic elements & functions - operator stations - data highways - redundancy concepts.

UNIT 4 DISTRIBUTED CONTROL SYSTEMS: COMMUNICATION FACILITIES AND APPLICATIONS**9 Hrs.**

DCS communication Facilities - communication system requirements - architectural issues - protocol issues - communication system standards - operator interfaces - low level and high level operator interfaces - Operator Displays - Engineering interfaces - low level and high level engineering interfaces - Applications of DCS - oil and gas (extraction, production and storage)

UNIT 5 COMPUTER CONTROLLED SYSTEMS**7 Hrs.**

Basic building blocks of Computer controlled systems - SCADA - data acquisition System - supervisory Control - Direct digital Control - software - Velocity algorithm & Position algorithm

Max. 45 Hours**COURSE OUTCOMES:**

On completion of the course, student will be able to

CO1	Apply various PLC systems on controller.
CO2	Analyze the various application of PLC system and function.
CO3	Evaluate the Distributed control system and PLC architectures
CO4	Evaluate the communication facilities and application and operator interfaces

CO5	Analyze the characteristics Basic building blocks of Computer controlled systems.
CO6	Develop solutions SCADA and data acquisition System various applications.

TEXT / REFERENCE BOOKS

1. John Webb, W, Ronald Reis, A.,: "Programmable Logic Controllers Principles and Applications", 3rd Edition, Prentice hall Inc., New Jersey, 1995.
2. Krishna Kant, "Computer based Industrial Control", Prentice Hall India. 1997.
3. Lucas, M.P.,: "Distributed Control Systems", Van Nostrand Reinhold Co., New York, 2nd Edition, 1986
4. Petruzella., "Programmable Logic Controllers" 3rd Edition, Tata McGraw Hill, Newyork.
5. Hughes, T. "Programmable Logic Controllers", ISA Press 1994. 4th Edition.
6. Mckloni, D.T. "Real Time Control Networks", ISA Press 1994.

END SEMESTER EXAM QUESTION PAPER PATTERN**Max.Marks:100****Exam Duration : 3 Hrs.****PART A :** 10 Questions of 2 marks each-No choice**20 Marks****PART B :** 2 Questions from each unit of internal choice, each carrying 16 marks**80 Marks**

SIC1310	THEORY OF ROBOTICS	L	T	P	Credits	Total Marks
		3	0	0	3	100

UNIT 1 BASIC CONCEPTS**9 hrs**

Origin & various generation of Robots - Robot definition - Robotics system components - Robot classification
 Coordinate frames - Asimov's laws of robotics - degree of freedom - dynamic stabilization of robots - work volume. Need for
 Automation - types of automation - fixed, programmable and flexible automation

UNIT2 POWER SOURCES AND SENSORS**9 hrs**

Hydraulic, pneumatic and electric drives - determination of HP of motor and gearing ratio - variable speed
 arrangements - path determination - micro machines in robotics - machine vision - ranging - laser - acoustic - magnetic,
 fiber optic and tactile sensors

UNIT3 MANIPULATORS, ACTUATORS, GRIPPERS and ROBOT DYNAMICS**9 hrs**

Construction of manipulators - manipulator dynamics and force control - pneumatic electronic and manipulator control
 circuits - end effectors - various types of grippers - design considerations. Introduction to Robot Dynamics - Lagrange
 formulation - Newton Euler formulation - Properties of robot dynamic equations

UNIT4 KINEMATICS AND PATH PLANNING**9 hrs**

Forward Kinematics – Denavit Hartenberg Representation. Multiple solution Jacobian work envelopes, Inverse
 Kinematics - Geometric approach. Hill climbing techniques

UNIT5 PROGRAMMING LANGUAGES AND APPLICATIONS**9 hrs**

Robot programming - Fixed instruction, sequence control, General programming language, programming languages.
 Robots for welding, painting and assembly - Remote Controlled robots - robots in manufacturing and non- manufacturing
 applications - Robots for nuclear and chemical plants

COURSE OUTCOMES:

On completion of this course, students are able to

CO1	Apply the basic concepts for Robotic technology and selection of automation methods
CO2	Analyze different types of drives and sensors used in real world problems
CO3	Improve the various technology for sustainable built environment using manipulators, grippers and actuators
CO4	Evaluate different smart manufacturing technologies for industrial robotics based automation using Kinematic Techniques

CO5	Compare various advanced programming techniques for development of Robots
CO6	Build Robotic technology for Industry, Nuclear and Chemical Plants

TEXT / REFERENCE BOOKS:

1. Mikell P. Weiss G.M., Nagel R.N., Odraj N.G., "Industrial Robotics", McGraw-Hill Singapore, 1996
2. Ghosh, "Control in Robotics and Automation: Sensor Based Integration", Allied Publishers, Chennai, 1998
3. Deb.S.R. "Robotics technology and flexible Automation", John Wiley, USA 1992
4. Asfahl C.R., "Robots and Manufacturing Automation", John Wiley, USA 1992
5. Klafter R.D., Chimielewski T.A., Negin M., "Robotic Engineering - An integrated approach", Prentice Hall of India, New Delhi, 1994
6. McKerrow P.J. "Introduction to Robotics", Addison Wesley, USA, 1991.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN**Max. Marks: 100****Exam Duration: 3 hrs****Part A:** 10 questions of 2 marks each -No choice**20 Marks****Part B:** 2 questions from each unit with internal choice, each carrying 16 marks**80 Marks**

SIC1305	ELECTRONIC MEASUREMENTS AND INSTRUMENTATION (For EIE and E&C)	L	T	P	Credits	Total Marks
		3	0	0	3	100

UNIT 1 MEASURING INSTRUMENTS AND WAVEFORM GENERATORS**9 Hrs.**

Review of DC and AC voltmeter and Ammeter, Ohmmeter, Range Extension, Electronic Multimeters, Types of Voltmeters - Differential type, true RMS type, Vector voltmeter, Signal Generator - Audio and function generators - Pulse Generator, RF signal Generator, Frequency Synthesizer, Arbitrary Waveform Generator, Noise generators -- Pattern generator - Wobblscope

UNIT 2 DATA CONVERTORS AND CONNECTORS**9 Hrs.**

ADC and DAC - Specifications, ADC Quantization Error, Types of ADC - Flash, Counter, Successive Approximation, Dual- Slope types and Introduction to Delta-Sigma, Types of DAC - Weighted-Resistor, R-2R ladder and PWM type, ADC and DAC Problems

Probes and Connectors - Probes, Test Leads, Shielded Cables, Connectors, Low Capacitance Probes, High Voltage Probes, Current Probes, Special Probes for ICs.

UNIT 3 ANALYZERS AND DIGITAL INSTRUMENTS**9 Hrs.**

Wave Analyzer, Spectrum Analyzer and Distortion Analyzer, Measurement of Frequency and Time, Decimal Counting Assemblies, Frequency Counter, Period Counter, Counter Errors, Inherent errors, signal related errors, Digital Voltmeters, Digital Multimeters, Computer based digital instruments, IEEE 488 GPIB instruments

UNIT 4 DATA ACQUISITION AND OSCILLOSCOPES**9 Hrs.**

Data acquisition system, Data loggers, Problems in signal acquisition, Interference and screening, Grounding and Guarding Techniques

Introduction- Oscilloscope Block Diagram, Cathode Ray Tube, CRT Circuits, Vertical Deflection System, Triggered sweep, CRO specifications, CRO controls, measurements on CRO, Storage CRO, Digital Storage Oscilloscope, Sampling Oscilloscope

UNIT 5 VIRTUAL INSTRUMENTATION**9 Hrs.**

Virtual instrumentation - Definition, flexibility - Block diagram and architecture of virtual instruments - Virtual instruments versus traditional instruments -LabVIEW software and Hardware, VI programming techniques - VI, sub VI, loops and charts, arrays, clusters and graphs, case and sequence structures, formula nodes, string and file input / output. LabVIEW applications in Electronic Instrumentation

**Max. 45
Hours****COURSE OUTCOMES:**

On completion of the course, student will be able to

CO1	Analyze various characteristics of measurement instruments and waveform generators
CO2	Analyze the working principles of Analog to Digital & Digital to Analog Convertors
CO3	Analyze the working of wave analyzers and digital instruments
CO4	Analyze the techniques of data acquisition and the working of Oscilloscopes
CO5	Design a suitable instrument for an application
CO6	Develop an instrument to measure electrical and electronic parameters

TEXT/ REFERENCE BOOKS

1. Sawhney A.K, "A Course in Electrical and Electronics Measurements and Instrumentation", 18th Edition, Dhanpat Rai & Company Private Limited, 2007.
2. Golding. E. W, and Widdis F.C, "Electrical Measurements and Measuring Instruments", 5th Edition, A.H. Wheeler & Company, 2003.
3. Kalsi.H.S, "Electronic Instrumentation", 2nd Edition, Tata McGraw Hill Company, 2004.
4. Copper. W.D and Helfrick. A.D, "Modern Electronic Instrumentation and Measurement Techniques", 5th Edition, Prentice Hall of India, 2002

END SEMESTER EXAM QUESTION PAPER PATTERN**Max. Marks : 100****Exam Duration : 3 Hrs.****PART A :** 10 Questions of 2 marks each-No choice**20 Marks****PART B :** 2 Questions from each unit of internal choice, each carrying 16 marks**80 Marks**

SIC1613	INDUSTRIAL SAFETY MANAGEMENT (For EIE)	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

To educate on the safety, safety considerations and safety management systems in industries and to handle the complex industrial environment

To prevent accidents and pollution

UNIT 1 FIRE AND EXPLOSION 9 Hrs.

Introduction - Industrial processes and hazards potential, mechanical, thermal and process hazards. Shock wave propagation, vapor cloud and boiling liquid expanding vapors explosion (VCE and BLEVE), mechanical and chemical explosion, multiphase reactions, transport effects and global rates.

UNIT 2 RELIEF SYSTEMS 9 Hrs.

Preventive and protective management from fires and explosion - inerting, ventilation, and sprinkling, proofing, relief systems - relief valves, flares, scrubbers.

UNIT 3 TOXICOLOGY 9 Hrs.

Hazards identification - toxicity, fire, static electricity, noise and dust concentration - Material safety data sheet, -hazards indices - Dow and Mond indices, hazard operability (HAZOP) and hazard analysis (HAZAN).

UNIT 4 ELECTRICAL SAFETY 9 Hrs.

Primary and secondary hazards, shocks, burns, falls, human safety, capacity and protection of conductor - joints and connections, overload and short circuit protection - no load protection - earth fault protection - system grounding - equipment grounding maintenance of ground - ground fault circuit interrupter - safety in handling hand held electrical appliances tools and medical equipments.

UNIT 5 SAFETY MANAGEMENT 9 Hrs.

Evaluation of modern safety concepts - safety management functions - safety Organization, safety department - safety committee - safety audit - general safety considerations in power plants, pressure vessels and pressurized pipe lines - operation and inspection of extinguishers - preventing the spread of fire - emergency exit facilities.

Max. 45 Hours

TEXT / REFERENCE BOOKS

1. Fordham Coper, W. "Electrical Safety Engineering" Butterworth and Company, London, 1986
2. Blake Roland.P, "Industrial safety", Prentice Hall of India, 1973.
3. John.V.Grimaldi and Rollin. H Simonds, "Safety Management", All India traveler book seller, New Delhi - 1989.
4. Krishnan N.V, "Safety in Industry", Jaico Publisher House, 1996.
5. Crowl D.A. and Louvar J.F., "Chemical Process Safety: Fundamentals with Applications", 2nd Ed., Prentice Hall.2001.
6. John V Grimaldi, "Safety Management", AITB publishers, 2003.
7. Mannan S., "Loss Prevention in the Process Industries", Vol. I, 3rd Edition, Butterworth - Heinemann, 2004
8. Noel de Nerves, "Air Pollution Control Engineering", McGraw Hill Book Co., 2000.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100

Exam Duration : 3 Hrs.

PART A : 10 Questions of 2 marks each-No choice

20 Marks

PART B : 2 Questions from each unit of internal choice, each carrying 16 marks

80 Marks

SIC1614	SOFT COMPUTING TECHNIQUES (For EIE and E&C)	L	T	P	Credits	Total Marks
		3	0	0	3	100

UNIT 1 INTRODUCTION TO SOFT COMPUTING AND ARTIFICIAL NEURAL NETWORKS 9 Hrs.

Evolution of Computing - Soft Computing Constituents - From Conventional AI to Computational Intelligence - Machine Learning Basics, Fundamentals of ANN - Biological Neurons and Their Artificial Models - Types of ANN - Properties - Different Learning Rules - Types of Activation Functions - Training of ANN - Hebb learning - Perceptron Model (Both Single & Multi Layer) - Training Algorithm - Problems Solving Using Learning Rules and Algorithms - Linear Separability – Limitation.

UNIT 2 DETERMINISTIC & STATISTICAL NETWORKS 11 Hrs.

Back Propagation Training Algorithm - Practical Difficulties - Counter Propagation Network - Structure & Operation - Training of Kohonen and Grossberg Layer - Applications of BPN & CPN - Statistical Method - Training Application - Boltzman Training - Cauchy Training - Hop Field Network and Boltzman Machine - Speed Energy Function - Network Capacity - RBF Network, BAM, Architecture of SOM, ANN based water level controller.

UNIT 3 FUZZY LOGIC 9 Hrs.

Introduction to Fuzzy Set Theory - Basic Concepts of Fuzzy Sets - Classical Set Vs Fuzzy Set - Properties of Fuzzy Set - Fuzzy Logic Operation on Fuzzy Sets - Fuzzy Logic Control Principles - Fuzzy Relations - Fuzzy Rules - Defuzzification - Fuzzy Inference Systems - Fuzzy Expert Systems - Fuzzy Decision Making.

UNIT 4 FUZZY LOGIC CONTROLLER & ITS APPLICATION 9 Hrs.

Fuzzy Logic Controller - Fuzzification Interface - Knowledge Base - Decision Making Logic - Defuzzification, Interface - Application of Fuzzy Logic to Water Level Controller - Temperature Controller - Control of Blood Pressure during Anesthesia. Introduction to Neuro - Fuzzy Systems - Fuzzy System Design Procedures - Fuzzy Sets and Logic Background - Fuzzy / ANN Design and Implementation.

