Approved Syllabus (V to VIII semesters)

of UG Programme BE in

“Electronics and Instrumentation Engineering” (EI)

V SEMESTER

MANAGEMENT AND ENTREPRENEURSHIP

Sub Code	**:**	**10 AL 51**	**IA Marks**	**:**	**25**
Hrs/Week	**:**	**04**	**Exam Hours**	**:**	**03**
Total Hrs	**:**	**52**	**Exam Marks**	**:**	**100**

PART –A
MANAGEMENT

UNIT -1

MANAGEMENT : Introduction – Meaning – nature and characteristics of Management, Scope and functional areas of Management – Management as a Science, Art or Profession Management & Administration – Roles of Management, Levels of Management, Development of Management Thought – Early Management Approaches – Modern Management Approaches.

7 Hours

UNIT -2

PLANNING: Nature, importance and purpose of planning, process objectives – Types of plans (Meaning only) – Decision making – Importance of planning – steps in planning & planning premises – Hierarchy of plans.

6 Hours

UNIT -3

ORGANIZING AND STAFFING: Nature and purpose of organization - Principles of organization – Types of organization - Departmentation – Committees – Centralization Vs decentralization of authority and responsibility – Span of control – MBO and MBE (Meaning only) Nature and importance of Staffing – Process of Selection & Recruitment (in brief).

7 Hours

UNIT -4

DIRECTING & CONTROLLING: Meaning and nature of directing-Leadership styles, Motivation Theories, Communication – Meaning and importance – Coordination, meaning and importance and Techniques of Co-ordination. Meaning and steps in controlling – Essentials of a sound control system –Methods of establishing control.

6 Hours

PART – B
ENTREPRENEURSHIP

UNIT -5

ENTREPRENEUR: Meaning of Entrepreneur, Evolution of the Concept, Functions of an Entrepreneur, Types of Entrepreneur, Intrapreneur – an emerging Class. Concept of Entrepreneurship – Evolution of Entrepreneurship, Development of Entrepreneurship; Stages in entrepreneurial process ; Role of entrepreneurs in Economic Development ; Entrepreneurship in India; Entrepreneurship – its Barriers.

6 Hours

UNIT -6

SMALL SCALE INDUSTRY: Definition; Characteristics; Need and rationale: Objectives; Scope; role of SSI in Economic Development. Advantages of SSI, Steps to start an SSI – Government policy towards SSI; Different Policies of S.S.I; Government Support for S.S.I. during 5 year plans, Impact of Liberalization, Privatization, Globalization on S.S.I, Effect of WTO/GATT Supporting Agencies of Government for S.S.I, Meaning ; Nature of Support ; Objectives ; Functions ; Types of Help ; Ancillary Industry and Tiny Industry (Definition only).

7 Hours

UNIT -7

INSTITUTIONAL SUPPORT: Different Schemes: TECKSOK, KIADB, KSSIDC, KSIMC, DIC Single Window Agency: SISI; NSIC; SIDBI; KSFC.

6 Hours

UNIT -8

PREPARATION OF PROJECT: Meaning of project, project Identification, Project Selection, Project Report, Need and Significance of Report, Contents, formulation, Guidelines by Planning Commission for Project report, network Analysis, Errors of Project Report, Project Appraisal. Identification of Business Opportunities – Market Feasibility Study; Technical Feasibility Study; Financial Feasibility Study & Social Feasibility Study.

7 Hours

TEXT BOOKS:

1. **Principles of Management** – P.C Tripathi, P.N.Reddy, Tata McGraw Hill, 4th Edition, 2010.
2. **Dynamics of Entrepreneurial Development & Management** – Vasant Desai, Himalaya Publishing House, 2011
3. **Entrepreneurship Development-Small Business Enterprises** – Poornima M. Charantimath, Pearson Education, 2006 (2 & 4**).**

REFERENCE BOOKS:

1. **Management Fundamentals** – Concepts, Application, Skill Development -Robert Lusier, 5th edition, Thomson Publications, 2011.
2. **Entrepreneurship Development** – S. S. Khanka, S Chand & Co., 2007.
3. **Management** – Stephen Robbins, Pearson Education / PHI – 17th Edition, 2003.

ADVANCED CONTROL SYSTEMS

Sub Code	**:**	**10 EI 52**	**IA Marks**	**:**	**25**
Hrs/Week	**:**	**04**	**Exam Hours**	**:**	**03**
Total Hrs	**:**	**52**	**Exam Marks**	**:**	**100**

PART –A

UNIT -1

NONLINEAR SYSTEMS: Introduction, Common physical nonlinearities. Phase plane Method: Basic concepts singular points, Stability of non –linear system, Construction of phase trajectories, System - analysis by phase-plane method.

7 Hours

UNIT -2

NON –LINEAR SYSTEM ANALYSIS USING DESCRIBING FUNCTION METHOD: Describing function Method: Basic Concepts, Derivation of describing function, stability analysis by describing function method, Jump resonance, Liapunov's stability criteria, Popov's stability criteria.