UNIT 5 GENETIC ALGORITHMS 9 Hrs.

Introduction - Robustness of Traditional Optimization and Search Techniques - The goals of optimization - Survival of the Fittest - Fitness Computations - Cross over - Mutation - Reproduction - Rank method - Rank space method.

Max. 45 Hours

COURSE OUTCOMES:

On completion of the course, student will be able to

CO1	Comprehend the concept of ANN.
CO2	Design and compare the various ANN algorithm
CO3	Illustrate the basic concepts of fuzzification and defuzzification techniques
CO4	Analyze the various FLC techniques in different types of applications
CO5	Illustrate the concept of Genetic Algorithm
CO6	Explain the mutation and reproduction techniques in Genetic Algorithm

TEXT / REFERENCE BOOKS

1. Laurene Fausett, "Fundamentals of Neural Networks", Pearson Education, 2003
2. Timothy J. Ross, "Fuzzy Logic with Engineering Applications", McGraw- Hill International Editions, 1995
3. George J. Klir and Bo Yuan, "Fuzzy sets and Fuzzy Logic", Prentice Hall, USA 1995.
4. Jang J.S.R., Sun C.T. and Mizutani E, "Neuro-Fuzzy and soft computing", Pearson Education 2003
5. David E. Goldberg, "Genetic Algorithms in Search, Optimization and Machine Learning", Addison Wesley, 1997. 27
6. Rajasekaran. S, Pai. G.A.V. "Neural Networks, Fuzzy Logic and Genetic Algorithms", Prentice-Hall of India, 2003

END SEMESTER EXAM QUESTION PAPER PATTERN**Max. Marks : 100****Exam Duration: 3 Hrs.**

PART A : 10 Questions of 2 marks each-No choice

20 Marks

PART B : 2 Questions from each unit of internal choice, each carrying 16 marks

80 Marks

SEC1302	ANALOG INTEGRATED CIRCUITS	L	T	P	Credits	Total Marks
		3	0	0	3	100

UNIT1 INTRODUCTION TO OP-AMP AND ITS APPLICATIONS**9 hrs**

OP-AMP– DC and AC Characteristics- Input offset voltage- Input bias current-Input offset current- Total output offset voltage- Thermal drift- Slew rate- CMRR -Inverting amplifier- Non-inverting amplifier- Voltage follower- Summing and differential amplifier- Integrator- Differentiator- Logarithmic and Anti logarithmic amplifiers-Comparator and Schmitt trigger

UNIT 2 FILTERS AND SIGNAL GENERATORS**9 hrs**

First order and Second order Butterworth filters- low pass, high pass, band pass and band reject filters–RC phase shift, Wein's bridge oscillator- Astable and Monostable multivibrator-Precision half wave and full wave rectifiers

UNIT3 A/D AND D/A CONVERTERS**9 hrs**

Sample and Hold circuit – Digital to analog converters: R-2R ladder network and Binary weighted – Characteristics of D/A converters – Analog to digital converters: Flash converter – Successive approximation converter – Dual slope ADC.

UNIT4 PLL AND TIMER CIRCUITS**9 hrs**

Phase Locked Loop IC 565– Block schematic – Applications of PLL: FM demodulator and Frequency synthesizer-FSK Demodulator- VCO IC LM 566 – Timer IC LM 555 and its applications: Astable and Monostable multivibrator

UNIT5 SPECIAL FUNCTION ICs**9 hrs**

Integrated circuit Tuned amplifier, Instrumentation Amplifier, Series and shunt voltage regulator, Opto coupler, CMOS Operational Amplifier- Dc analysis- small signal analysis- specifications of IC MC 14573

COURSE OUTCOMES:

On completion of the course, students are able to

CO1	Analyze the impact of DC and AC characteristics of operational amplifiers on output and their compensation techniques.
CO2	Design the linear and non-linear circuits with op-amp for specific applications
CO3	Design filters and various amplifiers circuits for Real World Problems
CO4	Evaluate the performance of op-amp and IC 555 multivibrators
CO5	Design data converters for interfacing sensors with electronic circuits

CO6	Develop op-amp based circuits for resolving problems in communication adhering to standards

TEXT / REFERENCE BOOKS:

1. D.Roy Choudary, Shail Jain, Linear Integrated Circuits, New Age International Pvt. Ltd., 2000
2. Grey and Meyer, Analysis and Design of Analog Integrated Circuits, 4th Edition, Wiley International, 2001
3. Sergio Franco, "Design with Operational Amplifiers and Analog Integrated Circuits", 3rd Edition, Tata Mc Graw-Hill, 2007
4. S.Salivahanan, V.S.KanchanaBhaaskaran, "Linear integrated circuits", 3rd Edition, McGraw-Hill, 2011
5. William D.Stanely, Operational Amplifiers with Linear Integrated Circuits, 4th Edition, Pearson Education, 2004
6. D.Choudhari, S. Jain "Linear Integrated Circuits", New Age International (P) limited, 4th edition, 2010
7. Sedra A. S. and K. C. Smith, Microelectronic Circuits, 6/e, Oxford University Press, 2013

END SEMESTER EXAMINATION QUESTION PAPER PATTERN**Max. Marks: 100****Exam Duration: 3 hrs****Part A:** 10 questions of 2 marks each -No choice**20 Marks****Part B:** 2 questions from each unit with internal choice, each carrying 16 marks**80 Marks**

SIC1601	INSTRUMENTATION IN AEROSPACE & NAVIGATION (For EIE and E&C)	L	T	P	Credits	Total Marks
		3	0	0	3	100

UNIT 1 AIR CRAFT AND AEROSPACE VEHICLE INSTRUMENTATION**9 Hrs.**

Air data instruments: altimeter, air speed rate of climb - gyroscopic instruments - turn and back indicator - artificial horizon - directional Gyro Schuler Tuning, Stable Platform - Introduction to Auto pilots - integrated flight instruments - altitude compensation.

UNIT 2 GPS AND SENSORS**7 Hrs.**

GPS - propulsion controls - Sun sensors - Horizon sensors - Star tracker - Stabilization controls

UNIT 3 RADIO NAVIGATION AIDS AND FLIGHT INSTRUMENTATION AND CONTROL**10 Hrs.**

Automatic direction finder - distance measuring equipments - instruments landing system - visual omni range - radar - optical instruments - engine instruments and control - pressure measurements - thermal meter control - tachometer - accelerometer - smoke and fire detection - propeller controls - twin blade control - cabin pressure and temperature.

UNIT 4 AIR CRAFT FLIGHT SIMULATION INSTRUMENTATION**9 Hrs.**

Basic description of a flight simulator - Solution of Aerodynamics equations - simulation of abnormal conditions - Jet engine power plant troubles - Flight controls and auto pilot troubles, Simulation - Simulation of difficult conditions - Weapons system trainer - Need for realism - Instrumentation.

UNIT 5 FAULTS IN AEROSPACE VEHICLE**10 Hrs.**

Hydraulic systems troubles - landing gear troubles - cabin conditioning troubles - indication of unsafe canopy - Boeing condition - Radio troubles - Separate generator - System troubles - Trouble indicator light - Advantages of instrumented flight - Black box and its use.

Max. 45 Hours**COURSE OUTCOMES:**

On completion of the course, student will be able to

CO1	Illustrate the working of various aircraft instruments.
CO2	Explain different sensors and GPS.
CO3	Apply the concept of measurement and control in various devices used in flights
CO4	Describe the flight simulation and instrumentation concepts.
CO5	Discuss the diverse faults in aerospace vehicle
CO6	Compare the advantages of Instrumented flight

TEXT / REFERENCE BOOKS

1. Pallett E.G.H., "Aircraft Instrumentation and Integrated Systems", Longman Scientific and Technical, 1992
2. Nagaraja N.S., "Elements of Electronic Navigation", Tata McGraw Hill Publishing Ltd., New Delhi, 1975.
3. Douglas M. Considine and Ross. S.D. Handbook of Applied Instrumentation, McGraw Hill, 1965.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN**Max. Marks: 100****Exam Duration: 3 hrs****Part A:** 10 questions of 2 marks each -No choice**20 Marks****Part B:** 2 questions from each unit with internal choice, each carrying 16 marks**80 Marks**

SIC1605	FIBRE OPTICS AND LASER INSTRUMENTATION	L	T	P	Credits	Total Marks
		3	0	0	3	100

UNIT 1 OPTICAL FIBRES AND THEIR CHARACTERISTICS**9 hrs**

Quantum nature of light, optical laws and definitions- Principles of light propagation through a fiber -optical fiber modes, configurations and their properties-fiber materials-fiber fabrication vapor phase oxidization - fiber characteristics - Absorption losses - Scattering losses - Dispersion - Connectors and splicers - fiber termination

UNIT 2 OPTICAL SOURCES, DETECTORS AND SENSORS**9 hrs**

Characteristics-LED structures: Surface Emitting LED- Double Heterojunction LED, Basic concepts of Laser. Optical Detectors: PN Photo diode, Avalanche photo diode, PIN diode, Photo transistor, Photo thyristors, Photo thermistor, opto- couplers, optrodes, modulators. Fibre optic sensors - Fiber optic instrumentation system - Interferometric method of measurement of length - Moire fringes - Measurement of pressure and temperature

UNIT 3 LASER FUNDAMENTALS**9 hrs**

Laser Diode Rate Equation - External Quantum Efficiency- Resonant Frequencies - Three level and four level lasers Properties of laser -Laser modes - Resonator configuration - Q-switching and mode locking - Cavity damping - Types of lasers - Gas lasers, Solid lasers, Liquid lasers, Semiconductor lasers, Non-semiconductor lasers - The Nd:YAG laser and glass fiber lasers

UNIT 4 LASER APPLICATIONS**9 hrs**

Optical transmitter and Receiver designs - Laser for measurement of distance, length, velocity, acceleration, current, voltage and atmospheric effect - material processing - Laser heating, welding, melting and trimming of materials - Removal and vaporization

UNIT 5 HOLOGRAM AND MEDICAL APPLICATION**9 hrs**

Holography- Basic principle - methods - Holographic Interferometer and application - Holography for non-destructive testing - Holographic Components - Medical applications of lasers, laser and tissue interactive - Laser instruments for surgery, tumor, vocal chords, brain surgery, plastic surgery, gynecology and oncology

Max. 45 hrs**COURSE OUTCOMES:**

On completion of the course, students are able to-

CO1	Describe the basic laws of light, types of optical fiber, and characteristics of fiber
CO2	Report the working of Optical sources, detectors, sensors and Laser
CO3	Compare and contrast different types of Laser

CO4	Justify the selection of appropriate optical fibers and Laser in various fields
CO5	Apply the knowledge of laser devices for medicinal application
CO6	Apply principle of holography in various fields.

TEXT / REFERENCE BOOKS

1. Senior J.M, "Optical Fibre Communication - Principles and Practice", Prentice Hall of India, 1985.
2. Wilson J and Hawkes J.F.B, "Introduction to Opto Electronics", Prentice Hall of India, 2001.
3. Keiser G, "Optical Fibre Communication", McGraw Hill, 1995.
4. Arumugam M, "Optical Fibre Communication and Sensors", Anuradha Agencies, 2002.
5. John F. Read, "Industrial Applications of Lasers", Academic Press, 1978.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN**Max. Marks: 100****Exam Duration: 3 hrs****Part A:** 10 questions of 2 marks each -No choice**20 Marks****Part B:** 2 questions from each unit with internal choice, each carrying 16 marks**80 Marks**

SIC1304	ANALYTICAL INSTRUMENTATION (For EIE and E&C)	L	T	P	Credits	Total Marks
		3	0	0	3	100

UNIT 1 pH, CONDUCTIVITY & DISSOLVED COMPONENT ANALYSER**9 Hrs.**

Conductivity meters - pH meters - dissolved oxygen hydrogen analyser - sodium analyser - silica analyser and Sampling systems.

UNIT 2 GAS ANALYSER**9 Hrs.**

Thermal conductivity - thermal analyser - type Oxygen analyser - CO monitor - NOx analyser - H2S analyser - dust and smoke measurement.

UNIT 3 CHROMATOGRAPHY**9 Hrs.**

Gas chromatography - liquid chromatography -- high-pressure liquid chromatography - principles, types and applications detectors.

UNIT 4 SPECTRO PHOTOMETERS**9 Hrs.**

Spectral methods of analysis - Beer's law UV - visible spectrophotometers - single beam and double beam instruments - source and detectors - IR spectrophotometers - sources and detectors - FTIR spectrometers - atomic absorption spectrophotometer - flame emission spectrophotometers - sources of flame photometry - applications ESR, EPR spectroscopy - TOF spectrometer - Introduction to x-ray spectroscopy

UNIT 5 PRINCIPLE OF NUCLEAR MAGNETIC RESONANCE**9 Hrs.**

NMR - basic principle - NMR spectrometers - Applications - Introduction to mass spectrophotometer - Nuclear radiation detectors - GM counter - proportional counter - solid state detectors -.

Max. 45 Hours**COURSE OUTCOMES:**

On completion of the course, student will be able to

CO1	Illustrate the application of pH meter, conductivity meter and dissolved component analyser
CO2	Describe the working of gas analyser
CO3	Select the type of chromatography for a separation
CO4	Explain the working of different spectrophotometers
CO5	Explain the working of NMR spectrometer
CO6	Apply the NMR spectrometer to detect nuclear radiation, GM counter.

TEXT / REFERENCE BOOKS

1. Hobart H. Willard, Lynne L. Merrit, John A. Dean, Frank A. Settle, "Instrumental Methods of Analysis", 7th Edition, CBS Publishing & Distribution, 1986.
2. Jain R.K, "Mechanical & Industrial Measurements", Khanna Publishers, 11th Edition, 2004
3. Khandpur R.S, "Handbook of Analytical Instruments", II Edition, Tata McGrawHill, New Delhi, 2006.
4. Gurdeep R. Chatwal, Sham.K. Anand, "Instrumental methods of Chemical Analysis" Himalaya Publishing house, Reprint 2006.
5. Robert D. Braun, "Introduction to Instrumental Analysis", Pharma Book Syndicate, Hyderabad, Reprint 2006.
6. Douglas.A. Skoog, F. James Holker, Stanley R. Gouch, "Instrumental Analysis", CEngage Learning India, India Edition 2008.

END SEMESTER EXAM QUESTION PAPER PATTERN**Max. Marks : 100****Exam Duration : 3 Hrs.****PART A :** 10 Questions of 2 marks each-No choice**20 Marks****PART B :** 2 Questions from each unit of internal choice, each carrying 16 marks**80 Marks**

SIC1611	FUNDAMENTALS OF MECHATRONICS (For EIE, E&C and EEE)	L	T	P	Credits	Total Marks
		3	0	0	3	100

UNIT 1 INTRODUCTION**9 Hrs.**

Mechatronics: Definition & Key Issues - Evolution - Elements - Mechatronics Approach to Modern Engineering, Industrial design and safety Design.

UNIT 2 SENSORS AND TRANSDUCERS**9 Hrs.**

Introduction and background, difference between transducer and sensor, transducers types, transduction principle, photoelectric transducers- thermistors, thermodevices, thermocouple, inductive transducers capacitive transducers, piezoelectric transducers, piezoelectric transducers. Hall Effect transducers, Fiber optic transducers, Signal Processing - Data Display.

UNIT 3 ACTUATION SYSTEMS**9 Hrs.**

Introduction to Mechanical Types and Electrical Types - Pneumatic & Hydraulic Systems - Applications - Selection of Actuators, Kinematics of robot manipulator links.

UNIT 4 DIGITAL AND CONTROL SYSTEMS**9 Hrs.**

Digital logic neuron system, Types of Controllers - Programmable Logic Controllers - applications - ladder diagrams - Microprocessor Applications in Mechatronics: Temperature measurement system, Domestic washing machine - Programming Interfacing - Computer Applications: CNC drilling machine

UNIT 5 RECENT ADVANCES**9 Hrs.**

Manufacturing Mechatronics - Automobile Mechatronics - Medical Mechatronics - Office Automation - Case Studies

Max. 45 Hours

COURSE OUTCOMES:

On completion of the course, student will be able to

CO1	Illustrate the approach of Mechatronics to engineering concepts
CO2	Classify the different types of sensors, transducers.
CO3	Select an actuator and use of robot kinematics.
CO4	Apply the different control techniques for a process.
CO5	Comprehend the applications of mechatronics in the fields of automobile, robotics, medicine, manufacturing, office automation through case studies.
CO6	Apply the knowledge of mechatronics in various industries

TEXT / REFERENCE BOOKS

1. Bolton. W “Mechatronics: Electronic Control System for Mechanical & Electrical Engineering”, 2nd Edition Pearson Education, 2004.
2. Ramachandran. K.P, Vijaya Raghavan. G.K, Mechatronics, A.R.S. Publications, Second Edition, 2008.
3. Bradley.D.A, Dawson.D, Burd. N.C, Loader. A.J “Mechatronics: Electronics in Products and Processes” Nelson Publisher, 2004.
4. Michael B. Hstand & David G. Alciators, “Introduction to Mechatronics & Measurement systems”, McGraw-Hill International Editions, 1998
5. Dan Neculescu, “Mechatronics”, Pearson Education, 2005. Bishop, Robert H, "Mechatronics Hand book", CRC Press, 2002.

END SEMESTER EXAM QUESTION PAPER PATTERN**Max. Marks : 100****Exam Duration :3Hrs.**

PART A : 10 Questions of 2 marks each-No choice

20 Marks

PART B : 2 Questions from each unit of internal choice, each carrying 16 marks

80 Marks

SE E 1305	POWER ELECTRONICS (For EEE, ECE, EIE and E&C)	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

To understand the various applications of electronic devices for conversion and control of the electrical power.

UNIT 1 POWER SEMICONDUCTOR DEVICES**9 Hrs.**

Overview of V-I characteristics of switching devices - Switching characteristics of Power Diode, BJT power MOSFETS, IGBT and Thyristor - SCR Protection circuits - Thyristor Turn-ON methods - firing circuits - Commutation techniques.

UNIT 2 PHASE CONTROLLED RECTIFIERS**10 Hrs.**

Principle of phase controlled converter operation - single phase half wave converter, semi converter & full converter with R, RL & RLE load - Freewheeling diode - Inverter operation of full converter - Three phase Semi converter & full converter with RL load.

UNIT 3 DC & AC CHOPPERS**9 Hrs.**

DC - DC Chopper: Principle of operation of Step down and step up choppers - Control Strategies - One, Two and Four quadrant operation.

AC - AC Chopper: Single phase AC voltage controllers with R & RL load - Multistage sequence control. Single phase step up and step down cycloconverters.

UNIT 4 INVERTERS**9 Hrs.**

Principle of operation: Single phase half bridge & full bridge voltage source inverters - Three phase Voltage source inverters (120° and 180° mode) - Single phase current source inverter. PWM techniques: Single pulse PWM, Sinusoidal PWM, Modified sinusoidal PWM and multiple PWM

UNIT 5 APPLICATIONS**8 Hrs.**

SMPS: Flyback and Push Pull - UPS: Redundant and Non-Redundant - HVDC Transmission systems - Single phase full converter fed DC drives - Inverters for standalone photovoltaic systems.

Max. 45 Hours**TEXT / REFERENCE BOOKS**

1. Rashid M.H., "Power Electronics circuits Devices and Applications", Prentice Hall, 3rd Edition, New Delhi, 2013
2. P.S.Bimbhra, "Power Electronics", Khanna Publishers, 4rd Edition, 2003
3. P.C.Sen, "Power Electronics", Tata Mc Graw Hill Company, New Delhi, 1987.
4. M.D.Singh and K.B.Khanchandani, "Power Electronics" TMH, New Delhi, 2nd Edition, 2008.
5. Dubey G.K., Doradla S.R., Joshi A and Sinha R.M., "Thyristorised Power Controllers" - Wiley Eastern Limited 1986.
6. Ned Mohan, "Power Electronics", 2nd Edition, 2001.
7. Rashid M.H., Power electronics hank book, Academics press publications., 2nd Edition, 2007

END SEMESTER EXAM QUESTION PAPER PATTERN**Max. Marks : 100****Exam Duration : 3 Hrs.****PART A :** 10 Questions of 2 marks each - No choice**20 Marks**

PART B : 2 Questions from each unit of Internal choice, each carrying 16 marks
(Distribution may be 90% Theory & 10% Numerical)

80 Marks

SICX1007	PROCESS CONTROL (Common to E&C & EIE)	L	T	P	Credits	Total Marks
		3	0	0	3	100

UNIT I INTRODUCTION TO PROCESS CONTROL**10 hrs.**

Process variable – load variables-dynamic of simple pressure, flow, level and temperature process-transient response of first order system for thermal & level process – interacting & non-interacting system – degrees of freedom – batch process and continuous process – self regulator – servo and regulator operation.

UNIT II CONTROL ACTION OF CONTROLLERS**10 hrs.**

Characteristics of On-Off, Proportional, Integral, Derivative modes – $P + I$, $P + D$ And $P + I + D$ control modes – pneumatic and electronics controller – quantitative analysis

UNIT III CONTROLLER TUNING & ADVANCED CONTROL TECHNIQUES**10 hrs.**

$\frac{1}{4}$ decay ratio, IAE, ISE, ITAE – determination of optimum setting for mathematically described process by using time response and frequency response – tuning of controller by process reaction curve method, continuous cycling method, feed forward control, cascade control, ratio control, split -range control and multivariable control – introduction to adaptive control and inferential control

UNIT IV FINAL CONTROL ELEMENTS**10 hrs.**

I/P and P/I Converter – pneumatic, electric and hydraulic actuator – valve positioner – control valves – characteristics of control valve – valve body – globe, butterfly valves – control valves sizing – cavitation, flashing in control valves

UNIT V MULTIVARIABLE CONTROL & APPLICATIONS**10 hrs.**

Piping and instrumentation diagram of loops, interaction of control loops, non interacting control loops, relative gain array – control of distillation column – control of heat exchanger.

TEXT BOOKS:

1. Stephanopoulos.C, "Chemical Process Control", Prentice Hall of India Pvt Ltd, 2004
2. Eckman D.P, "Automatic Process Control", Wiley Eastern Ltd, 1972.
3. Curtis D Johnson, "Process Control Instrumentation Technology ", John Wiley & Sons, 2004.

REFERENCE BOOKS:

1. P.Harriot, "Process Control ", Tata McGraw Hill , 1984.
2. B.G.Liptak, "Instrumentation in Process Industries ", Vol. 1 & 2, Chilton Book&Co. 1974.
3. D.R.Coughanowr, "Process System Analysis and Control", 2nd Edition, John Wiley & Sons, 1991.
4. F.G.Shinsky, "Process Control System", 3rd Edition, McGraw Hill, 1991.
5. B.G.Liptak, "Process Control", Chilton Book & Co, 2001

UNIVERSITY EXAM QUESTION PAPER PATTERN

Max.Marks : 80

Exam Duration : 3 hrs

PART A : 2 Questions from each unit, each carrying 2 marks

20 marks

PART B : 2 Questions from each unit with internal choice, each carrying 12 marks

60 marks

SECX4028	MICROPROCESSOR AND MICROCONTROLLER LAB	L	T	P	Credits	Total Marks
		0	0	4	2	100

List of experiments

1. Familiarization of 8085 trainer kit, 8086 trainer kit, 8051 trainer kit & 89C51 μ C.
2. Addition & subtraction of 8 and 16 bits using 8085.
3. Multiplication & division 8 and 16 bits using 8085
4. Interfacing of stepper motor using 8085.
5. Interfacing of traffic light using 8085.
6. Addition and subtraction of two 16 bit numbers using 8086.
7. Code converters using 8086.
8. Sorting of N numbers using 8086.
9. Arithmetic operation programs using 8051.
10. Interfacing of ADC using 8051.
11. Interfacing of DAC using 8051.
12. Addition and subtraction using 89C51.
13. Filling of internal memory using 89C51.

SICX4003	PROCESS CONTROL LAB	L	T	P	Credits	Total Marks
		0	0	4	2	100

List of experiments

1. Characteristics of I/P & DPT converter
2. Characteristics of valve (a) based on position
(b) Shape of valve body
3. Study and control of a level process using ON-OFF, P, PI, PD, PID controllers.
4. Study and control of a Pressure process using ON-OFF, P, PI, PD, PID controllers.
5. Study and control of a flow process using ON-OFF, P, PI, PD, PID controllers.
6. Study and control of a Temperature process using ON-OFF, P, PI, PD, PID controllers.
7. Verification of logic gates using PLC
8. Study of DCS
9. Cascade control
10. Study of Ratio control
11. Interacting and non- interacting system
12. Tuning of controller using Zeigler Nicholas method

SICX1010	COMPUTER CONTROL OF PROCESS (Common to E&C & EIE)	L	T	P	Credits	Total Marks
		3	0	0	3	100

UNIT I DIGITAL CONTROL SYSTEM**10 hrs.**

Need for computer in a control system- functional block diagram of a control system- direct digital control- supervisory control-scheduling control- digital control interfacing: process inputs, outputs interface-data loggers-data acquisition system- type of displays, computer – various input/outputs- computer control action- treatment of inputs, outputs, and control strategies.

UNIT II TRANSFORMS AND STABILITY ANALYSIS**10 hrs.**

Mathematical representation of sampling process- Z transform & properties- inverse Z transform-pulse transfer function-data hold sampling frequency consideration-open loop & closed loop response of sampled data control system- modified Z transform- stability of sampled data control system- stability in Z domain- Schur-Cohn stability test, bilinear transformation, Jury's test of stability.

UNIT III CONTROL ALGORITHM**10 hrs.**

Control algorithm- design of control algorithm using Z transform-dead beat algorithm - Dahlin's method-ringing Kalman's approach-PID algorithm position & velocity form- tuning the algorithm- selection of sampling time.

UNIT IV PROGRAMMABLE LOGIC CONTROLLER**10 hrs.**

PLC- configuration- ladder diagrams- relay based PLC- computer based PLC- typical control features- interlocks & alarms.

UNIT V DISTRIBUTED CONTROL SYSTEMS**10 hrs.**

DCS-different architectures - functional elements- remote electronic unit- redundancy- different methods of communication protocol network.

TEXT BOOKS:

1. Deshpande P.B. & Ash R.H, "Elements of Computer Process Control", Instrument Society of America 1981.
2. Michal.P Lucas, "Distributed Control System", Van Nostrand Reinhold & Co 1986.
3. Frank D.Petruzella, "Programmable Logic Controllers", 3rd Edition 2005.

REFERENCE BOOKS:

1. Liptak B.G, "Instrumentation in Process Industries", Vol.I &II Chilton Book Co, 1974
2. George Stephanopoulos.C, "Chemical Process Control", PHI, 2005
3. Curtis D Johnson, "Process Control Instrumentation Technology", John Wiley & Sons, 2006.
4. John.W.Webb, "Programmable Logic Controllers-Principle & Application", PHI 2007.

UNIVERSITY EXAM QUESTION PAPER PATTERN

Max.Marks : 80

Exam Duration : 3 hrs

PART A : 2 Questions from each unit, each carrying 2 marks

20 marks

PART B : 2 Questions from each unit with internal choice, each carrying 12 marks

60 marks

SICX4004	INDUSTRIAL INSTRUMENTATION LAB	L	T	P	Credits	Total Marks
		0	0	4	2	100

List of Experiments

1. Level measurement using d/p transmitter
2. Flow measurement using Orifice and Venturi meter
3. Calibration of Thermocouple
4. Calibration of Pressure transmitter
5. Torque measurement
6. Viscosity measurement
7. UV-Visible Spectrophotometer
8. IR Spectrophotometer
9. Vacuum Pressure measurement
10. Conductivity meter calibration and measurements of conductivity of test solutions.
11. pH meter standardization and measurement of pH values of test solutions
12. Radiation Pyrometer & IR Thermometer

SICX4005	SYSTEM DESIGN LAB	L	T	P	Credits	Total Marks
		0	0	4	2	100

List of Experiments

USING MATLAB

1. Design of digital controller using dead beat algorithm.
2. Design of digital controller using Dahlin's algorithm
3. Design of digital controller using Kalman's algorithm

USING VHDL

4. Implementation of Logic gates
5. Design of Half adder and Full adder

USING LAB VIEW

6. Building of VI to demonstrate conversion of Centigrade to Fahrenheit and create a subroutine for conversion of Centigrade to Fahrenheit
7. Building of VI to demonstrate software timings while loop and waveform chart.
8. Building VI for analysing and logging of data
9. Building of VI to demonstrate Multi-plot graph using waveform charts
10. Building of VI to demonstrate error clusters and handling.
11. Building of VI to stimulate simple test sequence using simple state machine architecture.
12. Building of VI to design Multimeter.