6 Hours

UNIT-3

STATE-SPACE ANALYSIS OF CONTROL SYSTEMS-1: State- space representation of continuous – time systems, Solving time variant state equations, Transfer function, State Transition matrix.

7 Hours

UNIT – 4

STATE-SPACE ANALYSIS OF CONTROL SYSTEMS-2: State- space representation of discrete – time systems, Solving time variant state equation, Transfer Function, State Transition matrix.

6 Hours

PART –B

UNIT-5

SAMPLED DATA CONTROL SYSTEMS: Introduction, Spectrum, Analysis of sampling process, Signal reconstruction, Difference Equations, Z- transform, Z- transfer function (pulse transfer function).Stability analysis in Z – plane, Jury's Stability Test, Bi – Linear Transformation.

7 **Hours**

UNIT – 6

POLE PLACEMENT: Controllability, Observability for continuous time systems, Pole placement design and state observers.

6 Hours

UNIT -7

OPTIMAL AND ADAPTIVE CONTROL SYSTEMS: Optimal control system based on quadratic performance index. Adaptive controller (block diagram description only) and model reference adaptive control (block diagram description only).

6 Hours

UNIT -8

COMPENSATION TECHNIQUES: Lead, Lag, Lead-lag network and compensator, Design using Root locus techniques, Feedback Compensation.

7 Hours

TEXT BOOKS:

1. **Modern Control Engineering** – K. Ogata, 3rd Edition, Prentice Hall of India, 1997.
2. **Discrete Time Control Systems** – K. Ogata, 2nd Edition, Prentice Hall of India, 1995.
3. **Control Systems Engineering** – J. Nagarath & M. Gopal, New Age Int. Pvt. Ltd.Publishers, 5th Edn 2008. (Unit1,2 & 7)
4. **Advanced Control Theory** – A. Nagoor Kani, 2nd Edition, RBA Publications, 1999 (Unit 7 & 8)

REFERENCE BOOKS:

1. **Digital Control and State Variable Methods**- Madan Gopal, 2nd edition, TMH, 2006.
2. **Modern Control Engineering** – Roy Choudhury, Prentice Hall of India, 2005.

MICROPROCESSOR & PERIPHERALS

Sub Code	**:**	**10 EI 53**	**IA Marks**	**:**	**25**
Hrs/Week	**:**	**04**	**Exam Hours**	**:**	**03**
Total Hrs	**:**	**52**	**Exam Marks**	**:**	**100**

PART-A

UNIT-1

INTEL 8086 MICROPROCESSOR: Architecture of 8086, Register organization, Signal description, Physical memory organization, General bus operation, Input/output addressing capability, Special processor activities, Minimum and Maximum mode of 8086 system and timings.

7Hours

UNIT-2

8086 Machine language instruction formats, Addressing modes - Register, Immediate, Direct, Register indirect, Base plus index, Register relative and Base relative plus index addressing modes. Assembler directives –Symbols, variables, constants, different types of directives, Programming examples.

6Hours

UNIT-3

INSTRUCTION SET OF 8086 MICROPROCESSOR – Data transfer instructions, Arithmetic and logical instructions, conditional and unconditional branch instructions, String instructions, Looping instructions, Machine control instructions, Shift and rotate instructions, Assembly language programming .

7Hours

UNIT-4

Introduction to stack, Stack structure of 8086, Interrupts and interrupt service routines, Interrupt cycle of 8086, Nonmaskable interrupt, Maskable interrupt (INTR).Interrupt programming, Timing and delays, Macros.

6Hours

PART-B

UNIT-5

PERIPHERALS AND THEIR INTERFACING WITH 8086-Static and dynamic RAM interfacing, Input and output ports Interfacing, Stepper motor Interfacing, Interfacing of Analog to digital converter and Digital to analog converter.

7Hours

UNIT-6

PROGRAMMABLE INPUT-OUTPUT PORT (PIO) 8255- Modes of operation of 8255, Key board and display interfacing, Control of high power devices using 8255, programming examples.

6 Hours

UNIT-7

SPECIAL PURPOSE PROGRAMMABLE PERIPHERAL DEVICES AND THEIR INTERFACING- Programmable interval timer 8253, Programmable Interrupt controller 8259A, Key board display controller 8279, Programmable communication Interfacing 8251 UART.

7 Hours

UNIT-8

DMA CONTROLLER- DMA Transfer and operations, programmable DMA Interface 8237, Numeric processor 8087-Numeric data processor and interfacing.

6 Hours

TEXT BOOKS

1. **Advanced Microprocessor and Peripherals** –A. K Ray and K.M. Bhurchandi, Tata McGraw Hill, 2007.
2. **Microprocessor X86 Programming -** K.R. Venugopal and Rajakumar, BPB Publications, 2003.