S18XPROJ	PROJECT WORK & VIVA-VOCE	L	T	P	Credits	Total Marks
		0	0	30	15	100

The objective of the project work is to make use of the knowledge gained by the student at various stages of the degree course. Students, will also be permitted to undertake industrial/consultancy project Work, outside the department, in industries/Research labs.

There shall be three assessments during the semester by a review committee. The student shall make three presentations on the progress made before the committee at various stages of the Project work. The Head of the Department shall constitute the review committee for each branch of study. The total marks obtained in the three reviews, shall be taken in to account. There will be a viva-voce examination at the end of the Project work, conducted by one internal examiner and one external examiner. The total marks secured will be the sum of marks secured in the Project reviews and Viva Voce Examination.

Each student is required to submit a Project report on the project assigned to him by the department. The report should be based on the information available in the literature or data obtained by the student by way of experiments conducted in the laboratory/industry.

SICX1015	ANALYTICAL INSTRUMENTATION (Common to EIE & E&C)	L	T	P	Credits	Total Marks
		3	0	0	3	100

UNIT I PH CONDUCTIVITY & DISSOLVED COMPONENT ANALYSER**5 hrs.**

Sampling systems – ion selective electrodes – conductivity meters – pH meters - dissolved oxygen analyser –sodium analyser – silica analyser – moisture measurement.

UNIT II GAS ANALYSER**9 hrs.**

Oxygen analyser – CO monitor – NO_x analyser – H₂S analyser – dust and smoke measurement- thermal conductivity type – thermal analyser – industrial analysers.

UNIT III CHROMATOGRAPHY**10 hrs.**

Gas chromatography – liquid chromatography – principles, types and applications – high-pressure liquid chromatography – detectors.

UNIT IV SPECTRO PHOTOMETERS**13 hrs.**

Spectral methods of analysis – Beer's law UV – visible spectrophotometers – single beam and double beam instruments – source and detectors – IR spectrophotometers – sources and detectors – FTIR spectrometers –atomic absorption spectrophotometer – flame emission spectrophotometers – sources of flame photometry –applications.

UNIT V NUCLEAR MAGNETIC RESONANCE AND RADIATION TECHNIQUES**13 hrs.**

NMR – basic principle – NMR spectrometers – applications – introduction to mass spectrophotometers –nuclear radiation detectors – GM counter – proportional counter – solid state detectors – introduction – to x-ray spectroscopy.

TEXT / REFERENCES BOOKS:

1. R.S. Khandpur, "Handbook of Analytical Instruments", 2nd Edition, Tata McGrawHill, New Delhi, 2006.
2. Gurdeep R. Chatwal, Sham.K. Anand, "Instrumental methods of Chemical Analysis" Himalaya Publishing house, Reprint 2006.
3. Hobart H. Willard, Lynne.L. Merrit, John A. Dean, Frank A.Settle, "Instrumental Methods of Analysis", 7th Edition,CBS Publishing & Distribution, 1986.
4. Robert D. Braun, "Introduction to Instrumental Analysis", Pharma Book Syndicate, Hyderabad, Reprint 2006.
5. Douglas.A. Skoog, F. James Holker, Stanley R. Gouch, "Instrumental Analysis", Cengage Learning India, India Edition 2008.
6. R.K. Jain, "Mechanical & Industrial Measurements", Khanna Publishers, 11th Edition, 2004.

UNIVERSITY EXAM QUESTION PAPER PATTERN

Max Marks : 80

Exam Duration : 3 hrs.

PART A : 2 Questions from each unit, each carrying 2 marks

20 marks

PART B : 2 Questions from each unit with internal choice, each carrying 12 marks

60 marks

SICX1009	BIOMEDICAL INSTRUMENTATION (Common to EIE, E&C, ECE, ETCE & EEE)	L	T	P	Credits	Total Marks
		3	0	0	3	100

UNIT I ELECTRO PHYSIOLOGY**10 hrs.**

Cell and Its Structure – Electrical, Mechanical and Chemical Activities – Action and Resting Potential- Organization of Nervous System – CNS – PNS – Neurons – Axons- Synapse – Propagation of Electrical Impulses along the Nerve- Sodium Pump – Cardio Pulmonary System- Physiology of Heart, Lung, Kidney.

UNIT II BIO POTENTIAL ELECTRODES AND TRANSDUCERS**11 hrs.**

Design of Medical Instruments – Components of Biomedical Instrument System – Electrodes: Micro Electrodes, Needle Electrodes, Surface Electrodes – Transducers – Piezo Electric, Ultrasonic, Passive Transducers – Resistive, Capacitive, Inductive – Biomedical Measurements Like PH, PCO₂, PO₂ of Blood, Isolation Amplifier, Preamplifier, Current Amplifier, Chopper Amplifier.

UNIT III INSTRUMENTS USED FOR DIAGNOSIS**9 hrs.**

ECG, Einthoven Triangle, Leads, Electrodes, Vector Cardiograph, Measurement of Cardiac Output, EEG, EMG, Plethysmography, Blood Flow Measurements, Holter Monitor- Respiratory Rate Measurement – Oximeter, Patient Monitoring System, ICCU.

UNIT IV MODERN IMAGING SYSTEM**10 hrs.**

Ultrasonic Diagnosis, Ultrasonic Scanning, Isotopes in Medical Diagnosis- Pace Makers, Defibrillators, Doppler Monitor(colour), Medical imaging-X-ray generation, Radiographic & Fluoroscopic Techniques – Image Intensifiers-Computer Aided Tomography, PET, SPECT- Laser Applications-Echocardiography-CT Scan-MRI/NMR-Endoscopy.

UNIT V RECENT TRENDS & INSTRUMENTS FOR THERAPY**10 hrs.**

Dialysers – Surgical Diathermy – Electro Anaesthetic and Surgical Techniques. Sources of Electric Hazards and Safety Techniques. Single Channel Telemetry, Multi channel Telemetry, Implantable Telemetry, Wireless Telemetry, Telemedicine, Telemedicine Applications.

TEXT BOOKS:

1. Khandpur, "Handbook of Biomedical Instrumentation" 2nd Edition, Tata McGraw Hill, 2003.
2. M.Arumugam, "Biomedical Instrumentation", Anuradha Publications, Reprint 2009.

REFERENCE BOOKS:

1. Leslie Cromwell, Fred J. Werbell and Eruch A. Pfeiffer, "Biomedical Instrumentation and Measurements" 2nd Edition
2. W.J.Tompkins and J.G. Webster, "Design of Microcomputer Based Medical Instrumentation", Prentice Hall, 1991
3. L.A. Geddes and L.E. Baker, "Principle of Applied Biomedical Instrumentation" 3rd Edition, Wiley, 1989
4. D.W. Hill, "Principle of Electronics for Medical Research", 2nd Edition, Butterworths, 1965.

UNIVERSITY EXAM QUESTION PAPER PATTERN

Max.Marks : 80

Exam Duration : 3 hrs.

PART A : 2 Questions from each unit, each carrying 2 marks

20 marks

PART B : 2 Questions from each unit with internal choice, each carrying 12 marks

60 marks

SECX1015	MICROPROCESSORS & MICROCONTROLLERS (Common to E&C & EIE)	L	T	P	Credits	Total Marks
		3	0	0	3	100

UNIT I MICROPROCESSORS**10 hrs.**

Microprocessors evolution and types, general 8 bit microprocessors and its architecture-8085,Z80,6800-8086 microprocessors family overview,8086 internal architecture,introduction to programming of 8086

UNIT II INSTRUCTION SETS AND ASSEMBLY LANGUAGE PROGRAMMING-8085**10 hrs.**

Instruction cycle – timing diagram-machine cycle-instruction format-addressing modes-instruction set of 8085-assembler directives-stack &subroutines-assembly language programs

UNIT III MICROCONTROLLER-8051**10 hrs.**

Microprocessors and microcontrollers-microcontroller evolution-8051 architecture input/output ports, program and data memory, counters and timers, serial data I/O, interrupts-introduction set and assembly language programs

UNIT IV PERIPHERAL DEVICES & INTERFACING**10 hrs.**

Data transfer schemes-programmable I/O-serial I/O-peripheral IC'S-8251,8255,8259,8279-DMA, interfacing-7 segment LED & LCD Display- stepper motor – water level control-ADC & DAC-applications

UNIT V INTRODUCTION TO OTHER 16 BIT MICROPROCESSOR AND MICROCONTROLLERS**10 hrs**

Intel 80286,80386,80486,80196,PIC ,ARM architecture & features, introduction to embedded systems.

TEXT/REFERENCE BOOKS:

1. Gaonkar, "Microprocessors Architecture, Programming, And Application With 8085", Wiley Eastern Publication.,1997.
2. Kenneth J. Ayala, "The 8051 Microcontroller:Architecture, Programming And Applications", Penram International Publishings, 1996.
3. Dougals .V.Hall, "Microprocessors &Interfacing-Programming and Hardware", Tata McGraw Hill, 1991.
4. Walter A.Trebel & Avtar Singh, "The 8088 and 8086 Microprocessors", PHI, 1985.
5. Barry B. Brey, "The Intel Microprocessor 8086 8088 80186 80286 80386 80486 Pentium And Pentium Pro Processor Architecture, Programming And Interfacing", PHI, 7th Edition (March 23, 2005).
6. Mazidi & Mazidi, "The 8051 Microcontroller And Embedded System", PHI, 2000.

UNIVERSITY EXAM QUESTION PAPER PATTERN

Max.Marks : 80

Exam Duration : 3 hrs

PART A : 2 Questions from each unit, each carrying 2 marks

20 marks

PART B : 2 Questions from each unit with internal choice, each carrying 12 marks

60 marks

SECX4027	INTEGRATED CIRCUITS AND DSP LAB	L	T	P	Credits	Total Marks
		0	0	4	2	100

INTEGRATED CIRCUITS LAB**List of Experiments**

1. Characteristics of Op amps and applications: Summer, Integrator, and Differentiator.
2. Design and testing of waveform generators using Op-amps: square, triangular.
3. Design and testing of Precision Rectifier, Active Filters.
4. Design and testing of an Instrumentation amplifier & D/A Converter.

DIGITAL SIGNAL PROCESSING LAB**List of Experiments**

1. Study of DSP Processor.
2. Arithmetic and Logical Operation Using DSP Processor.
3. Multiplication / Division operation Using DSP Processor.
4. Convolution – Linear / Circular Convolution using MATLAB.
5. Cross Correlation / Auto Correlation using MATLAB.
6. Generation of Square / Sine Waveform using MATLAB.
7. Design FIR – Low pass filter / High Pass Filter using MATLAB.
8. Design IIR – Low pass filter / High Pass Filter using MATLAB.

SECX4002	MEASUREMENT AND TRANSDUCER LAB	L	T	P	Credits	Total Marks
		0	0	4	2	100

List of experiments

1. Measurement of Medium Resistance Using Wheat stone's Bridge
2. Measurement of Low Resistance Using Kelvin's Double Bridge
3. Measurement of Capacitance Using Schering's Bridge
4. Measurement of Inductance Using Anderson's Bridge
5. Calibration of Ammeter, Voltmeter
6. Design of Current to voltage & Voltage to current converters
7. Displacement versus output characteristics of potentiometer transducer
8. Strain Gauge characteristics
9. Load cell characteristics
10. Characteristics of LVDT
11. Characteristics of Thermocouple
12. Characteristics of Thermistors
13. Step response characteristics of RTD
14. Hall Effect transducers

SICX4004	INDUSTRIAL INSTRUMENTATION LAB	L	T	P	Credits	Total Marks
		0	0	4	2	100

List of Experiments

1. Level measurement using d/p transmitter
2. Flow measurement using Orifice and Venturi meter
3. Calibration of Thermocouple
4. Calibration of Pressure transmitter
5. Torque measurement
6. Viscosity measurement
7. UV-Visible Spectrophotometer
8. IR Spectrophotometer
9. Vacuum Pressure measurement
10. Conductivity meter calibration and measurements of conductivity of test solutions.
11. pH meter standardization and measurement of pH values of test solutions
12. Radiation Pyrometer & IR Thermometer

SICX4005	SYSTEM DESIGN LAB	L	T	P	Credits	Total Marks
		0	0	4	2	100

List of Experiments**USING MATLAB**

1. Design of digital controller using dead beat algorithm.
2. Design of digital controller using Dahlin's algorithm
3. Design of digital controller using Kalman's algorithm

USING VHDL

4. Implementation of Logic gates
5. Design of Half adder and Full adder

USING LAB VIEW

6. Building of VI to demonstrate conversion of Centigrade to Fahrenheit and create a subroutine for conversion of Centigrade to Fahrenheit
7. Building of VI to demonstrate software timings while loop and waveform chart.
8. Building VI for analysing and logging of data
9. Building of VI to demonstrate Multi-plot graph using waveform charts
10. Building of VI to demonstrate error clusters and handling.
11. Building of VI to stimulate simple test sequence using simple state machine architecture.
12. Building of VI to design Multimeter.

S18XPROJ	PROJECT WORK & VIVA-VOCE	L	T	P	Credits	Total Marks
		0	0	30	15	100

The objective of the project work is to make use of the knowledge gained by the student at various stages of the degree course. Students, will also be permitted to undertake industrial/consultancy project Work, outside the department, in industries/Research labs.

There shall be three assessments during the semester by a review committee. The student shall make three presentations on the progress made before the committee at various stages of the Project work. The Head of the Department shall constitute the review committee for each branch of study. The total marks obtained in the three reviews, shall be taken in to account. There will be a viva-voce examination at the end of the Project work, conducted by one internal examiner and one external examiner. The total marks secured will be the sum of marks secured in the Project reviews and Viva Voce Examination.

Each student is required to submit a Project report on the project assigned to him by the department. The report should be based on the information available in the literature or data obtained by the student by way of experiments conducted in the laboratory/industry.

SICX1014	LOGIC AND DISTRIBUTED CONTROL SYSTEMS	L	T	P	Credits	Total Marks
		3	1	0	4	100

UNIT I PROGRAMMABLE LOGIC CONTROLLER (PLC) BASICS**10 hrs.**

Definition- overview of PLC systems - Input/ Output modules - Power supplies –IO slots. General PLC programming procedures - programming on-off outputs. Auxiliary commands and functions - creating ladder diagrams from process control descriptions. PLC basic programming – digital logic Gates-boolean algebra. Basic PLC functions-register basics - timer functions - counter functions.

UNIT II PLC INTERMEDIATE FUNCTIONS**12 hrs.**

Arithmetic functions - number comparison functions - skip and MCR functions - data move systems. PLC Advanced intermediate functions- utilizing digital bits - sequencer functions - PLC Advanced functions: alternate-programming languages - operation. PLC-PID functions -PLC installation - trouble shooting and maintenance - controlling a robot - processes with PLC - design of inter locks and alarms using PLC.

UNIT III INTERFACE AND BACKPLANE BUS STANDARDS FOR INSTRUMENTATION SYSTEMS**6 hrs.**

Field bus: Introduction - concept - international field bus standards. HART protocol: method of operation - structure - operating conditions and applications.

UNIT IV DISTRIBUTED CONTROL SYSTEMS (DCS)**10 hrs.**

Evolution of DCS - building blocks – different architectures-comparison of architectures-detailed descriptions and functions of local control units – basic elements & functions-operator stations - data highways - redundancy concepts.

Unit V DISTRIBUTED CONTROL SYSTEMS :COMMUNICATION FACILITIES**12 hrs.**

DCS communication Facilities-communication system requirements-architectural issues-protocol issues-communication system standards-operator interfaces-low level and high level operator interfaces-Engineering interfaces- low level and high level Engineering interfaces

TEXT BOOKS:

1. John Webb, W, Ronald Reis, A.: "Programmable Logic Controllers Principles and Applications", 3rd Edition, Prentice hall Inc., New Jersey, 1995.
2. Krishna Kant, "Computer based Industrial Control", Prentice Hall India. 1997.
3. Lucas, M.P.,: "Distributed Control Systems", Van Nostrand Reinhold Co., New York, 2nd Edition, 1986

REFERENCE BOOKS:

1. Petruzella., "Programmable Logic Controllers" 3rd Edition, Tata McGraw Hill, Newyork.
2. Hughes, T. "Programmable Logic Controllers", ISA Press 1994. 4th Edition.
3. Mckloni, D.T. "Real Time Control Networks", ISA Press 1994.

UNIVERSITY EXAM QUESTION PAPER PATTERN

Max.Marks : 80

Exam Duration : 3 hrs.

PART A : 2 Questions from each unit, each carrying 2 marks

20 marks

PART B : 2 Questions from each unit with internal choice, each carrying 12 marks

60 marks

SECX1048	FUNDAMENTALS OF FUZZY LOGIC AND ARTIFICIAL NEURAL NETWORKS (Common to EIE, ECE, ETCE & EEE)	L	T	P	Credits	Total Marks
		3	0	0	3	100

UNIT I INTRODUCTION TO FUZZY LOGIC**8 hrs.**

Introduction to Fuzzy Set Theory – Basic Concepts of Fuzzy Sets - Classical Set Vs Fuzzy Set – Properties of Fuzzy Set – Fuzzy Logic Operation on Fuzzy Sets – Fuzzy Logic Control Principles – Fuzzy Relations – Fuzzy Rules – Defuzzification.

UNIT II FUZZY LOGIC CONTROLLER & ITS APPLICATION**10 hrs.**

Fuzzy Logic Controller – Fuzzification Interface – Knowledge Base – Decision Making Logic – Defuzzification Interface – Application of Fuzzy Logic to Water Level Controller - Temperature Controller- Inverted Pendulum Control – Control of Blood Pressure during Anaesthesia.

UNIT III FUNDAMENTALS OF ANN**10 hrs.**

Fundamentals of ANN – Biological Neurons and Their Artificial Models – Types of ANN – Properties – Different Learning Rules – Types of Activation Functions – Training of ANN – Perceptron Model (Both Single & Multi Layer) – Training Algorithm – Problems Solving Using Learning Rules and Algorithms – Linear Separability Limitation and Its Over Comings

UNIT IV DETERMINISTIC & STATISTICAL NETWORKS**12 hrs.**

Back Propagation Training Algorithm – Practical Difficulties – Counter Propagation Network – Structure & Operation – Training of Kohonen and Grossberg Layer – Applications of BPN & CPN - Statistical Method – Training Application – Boltzman Training – Cauchy Training – Hop Field Network and Boltzman Machine – Speed Energy Function – Network Capacity – Applications A / D Converter – Travelling Sales Man Problem – RBF Network

UNIT V BAM, ART & OPTICAL NETWORKS**10 hrs.**

BAM – Structure – Types – Encoding and Retrieving – Adaptive Resonance Theory – Architecture of ART 1 & ART 2 – Implementation – Training – Characteristics – Introduction to Optical Neural Network – Cognitron & Neocognitron

TEXT BOOKS:

1. Timothy Ross, Fuzzy Logic with Engineering Application, McGraw Hill, Edition 1997.
2. James A. Freeman & Skapura, Neural Networks, Pearson Education, 2007.

REFERENCE BOOKS:

1. B.Yegnanarayana, "Artificial Neural Networks" Prentice Hall, September 2007.
2. Simon Haykin, "Artificial Neural Networks", 2nd Edition, Pearson Education.
3. Drainkov, H.Hallendoor and M.Reinfrank, "An Introduction to Fuzzy Control", Edition 2001.

UNIVERSITY EXAM QUESTION PAPER PATTERN

Max.Marks : 80

Exam Duration : 3 hrs.

PART A : 2 Questions from each unit, each carrying 2 marks

20 marks

PART B : 2 Questions from each unit with internal choice, each carrying 12 marks

60 marks

80% theoretical and 10% numerical from Unit I & II, 10% from Unit III,IV, V may be asked

SECX1064	DATA ACQUISITION AND COMMUNICATION SYSTEMS	L	T	P	Credits	Total Marks
		3	0	0	3	100

UNIT I DATA CONVERTERS**10 hrs.**

Definition, Design and need for Data Acquisition Systems -D/A Converters-Implementing a DAC Function-Use of Ladder Networks-Bipolar Coded DACs -A/D Converters-Parallel A/D, Feedback A/D, Ramp type A/D, Dual slope A/D, Successive Approximation A/D-Comparison of A/D Conversion Techniques- Microprocessor/PC based Data Acquisition Systems

UNIT II COMPUTER NETWORKS**10 hrs.**

Topology- TCP/IP-Data Link Control Protocol-BISYNC,SDLC,HLDC,LLA,MA-

Principles of Internet Working-Repeaters, Hubs, Bridges, Switches, Routers, Gateways-Internet Protocol-Encoding-Types of Encoding-Frequency and time-division Multiplexing techniques

UNIT III AMPLITUDE MODULATION**8 hrs.**

Modulation- Need for Modulation- AM-Frequency Spectrum- Power Relation – Different types of Modulators- SSB and VSB Generation-AM Transmitters- Block Diagram- Functions of each block – High level and Low Level Transmitters.

UNIT IV FREQUENCY MODULATION**10 hrs.**

Angle Modulation-Principle of Frequency and Phase Modulation-Relation between FM and PM Waves- Band width of FM-Narrow Band And Wide Band FM Wave- Generation of FM wave- Direct and Indirect Methods –FM Transmitters-Block Diagram- Functions of each block

UNIT V DETECTORS & RECEIVERS**12 hrs.**

Detection and Receivers –Detection of AM Waves-Diode Detectors-Synchronous Detectors-FM Detectors-Phase Discriminators-Ratio Detectors. Receivers-Different types-Superheterodyne receivers-Block Diagram-Choice of IF and Oscillator Frequencies- Tracking-Alignment-AVC,AFC, Receiver Characteristics.

TEXT BOOKS:

1. G.B.Kennedy, "Electronic Communication Systems", 4th Edition, Tata McGraw Hill, 1993.
2. Anokh Singh, "Principles of Communication Engineering" S.Chand & CO.
3. A.S.Tanenbaum, Computer Networks ,3rd Edition, Prentice Hall of India, 1996

REFERENCE BOOKS:

1. G.B.Clayton, "Data Converters", The Macmillan Press Ltd., 1982
2. Roddy D.Coolen.J, "Electronic Communications", 4th Edition, PHI, 2007.
3. Taub and Schilling, "Principles of communication systems", Tata McGraw Hill, New Delhi, 1995.
4. Behrouz A Forouzan, "Data Communication and Networking".
5. Simon Haykin, "Communication System, John Wiley & Sons, 4th Edition, 2001
6. Bruce Carlson et al., "Communication Systems", Tata McGraw Hill, 4th Edition, 2002.

UNIVERSITY EXAM QUESTION PAPER PATTERN

Max.Marks : 80

Exam Duration : 3 hrs

PART A : 2 Questions from each unit, each carrying 2 marks

20 marks

PART B : 2 Questions from each unit with internal choice, each carrying 12 marks

60 marks

SMEX4005	THERMAL & FLUID MECHANICS LAB	L	T	P	Credits	Total Marks
		0	0	4	2	100

(A) THERMAL LAB

1. Valve Timing Diagram of 4-Stroke Engine.
2. Port Timing Diagram of 2- Stroke Engine.
3. Performance Test on I.C Engine Using Electrical Dynamometer.
4. Performance Test on I.C Engine Using Hydraulic Dynamometer.
5. Performance Test on Air Condition Plant.
6. Performance Test on Air Compressor.Air Pressure Measurement And Regulation
7. Heat Balance Sheet of An I.C Engine.
8. Boiler Trail And Heat Balance Sheet.
9. Performance Test on A Refrigerator.
10. Free And Forced Convection Heat Transfer.

(B) FLUID MECHANICS LAB

1. Performance Study Of Centrifugal Pump.
2. Performance Study Of Reciprocating Pump.
3. Performance Study Of Gear Oil Pump.
4. Performance Study Of Jet Pump/Deep Well Pump.
5. Performance Study Of Submersible Pump.
6. Performance Study Of Pelton Wheel/Francis Turbine.
7. Pipe Friction Apparatus.
8. Flow Through Venturimeter.
9. Flow Through Orificemeter.

SECX4022	ELECTRONIC CIRCUITS -II LAB	L	T	P	Credits	Total Marks
		0	0	4	2	100

List of experiments:

1. Design and Testing of Hartley Oscillator.
2. Design and Testing of RC Phase Shift Oscillator.
3. Design and Testing of Colpitt's Oscillator.
4. Design and Testing of Astable Multivibrator.
5. Design and Testing of Schmitt Trigger.
6. Design and Testing of Tuned Amplifier.
7. Design and Testing of Monostable Multivibrator Using PSPICE Simulation.
8. Design and Testing of Bistable Multivibrator Using PSPICE Simulation.
9. Design and Testing of Feedback Amplifier Using PSPICE Simulation.
10. Design and Testing of Wein Bridge Oscillator Using PSPICE Simulation.

SECX1021	FUNDAMENTALS OF VLSI DESIGN (Common to E&C & EIE)	L	T	P	Credits	Total Marks
		3	0	0	3	100

UNIT I MOS TRANSISTOR THEORY**10 hrs.**

The MOS transistor-Current Voltage Relations-Threshold Voltage-Second order effects-MOS models-Design of Logic gates-Stick diagrams – DC characteristics – Small signal AC characteristics of CMOS inverter – Dynamic behavior – Power consumption – Scaling of MOS circuits.

UNIT II COMBINATIONAL LOGIC DESIGN**10 hrs.**

Static CMOS design – Determination of Pull-up and Pull-down ratio-Sizing of transistors – Ratioed logic-Pass transistor logic – Dynamic CMOS design – Noise consideration – Domino logic, np CMOS logic – Power consumption in CMOS gates – Multiplexers – Transmission gates design.

UNIT III SEQUENTIAL LOGIC DESIGN**10 hrs.**

Introduction – Static sequential circuits- CMOS static flip-flop – Dynamic sequential circuits – Pseudo static latch - Dynamic two phase flip-flop – clocked CMOS logic – C² MOS latch- Pipelining – NORA CMOS logic – True single phase clocked logic – Realization of DFF in TSPC logic.

UNIT IV SUBSYSTEM DESIGN**10 hrs.**

Introduction-Designing Static and Dynamic Adder circuits – The Array Multiplier – Multiplier structures- Baugh-Wooly – Booth Multiplier – Barrel shifter – Memory structures – SRAM and DRAM design – Design approach of Programmable logic devices – PLA, PAL and FPGA.

UNIT V INTRODUCTION TO VHDL**10 hrs.**

Digital system design process – Language elements of VHDL- Operators-Data Types – Signal assignments – Concurrent and Sequential assignments-Process statement – Wait statement – If statement - Loop statement - Assertion statement – Data flow modeling - Structural modeling – Behavioral Modeling- Examples

Total Hours: 50**TEXT BOOKS**

1. Jan M.Rabaey, "Digital Integrated Circuits", 2nd Edition, September 2000, PHI Ltd.
2. M.J.S.Smith, "Application Specific Integrated Circuits", 1st Edition 1997, Pearson Education.

REFERENCE BOOKS

1. Douglas A.Pucknell, "Basic VLSI design", PHI Limited 1998.
2. E.Fabricious, "Introduction to VLSI design", Mc Graw Hill Limited 1990.
3. Neil Weste, "Principles of CMOS VLSI design", Addison Wesley 1998.
4. Wayne Wolf, "Modern VLSI design", 2nd Edition 2003, Pearson Education.
5. Sung-Mo Kang & Yusuf "CMOS Digital Integrated Circuits- Analysis & Design", 2nd Edition, MGH.

UNIVERSITY EXAM QUESTION PAPER PATTERN

Max. Marks : 80

Exam Duration : 3 hrs.

Part A : 6 Questions of 5 marks each – No choice

30 marks

Part B : 5 Questions from each of the five units of internal choice, each carrying 10 marks each

50 marks

SICX1004	SENSORS AND TRANSDUCERS	L	T	P	Credits	Total Marks
		3	0	0	3	100

UNIT I SENSORS**10 hrs**

Difference between Sensors and Transducers – Sensors for Motion and Position Measurement , GPS, INS, Doppler, SONAR.