REFERENCE BOOKS:

1. **Microcomputer systems 8086/8088 family, Architecture, Programming and Design** – Yu Cheng Liu & Glenn A Gibson, 2nd Edition, Prentice Hall of India, July 2003.
2. **Microprocessor and Interfacing, Programming & Hardware Douglas V Hall**, 2nd Edition, Penram International, 2006.
3. **Microprocessor Architecture, Programming and Applications with the 8085** – Ramesh S Gaonkar, 4th Edition, Penram International, 2000.
4. **The Intel Microprocessor - Barry. B. Bray,** 4th Edition, PHI, 1997.

DIGITAL SIGNAL PROCESSING

Sub Code	**:**	**10 EI 54**	**IA Marks**	**:**	**25**
Hrs/Week	**:**	**04**	**Exam Hours**	**:**	**03**
Total Hrs	**:**	**52**	**Exam Marks**	**:**	**100**

PART –A

UNIT-1

DISCRETE FOURIER TRANSFORM-1: Definition of DFT and IDFT, DFT as a linear transformation, relationship between DFT and Z-transform, properties of DFT - Periodicity, linearity and symmetry properties, multiplication of two DFT's and circular convolution, Computation of DFT and IDFT.

7 Hours

UNIT -2

DISCRETE FOURIER TRANSFORM-2: Additional DFT Properties, Linear filtering methods based on the DFT, use of the DFT in linear filtering, filtering of long data sequences.

6 Hours

UNIT -3

FAST FOURIER TRANSFORM: Direct computation of DFT, Efficient Computation of DFT, Radix- 2 FFT algorithms, Decimation in time & Decimation in frequency FFT, Radix -2 inverse FFT, Composite Radix FFT, Goertzel algorithm, Chirp-z transform algorithm.

7 Hours

UNIT -4

ANALOG FILTER DESIGN: Filter design problem, time domain approximation, frequency domain approximation, maximally flat low pass filter approximation, Chebyshev LPF approximation , comparison between Butterworth and Chebyshev filters, frequency transformation.

6 Hours

PART –B

UNIT -5

DESIGN OF IIR DIGITAL FILTERS: Design of IIR Digital Filters by approximation of Derivatives, Impulse invariance transformation, Bi-linear transformation, Design examples, frequency transformation.

7 Hours

UNIT -6

DESIGN OF FIR DIGITAL FILTERS: Properties of FIR filters, magnitude specifications of FIR filters, symmetric & antisymmetric FIR filters, Design of linear phase FIR filters using windows (Rectangular, Hamming, Hanning and Kaiser windows), Design of linear phase FIR filter using frequency sampling method.

6 Hours

UNIT -7

DIGITAL FILTER STRUCTURES: Realization of digital filters, Basic building blocks of digital filter, structures for IIR system, direct form, cascade form and parallel form structures, structures for FIR system, direct form, cascade form and lattice structures.

7 Hours

UNIT -8

MULITIRATE DIGITAL SIGNAL PROCESING: Decimation process, Interpolation process, Digital filter banks, DFT filter banks, Quadrature mirror filter banks.

ADAPTIVE FILTERS: Introduction, structure of adaptive filter, LMS adaptive algorithm, Applications.

6 Hours

TEXT BOOKS:

1. **Digital Signal Processing** - PROAKIS and MANOLAKIS, 4th Edition, Prentice Hall of India / Pearson, 2006.
2. **Modern Digital Signal Processing** – Includes Signals and Systems MATLAB Programs DSP Architecture with Assembly and C Programs – V. Udayashankara, Prentice Hall of India New Delhi, 2012 (Unit-8).
3. **Network analysis and synthesis** – FF KUO, 2nd edition, John Wiley and Sons, (Unit-4) 2002.

REFERENCE BOOKS:

1. **Digital Signal Processing** – ALAN V OPPENHEIM, Prentice Hall of India, 1975
2. **Introduction to Digital Signal Processing** – JOHNSON, Prentice Hall of India, 1999.
3. **Digital Signal processing** – Fundamentals and Applications – Li Tan – Academic press – Elsevier, 2007.

BIOMEDICAL INSTRUMENTATION

Sub Code	**:**	**10 EI 55**	**IA Marks**	**:**	**25**
Hrs/Week	**:**	**04**	**Exam Hours**	**:**	**03**
Total Hrs	**:**	**52**	**Exam Marks**	**:**	**100**

PART –A

UNIT-1

FUNDAMENTALS: Sources of biomedical signals, Basic Medical Instrumentation system, General constraints in design of biomedical instrumentation systems.

BIOELECTRIC SIGNALS AND ELECTRODES : Origin of Bioelectric signals, Types of bioelectric signals, Recording electrodes, Electrode – Tissue interface, polarization, skin contact- impedance, silver-silver chloride electrodes, Electrodes for ECG, EEG, EMG, Microelectrodes.

7 Hours

UNIT- 2

ELECTRO CARDIOGRAPH: Physiology of the heart, Electrical activity of the heart and Electrocardiogram (ECG), Normal & Abnormal cardiac Rhythms, Block diagram-description of an Electrocardiograph, The ECG leads, Effects of artifacts on ECG Recordings, Multi- channel ECG machine.

ELECTROENCEPHALOGRAPH: Block diagram description of an Electroencephalograph, 10-20 electrode systems, computerized analysis of EEG.

7 Hours

UNIT -3

PATIENT MONITORING SYSTEM: Bedside patient monitoring systems, Central monitors, Measurement of heart rate – Average heart rate meter, Instantaneous heart rate meter, Measurement of pulse rate.

6 Hours

UNIT -4

BLOOD PRESSURE MEASUREMENT: Direct method of monitoring Blood pressure, Indirect methods of Blood pressure measurements-Automatic Blood pressure measuring apparatus using Korotkoff's method, Rheographic method, Ultrasonic Doppler shift method.

BLOOD FLOW METERS: Electromagnetic blood flow meters, Ultrasonic blood flow meter – Doppler shift flow velocity meters. NMR blood flowmeter.

6 Hours

PART – B

UNIT -5

CARDIAC OUTPUT MEASUREMENT: Indicator dilution method, Dye dilution method, Thermal dilution techniques, Measurement of continuous cardiac output derived from the aortic pressure waveform, Impedance technique.

6 Hours

UNIT – 6

CARDIAC PACEMAKERS AND DEFIBRILLATORS: Need for cardiac pacemaker, External pacemaker, Implantable pacemaker, Types of Implantable pacemakers, Programmable pacemakers, Rate-responsive pacemakers, Power sources for Implantable pacemaker, Need for a Defibrillator, DC defibrillator, Implantable defibrillators.

7 Hours

UNIT – 7

BIOMEDICAL TELEMETRY & TELEMEDICINE: Wireless Telemetry single channel Telemetry systems-ECG Telemetry system, Multichannel wireless telemetry system – Telemetry of ECG & Respiration, Multipatient Telemetry, Implantable Telemetry systems.

TELEMEDICINE: Applications, concept, essential parameter for Telemedicine, Telemedicine Technology, Video conferencing, Digital Communication systems ,Telemedicine using Mobile Communication.

6 Hours

UNIT -8

PULMONARY FUNCTION ANALYZER: Pulmonary function measurement, Spirometry, Pneumotachometer, Measurement of volume –flow volume curve, Nitrogen washout technique. Patient Safety: Electric shock hazards, Leakage currents.

7 Hours

TEXT BOOKS:

1. **Handbook of Biomedical Instrumentation** - R.S.Khandupur, 2nd Edition, Tata McGraw- Hill, 2003
2. **Medical Instrumentation Application & Design -** John G. Webster, 3rd Edition, John Wiley, 1997.

REFERENCE BOOK:

1. **Biomedical Instrumentation & Measurement** - Leslie Cromwell & Others, 2nd Edition, Prentice Hall of India, 1979.

PROCESS INSTRUMENTATION

Sub Code	**:**	**10 EI 56**	**IA Marks**	**:**	**25**
Hrs/Week	**:**	**04**	**Exam Hours**	**:**	**03**
Total Hrs	**:**	**52**	**Exam Marks**	**:**	**100**

PART-A

UNIT -1

GENERALIZED CONFIGURATION, FUNCTIONAL DESCRIPTION AND PERFORMANCE CHARACTERSTICS OF MEASURING INSTRUMENTS: Functional elements of an instrument, Analog and digital modes of Operation. Null and deflection methods, I/O configuration of Measuring Instruments and measurement systems. Methods of correction for interfering and modifying inputs, Measurement of displacement - Principle of Measurement, Digital displacement Transducers, Ultrasonic Displacement Transducers.

6 Hours

UNIT -2

MEASUREMENT OF FORCE AND TORQUE: Principle of Measurement of force. Load cell, Column type devices, proving rings, cantilever beam, shear type load cell, pressductor, Effect of Temperature variations. Dynamic response of elastic transducer. Hydraulic load cell, electronic weighing system, Torque Measurement-Absorption, Transmission, Stress and Deflection types.

6 Hours

UNIT -3

TEMPERATURE MEASUREMENT: Standards and calibration, thermal expansion methods, bimetallic thermometers, liquid in glass thermometers, pressure thermometers, Thermo Electric sensors (Thermocouples), Reference junction considerations, special materials, configurations and Techniques, Junction semiconductor sensors, Digital thermometers.

7 Hours

UNIT -4

RADIATION METHODS FOR TEMPERATURE MEASUREMENT: Radiation fundamentals, Radiation detectors, unchopped (DC) broad band radiation thermometers. Chopped (AC) selective bond (photon) radiation thermometers. Automatic Null balance Radiation thermometers, Monochromatic Brightness Radiation thermometers (optical pyrometers) Two colour Radiation thermometers. Blackbody – Tipped Fiber – Optic Radiation thermometers.IR Imaging systems Fluoroptic Temperature Measurement.