Thermal Sensors – Gas Thermometric Sensors, Acoustic Temperature Sensor, Thermoemf Sensors, NQR Thermometry, Heat Flux Sensor.

Biosensors – Types - Calorimetric Biosensors, Potentiometric Biosensors, Amperometric Biosensors, Optical Biosensors, Immunosensors

UNIT II MEASUREMENTS**9 hrs.**

Functional Elements of measurement system- Examples - Characteristics of instruments: Static characteristics - Dynamic characteristics - Types of errors -sources of errors- methods of elimination-Analysis of data - Limiting errors-Relative limiting error-Combination of Quantities with limiting errors – Statistical treatment of data: Histogram, Mean, Measure of dispersion from the mean, Range, Deviation, Average deviation, Standard Deviation, Variance.

UNIT III RESISTIVE TRANSDUCER**10 hrs.**

Transducers –Classification of Transducers, Characteristics - Basic Requirements of a Transducer - Mechanical Devices as Primary Detectors -Mechanical Springs, Proving Rings, Potentiometer, Strain Gauges -Theory, Types (includes Rossette), Temperature Compensation, Calibration – Resistance Hygrometer, Photoconductive cell, Hot wire anemometer.

UNIT IV INDUCTIVE & CAPACITIVE TRANSDUCER**11 hrs.**

Self inductive transducers, Mutual inductive transducer, Linear variable Differential transformer - Eddy current gauge, Proximity sensors, Microsyn, Induction potentiometer, Capacitive displacement transducers, Single ended capacitive displacement transducers - Desirable features of capacitive transducers -Practical capacitive pickups - Equibar differential pressure transducer -Feedback type capacitance proximity pickup – Capacitor microphone - Application in level measurement

UNIT V SPECIAL TRANSDUCER & SENSORS**10 hrs.**

Piezoelectric, Photovoltaic, Hall Effect, Magnetostrictive, Radio-Active Absorption, Ionic Conduction Transducers, Digital Transducers - Digital Displacement Transducer, Shaft Angle Encoder, Optical Encoders, Magnetic Encoders -Digital Speed Transducers -Variable Reluctance Type, Smart Sensors - SQUID Sensors - Film Sensors – MEMS., Sensors for angular measurement using non contact type (wireless)

TEXT BOOKS:

1. Sawhney A.K., "Electrical & Electronic Measurements and Instrumentation", Dhanpat Rai Publications, 2001
2. D. Patranabis, 'Sensors and Transducers', Prentice Hall of India, 1999.
3. Doebelin E.O. "Measurement System Applications and Design", TMH, 5th Edition, 2004.

REFERENCE BOOKS:

1. Rangan C.S. Mani V.S.V: and Sharma G.R., "Instrumentation Devices and Systems" Tata McGraw Hill.
2. D. Patranabis, "Principles of Industrial Instrumentation", TMH, 2nd Edition.
3. Dr. S. Renganathan, "Transducer Engineering" -Allied Publishers Limited.D.V.S Murthy –"Transducer and Instrumentation", PHI, 1st Edition

UNIVERSITY EXAM QUESTION PAPER PATTERN

Max.Marks: 80

Exam Duration :3 hrs.

PART A : 2 Questions from each unit, each carrying 2 marks

20 marks

PART B : 2 Questions from each unit with internal choice, each carrying 12 marks

60 marks

SICX1013	INDUSTRIAL AND CHEMICAL PROCESSES (Common to EIE & E&C)	L	T	P	Credits	Total Marks
		3	0	0	3	100

UNIT I INTRODUCTION TO UNIT OPERATIONS**10 hrs.**

Introduction to Industrial & chemical processes, unit operations-Transport of liquids, solids and gases- Adjusting of particle size of bulk solids- Mixing processes- Separation processes.

UNIT II DISTILLATION, CHEMICAL REACTORS, STEAM BOILERS**10 hrs.**

Qualitative study of unit operations with an understanding of operating variables; Distillation, chemical reactors, steam boilers.

UNIT III DRYERS, CRYSTALLIZATION, EVAPORATORS**10 hrs.**

Qualitative study of unit operations with an understanding of Operating variables, Dryers, Crystallization, Evaporators.

UNIT IV FURNACES, CENTRIFUGES, HEAT EXCHANGERS**10 hrs.**

Qualitative study of unit operations with an understanding of operating variables. Furnaces, Centrifuges, Heat exchangers.

UNIT V PUMPS, COMPRESSORS, EXTRUDERS**10 hrs.**

Qualitative study of Unit operations with an understanding of operating variables. Pumps, Compressors, Extruders.

TEXT / REFERENCE BOOKS:

1. Warren L.McCabe, Julian C.Smith, Peter Harriot, "Unit operations of chemical Engineering", 7th Edition, McGraw Hill, 2005.
2. George.T. Austin, Shreve's, "Chemical Process Industries", 5th Edition, McGraw Hill.
3. Balchan J.G and Mumme K.I, 'Process Control Structures and Applications', Van Nostrand Reinhold Company, 1988.

UNIVERSITY EXAM QUESTION PAPER PATTERN

Max.Marks : 80

Exam Duration : 3 hrs.

PART A : 2 Questions from each unit, each carrying 2 marks

20 marks

PART B : 2 Questions from each unit with internal choice, each carrying 12 marks

60 marks

SICX1008	INDUSTRIAL INSTRUMENTATION (Common to EIE & E&C)	L	T	P	Credits	Total Marks
		3	0	0	3	100

UNIT I MEASUREMENT OF SPEED, FORCE, TORQUE, ACCELERATION 10 hrs.

Measurement of speed- Revolution counter, Dragcup tachometer, AC and DC tachogenerators, photo electric pickup. Measurement of force - Load cell, pneumatic load cell, hydraulic load cell. Measurement of Torque using strain gauges and magneto elastic principle, Measurement of acceleration - Elementary accelerometers, seismic accelerometers, practical accelerometers, calibration.

UNIT II MEASUREMENT OF PRESSURE 10 hrs.

Manometers – different types of manometers, Elastic pressure transducers, Dead weight Tester, Electrical types, Vacuum gauges - McLeod gauge, Knudsen gauge, thermocouple gauge, ionization gauge, Differential pressure transmitter - electrical & pneumatic types

UNIT III MEASUREMENT OF TEMPERATURE 10 hrs.

Temperature scales, Bimetallic thermometer, filled- in Thermometers, Vapour pressure thermometers, Resistance thermometers, Thermistors, Thermostat, Thermocouples - types and ranges, characteristics, laws of thermocouples, cold junction compensation, IC temperature sensors AD 590, Pyrometers - radiation and optical pyrometers.

UNIT IV MEASUREMENT OF FLOW, LEVEL 10 hrs.

Orifice, Venturi, Pitot tube, flow nozzle rotameter, Positive displacement meter, turbine flowmeter, electromagnetic flow meter, ultrasonic flow meter, open channel flow measurement, solid flow measurement. Sight glass, float gauge, displacer, torque tube, bubbler tube, diaphragm box, Differential Pressure methods, electrical methods- resistance type, capacitance type, ultrasonic level gauging

UNIT V MEASUREMENT OF DENSITY, VISCOSITY, HUMIDITY 10 hrs.

Hydrometer – continuous weight measurement, liquid densitometer – float principle, air pressure balanced method, using gamma rays – gas density measurements – gas specific gravity measurements – Viscosity terms, saybolt viscometer, rotometer type viscometer, Industrial consistency meters. Humidity terms – dry & wet bulb psychrometers – hot wire electrode type hygrometer, electrolytic hygrometer, Dew point hygrometer

TEXT BOOKS:

1. D. Patranabis, "Principles of Industrial Instrumentation", Tata McGraw Hill, 2nd Edition, New Delhi, Reprint 2009.
2. S. K. Singh, "Industrial Instrumentation & Control " 3rd Edition, Tata McGraw Hill, Reprint 2009.
3. K.Krishnaswamy & S.Vijayachitra, "Industrial Instrumentation" New age International, Reprint 2008.

REFERENCE BOOKS:

1. Ernest O. Doebelin, Dhanish. N. Manik, "Measurement Systems Application & Design", TMH, 5th Edition, 2004.
2. R.K.Jain, "Mechanical & Industrial Measurements", Khanna Publishers, 11th Edition, 2004.

UNIVERSITY EXAM QUESTION PAPER PATTERN

Max.Marks : 80

Exam Duration : 3 hrs.

PART A : 2 Questions from each unit, each carrying 2 marks

20 marks

PART B : 2 Questions from each unit with internal choice, each carrying 12 marks

60 marks

SEEX1010	CONTROL SYSTEMS (Common to EEE, ECE, ETCE, E&C & EIE)	L	T	P	Credits	Total Marks
		3	1	0	4	100

UNIT I SYSTEM CONCEPTS**12 hrs.**

Types of system – open loop systems, closed loop systems, Basic elements in control system – Mathematical models of physical system: Differential equation- transfer functions of simple electrical networks, Electrical analogous of mechanical translational and Rotational system – D.C and A.C servomotor – Mechanical system- Translational and Rotational system – Block diagram reduction techniques – Signal flow graphs.

UNIT II TIME RESPONSE ANALYSIS OF CONTROL SYSTEMS**10 hrs.**

Standard test signals -Time response of first and second order system, Time domain- specifications- Generalized error series – Steady state error and error constants.

UNIT III STABILITY OF CONTROL SYSTEM**10 hrs.**

Characteristics equation – Location of roots in S plane for stability – Routh Hurwitz criterion – Root locus construction – Nyquist stability criterion.

UNIT IV FREQUENCY RESPONSE ANALYSIS**10 hrs.**

Frequency response of the system – Correlation between time and frequency response – Gain and Phase margin – Bode plot.

UNIT V COMPENSATION AND CONTROLLERS**8 hrs.**

Introduction to compensation networks – Lag, Lead and Lag Lead networks – Compensator Design – P, PI, PID Controllers design using Bode plot.

Total No of Hours: 50 hrs.**TEXT BOOKS:**

1. Ashok Kumar, "Control Systems", TMH Ltd, 1st Edition, 2006.
2. Kausuhio Ogata, "Modern Control Engineering", Prentice Hall of India Pvt. Ltd., 3rd Edition, 1998.
3. Smarajit Ghosh, "Control System Theory & applications", 2nd Edition, Pearson Education, Publishers, 2005

REFERENCE BOOKS:

1. I.J.Nagrath and M.Gopal, "Control Systems Engineering", New Age International (P) Limited, Publishers, 2nd Edition, 2009
2. M.N. Bandy Pathyay, "Control Engineering, Theory and Practice", PHI, 1st Edition, 2005.
3. N.K Sinha, "Control Systems", New Age International(p) Limited, Publishers, 3rd Edition, 1998
4. Roy Choudhury, "Modern Control Engineering", Prentice Hall of India, 2nd Edition, 2005
5. Richard Dorf, "Modern Control Systems", Pearson Education Ltd, 8th Edition. 2005

UNIVERSITY EXAM QUESTION PAPER PATTERN

Max. Marks : 80

Exam Duration : 3 hrs

PART A : 2 Questions from each unit, each carrying 2 marks

20 marks

PART B : 2 Questions from each unit with internal choice, each carrying 12 marks

60 marks

(Distribution may be 30% Theory & 70 % Numerical)

SECX4027	INTEGRATED CIRCUITS AND DSP LAB	L	T	P	Credits	Total Marks
		0	0	4	2	100

INTEGRATED CIRCUITS LAB**List of Experiments**

1. Characteristics of Op amps and applications: Summer, Integrator, and Differentiator.
2. Design and testing of waveform generators using Op-amps: square, triangular.
3. Design and testing of Precision Rectifier, Active Filters.
4. Design and testing of an Instrumentation amplifier & D/A Converter.

DIGITAL SIGNAL PROCESSING LAB**List of Experiments**

1. Study of DSP Processor.
2. Arithmetic and Logical Operation Using DSP Processor.
3. Multiplication / Division operation Using DSP Processor.
4. Convolution – Linear / Circular Convolution using MATLAB.
5. Cross Correlation / Auto Correlation using MATLAB.
6. Generation of Square / Sine Waveform using MATLAB.
7. Design FIR – Low pass filter / High Pass Filter using MATLAB.
8. Design IIR – Low pass filter / High Pass Filter using MATLAB.

SECX4002	MEASUREMENT AND TRANSDUCER LAB	L	T	P	Credits	Total Marks
		0	0	4	2	100

List of experiments

1. Measurement of Medium Resistance Using Wheat stone's Bridge
2. Measurement of Low Resistance Using Kelvin's Double Bridge
3. Measurement of Capacitance Using Schering's Bridge
4. Measurement of Inductance Using Anderson's Bridge
5. Calibration of Ammeter, Voltmeter
6. Design of Current to voltage & Voltage to current converters
7. Displacement versus output characteristics of potentiometer transducer
8. Strain Gauge characteristics
9. Load cell characteristics
10. Characteristics of LVDT
11. Characteristics of Thermocouple
12. Characteristics of Thermistors
13. Step response characteristics of RTD
14. Hall Effect transducers

SICX1006	MODERN CONTROL SYSTEM (Common to E&C & EIE)	L	T	P	Credits	Total Marks
		3	1	0	4	100

UNIT I REVIEW OF MATRICES**10 hrs.**

Review of matrices-co-ordinate transformation- Eigen values and Eigen vectors- diagonalization – Cayley Hamilton theorem- state transition matrix.

UNIT II STATE SPACE ANALYSIS**10 hrs.**

State space analysis – state space formulation- state space representation of control systems described by scalar differential equation – state variable- transformation of state space equation , physical ,phase & canonical variable, state space models-state space representation for discrete time system.

UNIT III CONTROLLABILITY AND OBSERVABILITY**10 hrs.**

Jordan and canonical forms, controllability and observability – condition for controllability and observability, Gilbert method and Kalman decomposition- design of state feedback by pole placement.

UNIT IV PHASE VARIABLE MATRIX**10 hrs.**

Controllable phase variable form, observable phase variable form, reduced order observer – full order observer-reducibility, irreducibility, transfer function matrix, impulse response functions.