7 Hours

PART – B

UNIT -5

PRESSURE MEASUREMENT: Basic principle of pressure Measurement. Diaphragms, Flat and corrugated diaphragms, capsules, Bourdon tubes, Bellows. Force balance pressure Transducer, Solid state Needle pressure Transducer, Thin film pressure Transducer, Digital pressure Transducer, piezoelectric pressure Transducer, pressure Multiplexer, pressure calibration

7 Hours

UNIT -6

FIOW MEASUREMENT: Classification of Flow Meters. Head type flow meters, Rotameters, Electromagnetic Flow Meters, Mechanical Flow Meters, Anemometers, Ultrasonic flow meters, Votex flow meters.

7 Hours

UNIT -7

VIBRATION MEASUREMENT: Principle of vibration Measurement, characteristics of vibration. Analysis of vibration sensing devices. Vibration sensing devices, signal conditioners Vibration exciters.

6 Hours

UNIT -8

LEVEL MEASUREMENT: Capacitance probe, conductivity probes, diaphragm level detector, Differential pressure level detector. Radiation level sensors. Level Transmitters. Ultrasonic level detector.

6 Hours

TEXT BOOKS:

1. **Measurement Systems application and design** - ERNEST O. DOEBLIN. 5th Edition, Tata McGraw Hill (Unit 1, 3 and 4), 2004.
2. **Instrumentation Devices and Systems** - C S Rangan, G R. Sharma and VSV Mani, 2nd Edition, Tata McGraw Hill, (Unit 2, 5, 6 and 7), 2001.
3. **Instrument Engineers Hand book** (Process Measurement), B.G. Liptak, Chiltan Book company (Unit 8) 4th edition 2003.

REFERENCES BOOKS:

1. **Transducers and Instrumentation** - by DVS Murty - Prentice Hall of India 2nd Edition, 2009.

ANALOG IC LAB

Sub Code	**:**	**10 EIL 57**	**IA Marks**	**:**	**25**
Hrs/Week	**:**	**03**	**Exam Hours**	**:**	**03**
Total Hrs	**:**	**42**	**Exam Marks**	**:**	**50**

1. Measurement of Opamp parameters (input offset current, input bias current, slew rate, input offset voltage, PSRR, CMRR)
2. Inverting amplifier & noninverting amplifier.
3. Adder, subtractor, integrator, differentiator.
4. I to V converter & V to I converter.
5. Half wave & full wave precision rectifiers.
6. Design of low pass filters (Butterworth I & II order).
7. Design of high pass filters (Butterworth I & II order).
8. Instrumentation amplifier – Design for different gains.
9. RC phase shift and Wein bridge Oscillators.
10. Zero Crossing Detector (ZCD), positive voltage level & negative voltage level detectors.
11. Schmitt trigger – design for different hysteresis .
12. Design of astable and monostable multivibrator using 555 timer.
13. Low voltage and high voltage regulators using LM723.

Note: i. Standard design procedure to be adopted.
ii. Students should build the circuit using discrete components and IC's (models are not to be used).

MICROPROCESSOR LAB

Sub Code	**:**	**10 EIL 58**	**IA Marks**	**:**	**25**
Hrs/Week	**:**	**03**	**Exam Hours**	**:**	**03**
Total Hrs	**:**	**42**	**Exam Marks**	**:**	**50**

PART-A

Write and execute Assembly Language Programs for the following:

1. To move a block of N bytes of data from source to destination.
2. To find sum of N array elements [16 bit and 8 bit].
3. Multiplication & Division of two 16 bit numbers.
4. To sort a set of unsigned integer numbers [16 bit] in an ascending/descending order using insertion sort method.
5. To add two 16 bit signed numbers stored in memory locations NUM1 and NUM2. If there is an overflow give a message "The output over flows" using a DOS interrupt function.
6. To find GCD of two 16 bit unsigned integers.
7. To sort a set of unsigned integer numbers [16 bit] in an ascending/descending order using bubble sort method.
8. To find an average of N 16 bit unsigned integer numbers.
9. To find the number of ones in a given block of data
10. To compute a factorial of a positive integer using recursive procedure.
11. To separate the odd and even numbers in a block of data.
12. Conversion of 16 bit: 1) BCD to HEX 2) HEX to BCD.
13. Conversion of 16 bit: 1) ASCII to BCD 2) HEX to ASCII.

PART-B

INTERFACING PROGRAMS

1. Generate a square wave on PC0 pin of 8255 in the add-on card
2. Generate different wave forms like sine, square, Triangle, Ramp using DAC Interface.
3. To identify the key function using key board interface
4. To display a character using seven segment display
5. Interface an 8-bit ADC and write program to store the converted data in memory location.

VI SEMESTER

COMMUNICATION SYSTEMS

Sub Code	**:**	**10 EI 61**	**IA Marks**	**:**	**25**
Hrs/Week	**:**	**04**	**Exam Hours**	**:**	**03**
Total Hrs	**:**	**52**	**Exam Marks**	**:**	**100**

PART –A

UNIT -1

INTRODUCTION TO COMMUNICATION SYSTEMS: Block diagram of communication system, Modulation and need for modulation, Amplitude modulation, Frequency spectrum of AM wave, Power relations in the AM wave, Generation of AM.

7 Hours

UNIT -2

SINGLE SIDE BAND TECHNIQUES: Evolution and description of SSB, Suppression of carrier, Effects of non linear resistance on added signals, Balanced modulator, Suppression of unwanted sideband: Filter system, Phase shift method and Third method, system evaluation and comparison.

6 Hours

UNIT -3

ANGLE MODULATION-1: Independent sideband systems, vestigial sideband transmission, Theory of Frequency and phase modulation, Mathematical representation of FM wave, Frequency spectrum of the FM wave, Phase modulation, Intersystem comparisons.

7 Hours

UNIT – 4

ANGLE MODULATION-2: Noise triangle, Pre-emphasis and De-emphasis, Generation of frequency modulation, Direct methods, Varactor diode modulator, Stabilized reactance modulator, Indirect method, Armstrong frequency modulation system.

6 Hours

PART –B

UNIT – 5

COMMUNICATION SYSTEM RECEIVERS: Tuned Radio F frequency (TRF) receiver, Super heterodyne receiver, AM receivers, RF section and characteristics, Sensitivity, Selectivity, Image frequency and its rejection, Intermediate frequencies and IF amplifiers.

7 Hours

UNIT -6

AM DETECTOR CIRCUITS: AM detection and automatic gain control, Practical diode AM detector, Basic block diagram of communication receiver, Beat-frequency oscillators, Noise limiter and Squelch (muting) circuit.

6 Hours

UNIT -7

FM RECEIVERS: Comparison with AM receivers, Amplitude limiting, Basic FM demodulator, Balanced slope detector, Phase discriminator, Ratio detector, FM demodulator, Single and independent sideband receivers, Product demodulator, Pilot carrier, SSB receiver, Suppressed carrier (ISB) receiver.

6 Hours

UNIT -8

PULSE COMMUNICATIONS: Introduction, Sampling theorem, Nyquist rate and Nyquist interval, Ideal sampling, Natural sampling, Flat top sampling, Comparison of various sampling techniques, Pulse amplitude modulation and demodulation, Pulse time modulation and demodulation, Comparison of various pulse– analog modulation methods, Pulse code modulation, PCM transmitter and receiver, Concept of quantization, Quantization noise, Companding and its characteristics, advantages, disadvantages and applications of P.C.M .

7 Hours

TEXT BOOKS:

1. **Electronic Communication Systems** by Kennedy and Davis, 4th Edition, TMH, 2005.
2. **Digital Communications by Sanjay Sharma** 1st Edition, K. Kataria & Sons Pub., New Delhi, 2006.

REFERENCES BOOKS:

1. **Electronic Communication** by Dennis Roddy and J Coolen, 4th Edition, Pearson Education, 2003.
2. **Principles of Communication Systems** by Taub and Schilling, 2nd Edition, TMH, 1996.

C+ + AND DATA STRUCTURES

Sub Code	**:**	**10 EI 62**	**IA Marks**	**:**	**25**
Hrs/Week	**:**	**04**	**Exam Hours**	**:**	**03**
Total Hrs	**:**	**52**	**Exam Marks**	**:**	**100**

PART –A

UNIT -1

C++ PROGRAMMING – BASICS: Need for object oriented programming, procedural languages, characteristics of OOP, preprocessor directives, data type, manipulators.

6 Hours

UNIT – 2

STRUCTURES: Structures, enumerated data types, Boolean type, Functions: passing arguments, returning values, reference arguments, overloaded functions, inline functions, variable and storage classes.

7 Hours

UNIT – 3

OBJECTS AND CLASSES: Objects as data types, constructors, destructors, overloaded constructors.
Arrays: arrays as class member data types, passing arrays, arrays as objects, strings, arrays of strings.

7 Hours

UNIT -4

OPERATOR OVERLOADING: Over loading of unary operators, binary operators, data conversion.

6 Hours

PART –B

UNIT -5

INHERITANCE: Inheritance, derived class and base class, overriding member functions, scope resolution, levels of inheritance, multiple inheritance.

7 Hours

UNIT-6

Pointers, Pointers to objects, linked list, virtual functions, functions, files and streams, input/output operations.

7 Hours

UNIT – 7

DATA STRUCTURES: Data representation, matrices, stacks, Queues, skip lists and hashing.

6 Hours

UNIT -8

BINARY TREES: Binary tree operation, representation of binary trees, binary tree transversals, representing list binary trees, searching an element in binary tree, deleting a tree, applications of binary tree.

6 Hours

TEXT BOOKS:

1. **Object oriented programming in TURBO C++ -** Robert Lafore, Galgotia Publications, 2002
2. **Date Structures, Algorithms and Applications in C++ :** Sartaj Sahni, Tata McGraw Hill, 2000.

REFERENCE BOOKS:

1. **Object Oriented Programming with C++,** E Balaguruswamy, 3rd Edition, Tata McGraw Hill, 2006.