UNIT V NON – LINEAR SYSTEM ANALYSIS**10 hrs.**

Non – linear systems – properties of non linear system – describing function for simple non linearity's like ON-OFF, dead zone and saturation- describing function analysis of non linear systems – phase plane method – basis concept- singular points – constructing phase plane trajectory for linear and nonlinear second order systems.

TEXT / REFERENCE BOOKS:

1. Gopal.M, "Modern Control Theory", 2nd Edition ,Wiley Eastern Publishers, 1993.
2. Tou.T.J. "Modern Control Theory", McGraw Hill publications, 1964.
3. Ogata.K.H, "State Space Analysis Of Control Systems ", Prentice Hall Publications, 1967.
4. Nagrath I.J. & Gopal.M, "Control Systems Engineering", 2nd Edition, Wiley & Sons, 1985.

UNIVERSITY EXAM QUESTION PAPER PATTERN

Max.Marks : 80

Exam Duration : 3 hrs

PART A : 2 Questions from each unit, each carrying 2 marks

20 marks

PART B : 2 Questions from each unit with internal choice, each carrying 12 marks

60 marks

SICX1017	INSTRUMENTATION AND CONTROL IN PETROCHEMICAL INDUSTRIES (Common to EIE and E&C)	L	T	P	Credits	Total Marks
		3	0	0	3	100

UNIT I INSTRUMENTATION AND CONTROL IN DISTILLATION COLUMNS & REACTORS 12 hrs.

Introduction to petroleum exploring, processing and refining constituents of crude oil – P& I diagram of petroleum refinery Instrumentation and control in distillation columns: distillation equipment- variable and degrees of freedom - measurement and control of column pressure - liquid distillate -vapour distillate and inserts - control of feed, re-boiler and reflux - use of gas chromatograph-cascade and feed forward controls. Temperature control and pressure control in batch reactors.

UNIT II INSTRUMENTATION AND CONTROL IN DRYERS AND HEAT EXCHANGERS 10 hrs.

Control of batch dryers and continuous dryers.- Instrumentation and control in heat exchangers: variables and degree of freedom - liquid to liquid heat exchangers - steam heaters – condensers -reboilers and vaporizers -use of cascade and feed forward control.

UNIT III CONTROL OF PUMPS 8 hrs.

Centrifugal pumps- on-off level control-pressure control-flow control- throttling control

Rotary pumps- on-off pressure control, Reciprocating pumps- throttling, On-Off control

UNIT IV INSTRUMENTATION AND CONTROL IN EFFLUENT AND WATER TREATMENT 10 hrs.

Chemical oxidation -chemical reduction -neutralization -precipitation -biological control.

UNIT V INSTRUMENTATION AND CONTROL IN EVAPORATORS AND INTRINSIC SAFETY 10 hrs.

Types Of Evaporators - Measurement And Control Of Absolute Pressure, Density, Conductivity, Differential Pressure And Flow In Evaporators- Intrinsic Safety Of Instruments

TEXT BOOKS:

1. Bela.G. Liptak - Instrumentation In The Processing Industries - Chilton Book Company, 1994.
2. R.F. Goldstien, A.L.Waddams, 'Petroleum Chemicals Industry', Spon-Publisher, 3rd Edition,1967.

REFERENCE BOOKS:

1. D.M. Considine and S.D.Ross - Handbook Of Applied Instrumentation -Mcgraw Hill, 1964.
2. Curtis D.Johnson, 'Process Control Instrumentation Technology', 17th Edition, Pearson Education, New Delhi, 2002.
3. George.T. Austin, Shreeve's Chemical Process Industries, 5th Edition, McGraw Hill, 1998.
4. Balchan J.G and Mumme K.I, 'Process Control Structures and Applications', Van Nostrand Reinhold Company, New York, 1988.

UNIVERSITY EXAM QUESTION PAPER PATTERN

Max.Marks : 80

Exam Duration : 3 hrs.

PART A : 2 Questions from each unit, each carrying 2 marks

20 marks

PART B : 2 Questions from each unit with internal choice, each carrying 12 marks

60 marks

SICX1020	THEORY OF ROBOTICS AND AUTOMATION (Common to EIE, E&C, ECE, ETCE, EEE & BIOMED)	L	T	P	Credits	Total Marks
		3	0	0	3	100

UNIT I BASIC CONCEPTS**10 hrs.**

Origin & various generation of Robots - Robot definition - Robotics system components – Robot classification - Coordinate frames - Asimov's laws of robotics – degree of freedom – work volume - Need for Automation - types of automation – fixed, programmable and flexible automation.

UNIT II SENSORS AND VISION SYSTEM**10 hrs.**

Sensing - Range, proximity, position, velocity, acceleration, Touch, Force, Torque. Optical & laser sensors. Machine vision - Introduction, Image acquisition, Illumination Techniques, Image conversion, Cameras, Image processing and analysis – image data reduction – segmentation feature extraction – Object recognition.

UNIT III GRIPPERS AND ROBOT DYNAMICS**10 hrs.**

Introduction - various types of grippers-design considerations. Construction of Manipulator – Introduction to Robot Dynamics – Lagrange formulation – Newton Euler formulation – Properties of robot dynamic equations.

UNIT IV KINEMATICS AND PATH PLANNING**10 hrs.**

Forward Kinematics – Denavit Hartenberg Representation. Inverse Kinematics – Geometric approach.

UNIT V PROGRAMMING LANGUAGES AND APPLICATIONS**10 hrs.**

Robot programming - Fixed instruction, sequence control, General programming language, Specific programming languages. Robots for welding, painting and assembly – Remote Controlled robots – Robots for nuclear, thermal and chemical plants.

TEXT BOOKS:

1. Mikell P. Groover, Weiss M. Nagel R.N. Odrey. N.G. , "Industrial Robotics", Tata McGraw Hill, 3rd Reprint, Edition 2008.
2. Deb.S.R. "Robotics Technology and Flexible Automation", Tata McGraw Hill, 9th Reprint 2004.
3. K.S Fu, R C.Gonzalez, CSG Lee- "Robotics", McGraw Hill, Edition 2008.

REFERENCE BOOKS:

1. John J Craig "Introduction to Robotics Mechanics & Control, Low price Edition, 7th Reprint, 2005.
2. Ghosh, "Control in Robotics and Automation : Sensor Based Integration", Allied Publishers.

UNIVERSITY EXAM QUESTION PAPER PATTERN

Max.Marks : 80

Exam Duration : 3 hrs.

PART A : 2 Questions from each unit, each carrying 2 marks

20 marks

PART B : 2 Questions from each unit with internal choice, each carrying 12 marks

60 marks

SICX1028	POWER PLANT INSTRUMENTATION (Common to EIE, E&C & EEE)	L	T	P	Credits	Total Marks
		3	0	0	3	100

UNIT I OVERVIEW OF POWER GENERATION**10 hrs.**

Brief survey of methods of power generation – Hydro, thermal, nuclear, solar wind and wave power – Importance of instrumentation in power generation – Thermal power plants – Block diagram – Details of boiler processes - P&I diagram of boiler – Cogeneration.

UNIT II MEASUREMENTS IN POWER PLANTS**10 hrs.**

Electrical measurements – Current, voltage, power, frequency, power factor reactive power.

Non electrical parameters – Flow of feed water, fuel, air and steam with correction factor for temperature and pressure – Drum level measurement – Radiation detector – Smoke density measurement – Dust monitor.

UNIT III ANALYSERS IN POWER PLANTS**10 hrs.**

Flue gas oxygen analyser – Analysis of impurities in feed water and steam -

Dissolved oxygen analyser – Chromatography – pH meter – Conductivity cell -

Fuel analyser – Pollution monitoring instruments. Spectrum analyser

UNIT IV CONTROL LOOPS IN BOILER**10 hrs.**

Combustion control – Air/fuel ratio control – Furnace draft control – Drum level control – Main steam and reheat steam temperature control – Super heater control – Air temperature – Deaerator control – Distributed control system in power plants – Interlocks in boiler operation.

UNIT V TURBINE – MONITORING AND CONTROL**10 hrs.**

Speed, vibration, shell temperature monitoring and control – Steam pressure control – Lubricant oil temperature control – Cooling system.

TEXT BOOKS:

1. Sam G. Dukelow, 'The Control of Boilers', Instrument Society of America, 1991.
2. P.K. Nag, 'Power Plant Engineering', Tata McGraw Hill, 2001.

REFERENCE BOOKS:

1. S.M. Elonka and A.L. Kohal, 'Standard Boiler Operations', Tata McGraw Hill, New Delhi, 1994.
2. R.K.Jain, 'Mechanical and Industrial Measurements', Khanna Publishers, New Delhi, 1995.
3. E.Al. Wakil, 'Power Plant Engineering', Tata McGraw Hill, 1984.

UNIVERSITY EXAM QUESTION PAPER PATTERN

Max Marks : 80

Exam Duration : 3 hrs.

PART A : 2 Questions from each unit, each carrying 2 marks

20 marks

PART B : 2 Questions from each unit with internal choice, each carrying 12 marks

60 marks

SICX1012	SOFTWARE FOR SYSTEM DESIGN (Common to E&C & EIE)	L	T	P	Credits	Total Marks
		3	0	0	3	100

UNIT I INTRODUCTION TO MATLAB**10 hrs.**

Introduction- function description-data types-tool boxes- graphical display-import and export of data-programs for solution of state equation-controller design-limitation-simple control application programs.

UNIT II MATLAB PROGRAMMING**10 hrs.**

Numerical solution- Rungekutta method - Adam bass worth technique- solution of ordinary differential equation- simulation of first order, second order and lead-lag transfer function- Matlab routine for step and impulse response - development of dynamic model and Laplace domain model using MATLAB

UNIT III SIMULINK**10 hrs.**

Introduction-graphical user interface- starting - selection of objects- blocks-lines- simulation-application programs-limitations- FIS editor- study of fuzzy logic tool box-GUI editor-rule view-membership function editor- rule editor.

UNIT IV INTRODUCTION TO VIRTUAL INSTRUMENTATION**10 hrs.**

Introduction to virtual instrumentation-VI's and sub VI's, loops and charts, arrays, cluster and graphs, case and sequence structure, formula nodes, local and global variables, string and file I/O.

UNIT V INSTRUMENT INTERFACE AND USE OF ANALYSIS TOOLS**10 hrs.**

DIO, RS232/RS485, GPIB,USB & PCMCIA – VISA and IVI-networking basics for office & industrial applications Fourier transform, power spectrum, correlation methods, windowing and filtering, VI applications in instrumentation and control, robotics, networking and communication, image acquisition and processing.

TEXT / REFERENCE BOOKS:

1. Sokoloff, "Basic Concepts of Lab View 4", Prentice Hall, 1998.
2. Katsuhiko Ogata, "Morden Control Engineering", 4th Edition, PHI, New Delhi, 2006.
3. MATLAB user manual
4. SIMULINK user manual
5. Gary Johnson, "Lab View Graphical Programming", Ide,Mcgraw Hill,1997
6. Lisa. K.Well & Jeffery Travels, "Lab View For Every One", Prentice Hall, 1997.
7. Gupta. S, Gupta. J.P, "PC Interfacing For Data Acquisition & Process Control", 2nd Edition, Instrument Society of America, 1994.

UNIVERSITY EXAM QUESTION PAPER PATTERN

Max.Marks : 80

Exam Duration : 3 hrs

PART A : 2 Questions from each unit, each carrying 2 marks

20 marks

PART B : 2 Questions from each unit with internal choice, each carrying 12 marks

60 marks

SICX1016	FUNDAMENTALS OF MECHATRONICS (Common to EIE, E&C, ECE, EEE, ETCE & BIOMED)	L	T	P	Credits	Total Marks
		3	0	0	3	100

UNIT I INTRODUCTION**10 hrs.**

Mechatronics: Definition & Key Issues – Evolution – Elements – Mechatronics Approach to Modern Engineering Design.

UNIT II SENSORS AND TRANSDUCERS**10 hrs.**

Types – Displacement, Position and Proximity & Velocity Sensors – Signal Processing – Data Display.

UNIT III ACTUATION SYSTEMS**10 hrs.**

Introduction to Mechanical Types and Electrical Types – Pneumatic & Hydraulic Systems – Applications – Selection of Actuators

UNIT IV CONTROL SYSTEMS**10 hrs.**

Types of Controllers – Microprocessor Applications in Mechatronics- 2 case studies in automobiles, and 2 case studies in robotics, – Programming Interfacing – Computer Applications

UNIT V RECENT ADVANCES**10 hrs.**

Manufacturing Mechatronics – Automobile Mechatronics -2 Case Studies – Medical Mechatronics – 2 Case Studies

TEXT BOOKS:

1. W.Bolton, N, "Mechatronics: Electronic Control System for Mechanical & Electrical Engineering", 2nd Edition, Pearson Education, 2004.
2. Dr. K.P. Ramachandran, G.K. Vijaya Raghavan, Mechatronics, A.R.S. Publications, Second Edition, 2008.

REFERENCE BOOKS:

1. D.A. Bradly, D. Dawson, N.C.Burd and A.J. Loader, "Mechatronics: Electronics in Products and Processes" Nelson Publisher, 2004.
2. Michael B.Histand & David G.Alciators, "Introduction to Mechatronics & Measurement systems", McGraw- Hill International Editions, 1998.
3. Dan Neculescu, "Mechatronics", Pearson Education, 2005.

UNIVERSITY EXAM QUESTION PAPER PATTERN

Max.Marks : 80

Exam Duration : 3 hrs.

PART A : 2 Questions from each unit, each carrying 2 marks

20 marks

PART B : 2 Questions from each unit with internal choice, each carrying 12 marks

60 marks

SICX1020	THEORY OF ROBOTICS AND AUTOMATION (Common to EIE, E&C, ECE, ETCE, EEE & BIOMED)	L	T	P	Credits	Total Marks
		3	0	0	3	100

UNIT I BASIC CONCEPTS**10 hrs.**

Origin & various generation of Robots - Robot definition - Robotics system components – Robot classification - Coordinate frames - Asimov's laws of robotics – degree of freedom – work volume - Need for Automation - types of automation – fixed, programmable and flexible automation.

UNIT II SENSORS AND VISION SYSTEM**10 hrs.**

Sensing - Range, proximity, position, velocity, acceleration, Touch, Force, Torque. Optical & laser sensors. Machine vision - Introduction, Image acquisition, Illumination Techniques, Image conversion, Cameras, Image processing and analysis – image data reduction – segmentation feature extraction – Object recognition.

UNIT III GRIPPERS AND ROBOT DYNAMICS**10 hrs.**

Introduction - various types of grippers-design considerations. Construction of Manipulator – Introduction to Robot Dynamics – Lagrange formulation – Newton Euler formulation – Properties of robot dynamic equations.

UNIT IV KINEMATICS AND PATH PLANNING**10 hrs.**

Forward Kinematics – Denavit Hartenberg Representation. Inverse Kinematics – Geometric approach.

UNIT V PROGRAMMING LANGUAGES AND APPLICATIONS**10 hrs.**

Robot programming - Fixed instruction, sequence control, General programming language, Specific programming languages. Robots for welding, painting and assembly – Remote Controlled robots – Robots for nuclear, thermal and chemical plants.

TEXT BOOKS:

1. Mikell P. Groover, Weiss M. Nagel R.N. Odrey. N.G. , "Industrial Robotics", Tata McGraw Hill, 3rd Reprint, Edition 2008.
2. Deb.S.R. "Robotics Technology and Flexible Automation", Tata McGraw Hill, 9th Reprint 2004.
3. K.S Fu, R C.Gonzalez, CSG Lee- "Robotics", McGraw Hill, Edition 2008.

REFERENCE BOOKS:

1. John J Craig "Introduction to Robotics Mechanics & Control, Low price Edition, 7th Reprint, 2005.
2. Ghosh, "Control in Robotics and Automation : Sensor Based Integration", Allied Publishers.

UNIVERSITY EXAM QUESTION PAPER PATTERN

Max.Marks : 80

Exam Duration : 3 hrs.

PART A : 2 Questions from each unit, each carrying 2 marks

20 marks

PART B : 2 Questions from each unit with internal choice, each carrying 12 marks

60 marks

SICX1029	PROCESS CONTROL SYSTEM COMPONENTS (Common to EIE & E&C)	L	T	P	Credits	Total Marks
		3	0	0	3	100

UNIT I FLOW AND TEMPERATURE SYSTEM**10 hrs.**

Orifice meter – design of orifice for given flow condition – design of rotameter – design of RTD measuring circuit – design of cold junction compensation circuit for thermocouple using RTD – Transmitters – Zero and span adjustment in D/P transmitters and temperature transmitters.

UNIT II PRESSURE AND LEVEL SYSTEM**10 hrs.**

Bourdon gauges – factors affecting sensitivity – design of Bourdon tube – Design of Air purge system for level measurement. Electronic $P + I + D$ controllers – design – adjustment of set point, bias and controller settings.

UNIT III CONTROL VALVES**10 hrs.**

Control valves – design of actuators and positioners – types for valve bodies – valve characteristics – materials for body, and trim – sizing of control valves – selection of body, materials and characteristics of control valves for typical applications.

UNIT IV PUMPS**10 hrs.**

Types of pumps – pump – performance – pipe work calculation – characteristics of different pumps – pump operation maintenance – instruments used in pumping practice pump noise and vibration – selection of pumps.

UNIT V LOGIC CIRCUIT**10 hrs.**

Design of logic circuits for alarm and annunciator circuits, interlocks – design of microprocessor based $P + I + D$ controller.

TEXT BOOKS:

1. N.A. Anderson, "Instrumentation for Process Measurement and Control", Chillton Company, 1980, 3rd Edition, 1997, CRC Press
2. D.M. Considine, "Process Instruments and Controls Handbook", McGraw Hill Book Co. 1985, McGraw Hill Professional, 5th Edition, 1999.

REFERENCES:

1. R.H. Warring, "Pumping Manual", Gulf Publishing Co., 1984.
2. C.D. Johnson, "Process Control Instrumentation Technology", Prentice Hall Inc.. 7th Edition, 2002.
3. Terry Bartelt, "Instrumentation and Process Control", Nov.28, 2006, Delmar Cengage Learning.
4. Donald.P. Eckman, "Automatic Process Control", Wiley Eastern Ltd., New Delhi, 1993.

UNIVERSITY EXAM QUESTION PAPER PATTERN:

Max Marks : 80

Exam Duration : 3 hrs.

PART A : 2 Questions from each unit, each carrying 2 marks

20 marks

PART B : 2 Questions from each unit with internal choice, each carrying 12 marks

60 marks

100% Numerical may be asked

SECX1047	EMBEDDED SYSTEMS (Common to E&C & EIE)	L	T	P	Credits	Total Marks
		3	0	0	3	100

UNIT I SYSTEMS DESIGN**10 hrs.**

Introduction to embedded systems – hardware and software components – types- examples- characteristics – challenges in embedded computing system design – embedded system design process.

UNIT II INTERFACE ISSUES OF EMBEDDED SYSTEMS**10 hrs.**

I/O devices – examples – synchronous – Iso- synchronous and asynchronous communications from serial devices – UART- RS232-RS485-USB- Power issues- FPGA-ASIC- diagnostic port.

UNIT II TECHNIQUES FOR EMBEDDED SYSTEMS**10 hrs.**

Interpreter – compiler- assembler – cross assembler – simulators & emulators – in-circuit emulators – high level language description of s/w for embedded systems, java based embedded systems design.

UNIT IV REAL TIME OPERATING SYSTEMS**10 hrs.**

Introduction to real time theory – operating systems – OS services – real time operating systems concepts – real time kernel –kernel services – task scheduling – interrupt processing – clocking communication & synchronization – control blocks, memory requirements and control – basic design using RTOS

UNIT V DESIGN EXAMPLES**10 hrs.**

Cell phones, smartcard, digital thermometer – personal digital assistants – set top boxes – inkjet printers – telephone PBX. introduction to micro C/OS-11 operating systems and its uses.

TEXT BOOKS:

1. Raj Kamal, "Embedded Systems- Architecture, Programming And Design", Tata Mcgraw Hill, 2003.

REFERENCE BOOKS:

1. Wayen Wolf, "Computer As Components-Principles of Embedded Computing Systems Design", Harcourt India pvt Ltd., 2001.
2. David E Simon, "An Embedded Software Primer", Pearson education, 2004.
3. Sriram V Iyer, Pankaj Gupta, "Embedded real-time systems programming", Tata Mcgraw Hill, 2004.
4. K.V.K.K. Prasad, "Embedded/real-time system: concepts, design and programming", Dreamtech press, 2004.

UNIVERSITY EXAM QUESTION PAPER PATTERN

Max.Marks : 80

Exam Duration : 3 hrs

PART A : 2 Questions from each unit, each carrying 2 marks

20 marks

PART B : 2 Questions from each unit with internal choice, each carrying 12 marks

60 marks

SICX1019	INSTRUMENTATION AND CONTROL IN IRON AND STEEL INDUSTRIES (Common to E&C & EIE)	L	T	P	Credits	Total Marks
		3	0	0	3	100

UNIT I INTRODUCTION TO FURNACES**10 hrs.**

Process description in diagrammatic and functional block details – raw materials preparation – operation of blast furnace (BF) and auxiliary units including stoves – basic oxygen furnace (BoF) – electric furnace (EF) – open hearth furnace (OHF) – relative merits of various steel making furnaces.

UNIT II CASTING AND ROLLING**10 hrs.**

Quality of steel – impurities present and allowed limits for usable steel – waste recycling. Continuous casting and batch casting of steel – primary and secondary rolling – features of cold rolling – steel finishing operations.

UNIT III MEASUREMENTS IN IRON AND STEEL INDUSTRIES**10 hrs.**

Identification of various process parameters in the industry – selection of suitable measurement hardware for temperature, pressure, level, flow, weighing and proportioning – special gauges for measurement of thickness and shape – Control room layout for mill operations – graphic displays – alarm management.

UNIT IV CONTROL APPLICATION**10 hrs.**

Special applications for controls – Blast Furnace (BF) Stove combustion control system – gas and water control system in Basic Oxygen Furnace (BoF) – Mould Level control system in Strand Casting operations.

UNIT V EVOLUTION OF COMPUTER APPLICATIONS**10 hrs.**

Evolution of computer applications in the industry – Review of data logging, SCADA, DDC and DCS. Practices for model calculating and data logging – steel rolling mill control – annealing process control – utilities management with computer system.

TEXT BOOK:

1. Liptak, Bela G, Instrumentation in the Processing Industries, Chilton Publishers, 1973.

REFERENCE BOOKS:

1. Considine D. M., Process/Industrial Instruments and control Handbook, McGraw Hill, 4th edition 1993.
2. Serop Kalpakjian, Manufacturing Engineering and Technology, Addison Wesley Publishing Company, Massachusetts, 3rd edition, 1995.
3. Robert H. Perry, D.W. Green and J.O. Maloney, Perry's Chemical Engineers, Handbook, McGraw Hill Inc, New York, 7th ed, 1998.

UNIVERSITY EXAM QUESTION PAPER PATTERN

Max.Marks : 80

Exam Duration : 3 hrs.

PART A : 2 Questions from each unit, each carrying 2 marks

20 marks

PART B : 2 Questions from each unit with internal choice, each carrying 12 marks

60 marks

SEEX1013	POWER ELECTRONICS (Common to EEE, EIE, ECE, ETCE & E&C)	L	T	P	Credits	Total Marks
		3	0	0	3	100

UNIT I POWER SEMICONDUCTOR DEVICES**10 hrs.**

Overview of V-I characteristics of switching devices – Power Diode, BJT, Switching characteristics of power MOSFETS, IGBT and Thyristor – SCR Protection circuits – firing circuits – Commutation techniques.

UNIT II PHASE CONTROLLED RECTIFIERS**10 hrs.**

Principle of phase controlled converter operation – single phase semi converter & full converter with R, RL & RLE load – Freewheeling diode – Inverter operation of full converter – Three phase Semi converter & full converter with RLE load.

UNIT III DC & AC CHOPPERS**10 hrs.**

DC – DC Chopper: Step down and step up choppers – One, two and four quadrant operation.

AC – AC Chopper: Single phase AC voltage controllers with R & RL load – Multistage sequence control. Single phase step up and step down cycloconverters.

UNIT IV INVERTERS**10 hrs.**

Principle of operation : Single phase half bridge & full bridge voltage source inverters – Three phase Voltage source inverters (120° and 180° mode) – Single phase current source inverter. PWM techniques : Single pulse PWM, Sinusoidal PWM, Modified sinusoidal PWM and multiple PWM

UNIT V APPLICATIONS**10 hrs.**

SMPS : Flyback and Push Pull – UPS : Redundant and Non-Redundant – HVDC Transmission systems – Single phase full converter fed DC drives. Inverters for standalone and grid connected photovoltaic systems.

Total No of Hours: 50 hrs.**TEXT BOOKS:**

1. Rashid M.H., "Power Electronics circuits Devices and Applications", Prentice Hall, 3rd Edition, New Delhi, 2004
2. P.S.Bimbhra, "Power Electronics", Khanna Publishers, 3rd Edition, 2003

REFERENCE BOOKS:

1. P.C.Sen, " Power Electronics", Tata Mc Graw Hill Company, New Delhi, 1987.
2. M.D.Singh and K.B.Khanchandani, "Power Electronics" TMH, New Delhi, 2nd edition, 2007.
3. Dubey G.K., Doradla S.R., Joshi A and Sinha R.M., "Thyristorised Power Controllers" – Wiley Eastern Limited 1986.
4. Ned Mohan, " Power Electronics", 2nd Edition, 2001.

UNIVERSITY EXAM QUESTION PAPER PATTERN

Max Marks : 80

Exam Duration : 3 Hrs

PART A : 2 Questions from each unit, each carrying 2 marks

20 marks

PART B : 2 Questions from each unit with internal choice, each carrying 12 marks

60 marks

(Distribution may be 90% Theory & 10 % Numerical)

SICX1021	FIBER OPTICS AND LASER INSTRUMENTATION (Common to E&C, EIE, EEE & ETC)	L	T	P	Credits	Total Marks
		3	0	0	3	100

UNIT I OPTICAL FIBERS AND THEIR PROPERTIES**10 hrs.**

Principles of light propagation through a fiber – different types of fibers and their properties transmission characteristics of optical fiber – absorption losses – scattering losses-dispersion – optical fiber measurement – optical sources – optical detectors –LED-LD-PIN and APD.

UNIT II INDUSTRIAL APPLICATION OF OPTICAL FIBERS**10 hrs.**

Fiber optic sensors – fiber optic instrumentation system –different types of modulators – detectors – application in instrumentation – interferometric method of measurement of length – moiré fringes – measurement of pressure, temperature, current, voltage, liquid level and strain –fiber optic gyroscope – polarization maintaining fibers.

UNIT III LASER FUNDAMENTALS**10 hrs.**

Fundamental characteristics of Lasers – three level and four level lasers – properties of laser – laser modes – resonator configuration – Q-switching and mode locking – cavity dumping – types of lasers – gas lasers, solid lasers, liquid lasers semi conductor lasers.

UNIT IV INDUSTRIAL APPLICATIONS OF LASERS**10 hrs.**

Laser for measurement of distance, length, velocity, acceleration, current, voltage and atmospheric effect – material processing – laser heating, welding melting and trimming of materials – removal and vaporization.

UNIT V HOLOGRAM AND MEDICAL APPLICATION**10 hrs.**

Holography – basic principle, methods, holographic interferometry and applications, holography for non-destructive testing – holographic components- medical applications of lasers – laser and tissue interaction – laser instruments for surgery, removal of tumors of vocal cords, brain surgery, plastic surgery, gynecology and oncology.

TEXT BOOK:

1. Ghatak A.K. and Thiagarajar K, "Optical Electronics Foundation Book", TMH, New Delhi, 1991.

REFERENCE BOOKS:

1. John and Harry, "Industrial lasers and their applications", McGraw Hill, 1974.
2. John F Ready, "Industrial applications of lasers", Academic Press, 1978.
3. Monte Ross, "Laser applications", McGraw Hill, 1968.
4. Jasprit Singh, "Semi conductor Optoelectronics", McGraw Hill, 1995.

UNIVERSITY EXAM QUESTION PAPER PATTERN

Max.Marks : 80

Exam Duration : 3 hrs

PART A : 2 Questions from each unit, each carrying 2 marks

20 marks

PART B : 2 Questions from each unit with internal choice, each carrying 12 marks

60 marks