PROCESS CONTROL SYSTEMS

Sub Code	**:**	**10 EI 63**	**IA Marks**	**:**	**25**
Hrs/Week	**:**	**04**	**Exam Hours**	**:**	**03**
Total Hrs	**:**	**52**	**Exam Marks**	**:**	**100**

PART – 1

UNIT – 1

INTRODUCTION TO PROCESS CONTROL AND MATHEMATICAL MODELING FOR PROCESS CONTROL: Process control principles, process- control block diagram, control system evaluation, Development of a mathematical model for stirred tank heater, continuously stirred tank reactor, modeling difficulties.

6 Hours

UNIT – 2

MODELING CONSIDERATIONS AND DYNAMIC BEHAVIOR OF FIRST ORDER AND SECOND ORDER SYTEMS : Degrees of freedom, degrees of freedom for process controllers, Processes modeled as first order systems with a capacity for mass and energy storage, dynamic response of a pure capacitive system, First order lag system and second order system, multicapacity processes as second order systems.

7 Hours

UNIT – 3

FINAL CONTROL OPERATIONS: Objectives, Elements of final control operation, Signal conversion, actuators, control elements, Basic instrumentation symbols.

6 Hours

UNIT – 4

CONTROLLER PRINCIPLES: Process characteristics, control system parameters, discontinuous controller modes, continuous controller modes, composite controller modes.

7 Hours

PART –B

UNIT – 5

ANALOG CONTROLLERS: General features, Electronic controllers**,** Error detector, Single mode, composite controller modes, Pneumatic controllers, Design considerations.

6 Hours

UNIT – 6

DIGITAL CONTROLLERS: Digital electronic methods, Simple alarms, Two position control, Multivariable alarms, Data loggers, Direct digital and Supervisory control.

6 Hours

UNIT – 7

PARADIGM OF PROCESS CONTROL: Cascade control systems, Selective control systems, Split- range control systems, Feed forward and Ratio control systems.

7 Hours

UNIT – 8

CONTROL-LOOP CHARACTERISTICS, ADAPTIVE & INFERENTIAL CONTROL SYSTEMS: Control system quality, measure of quality, Process loop tuning, Open - loop transient response method, Ziegler _ Nichols method, Programmed or scheduled adaptive control, Model – reference adaptive control, Self tuning regulator, Inferential control with examples.

7 Hours

TEXT BOOKS:

1. **Process Control Instrumentation Technology by C.D .Johnson,** 7th Edition, Pearson Education Private Limited, New Delhi 2002.
2. **Chemical Process Control** – George Stephanopoulos, 4th Indian reprint, PHI Ltd., 1997.

REFERENCE BOOKS:

1. **Process/ Industrial Instruments and Control Handbook**, 4th Edition by D.M. Considine, McGraw Hill International Edition, 1993.
2. **Computer Based Industrial Control** by Krishna Kant, PHI, New Delhi 1997.

3. **Process dynamics and control** by S.S.Bhagade and G.D.Nageshwar PHI publications New Delhi, 2011.
4. **Lessons in Industrial Instrumentation** by Tony R. Kuphaldt, Creative Commons Attribution License (open source textbook), Sept. 2008. (for basic instrumentation symbols, 6.5.1, 6.5.2, 6.5.3, 6.5.4, 6.5.9).

DSP ARCHITECTURE

Sub Code	**:**	**10 EI 64**	**IA Marks**	**:**	**25**
Hrs/Week	**:**	**04**	**Exam Hours**	**:**	**03**
Total Hrs	**:**	**52**	**Exam Marks**	**:**	**100**

PART-A

UNIT – 1

INTRODUCTION TO DIGITAL SIGNAL PROCESSING: Digital signal processing system, programmable digital signal processors, major features of programmable digital signal processors, sampling process, Design tool for DSP systems: MATLAB.

COMPUTATIONAL ACCURACY IN DSP IMPLEMENTATION: Introduction, Number formats for signals and coefficients in DSP systems, Dynamic range and precision, Sources of error in DSP implementations, A/D conversion error, DSP computational error and D/A Conversion error.

7 Hours

UNIT – 2

ARCHITECTURES FOR PROGRAMMABLE DSP DEVICES: Introduction, basic architectural features, DSP Computational building blocks, Bus architecture and memory, Data Addressing Capabilities, Address generation unit, Programmability and Program execution, Speed Issues.

6 Hours

UNIT – 3

PROGRAMMABLE DIGITAL SIGNAL PROCESSORS: Introduction, commercial digital signal-processing devices, Architecture of TMS320C54xx processors, Data addressing modes of TMS320C54xx processors, Memory space of TMS 320C54xx processors, program control.

7Hours

UNIT – 4

TMS320C54xx Instructions and programming, summary of instruction set of TMS320C54xx processors, programming examples, On-chip peripherals, Interrupts of TMS320C54xx processors, Pipeline operation of TMS320C54xx processors.

6 Hours

PART-B

UNIT – 5

IMPLEMENTATION OF BASIC DSP ALGORITHMS : Introduction, Q-notation, Linear Convolution, Circular Convolution, FIR Filters, IIR Filters, Interpolation Filters, Decimation Filters, Butterfly computation, overflow and scaling , bit-reversed index generation, 8-point FFT implementation on the TMS320C54xx

7 Hours

UNIT – 6

INTERFACING MEMORY AND PARALLEL I/O PERIPHERALS TO PROGRAMMABLE DSP DEVICES : Introduction, Memory space organization, External bus interfacing signals, Memory interface, Parallel I/O interface, Programmed I/O, Interrupts and I/O, Direct memory access (DMA).

7 Hours

UNIT – 7

INTERFACING SERIAL CONVERTERS TO A PROGRAMMABLE DSP DEVICE: Introduction, Synchronous serial Interface, A Multichannel Buffered serial port (McBSP), McBSP programming, A CODEC Interface circuit, CODEC programming, A CODEC interface example (only flowchart).

6 Hours

UNIT – 8

APPLICATIONS OF PROGRAMMABLE DSP DEVICES: Introduction, DSP –based Biotelemetry Receiver, A Speech processing system, An image processing system. A position control system for a hard disk drive.

6 Hours

TEXT BOOK:

1. **Digital Signal Processing** – Avtar Singh and S. Srinivasan, CENGAGE Learning, India Edition, Reprint 2009.

REFERENCE BOOKS:

1. **Real Time Digital Signal Processing : Fundamentals, Algorithms and Implementation Using TMS Processor** – V.Udayashankara, Prentice Hall of India, New Delhi, 2010.
2. **Digital Signal Processing**: B. Venkataramani and M Bhaskar, Tata- McGraw Hill, New Delhi, 2002
3. **Digital Signal Processing**: **A Practical Approach** - Emmanuel C Ifachor and B W Jervis, Pearson Education, New Delhi, 2001.

ANALYTICAL INSTRUMENTATION

Sub Code	**:**	**10 EI 65**	**IA Marks**	**:**	**25**
Hrs/Week	**:**	**04**	**Exam Hours**	**:**	**03**
Total Hrs	**:**	**52**	**Exam Marks**	**:**	**100**

PART –A

UNIT -1

VISIBLE ULTRAVIOLET SPECTROPHOTOMETERS: Electromagnetic radiation, Beer Lambert law, absorption instruments, colorimeters, spectrophotometers, sources of error in spectrophotometers, measurements, calibration.

6 Hours

UNIT -2

FLAME PHOTOMETERS: Principle of flame photometers, constructional details of flame photometers, clinical flame photometers, accessories of flame photometers, interference in flame photometry and determinations.

7 Hours

UNIT -3

FLUORIMETERS & PHOSPHORIMETERS: Principle of fluorescence, measurement of fluorescence, spectro-fluorimeters, microprocessor based spectrofluorometer, Measurement of phosphorescence.

6 Hours

UNIT -4

MASS SPECTROMETER & NMR SPECTROMETER: Basic mass spectrometer, types of mass spectrometer, components of mass spectrometer, resolution and applications.

Principle of NMR, constructional details, sensitivity enhancement for analytical NMR spectroscopy, use of computers with NMR spectrometers.

7 Hours

PART – B

UNIT -5

INFRARED SPECTROPHOTOMETER: Infrared spectroscopy, Basic components of infrared spectrophotometer, Types of IR spectrophotometer, Fourier transform IR spectroscopy.

Thermo-analytical Method: Thermogravimetric analysis (TGA), Differential Thermal analysis (DTA).

7 Hours

UNIT - 6

ELECTROPHORESIS AND DENSITOMETERS: Basic Electrophoresis, Electrophoresis techniques, paper Electrophoresis, Electrophoresis apparatus, spectrodensitometer, microprocessor based densitometer, microelectrophoresis.

6 Hours

UNIT - 7

CHROMATOGRAPHY: Gas chromatograph – basic concepts, parts of gas chromatograph, Method of peak areas, Liquid chromatography, basic concepts, types of liquid chromatography, liquid chromatograph, HPLC principle and block diagram description.

7 Hours

UNIT -8

BLOOD GAS ANALYZER: Principle of pH measurement, electrode for pH measurement, Blood pH measurement, measurement of Blood pCO_2, measurement of Blood pO_2 complete Blood gas analyzer, commercially available blood gas analyzers.

6 Hours

TEXT BOOK:

1. **Hand Book of Analytical Instruments -** By R.S. Khandpur, TMH Publications, 1st Edn. 1989.

REFERENCE BOOKS:

1. **Instrumental methods of analysis by** H.H Willard, L.L. Meritt & A. Dean, CBS Publications 7th Edn., 1988
2. **Principles of Instrumental analysis by** S.J. Holler & T. A. Nilman Saunders college publications, 5th Edn, 1998**.**

DSP LAB

Sub Code	**:**	**10 EIL 67**	**IA Marks**	**:**	**25**
Hrs/Week	**:**	**03**	**Exam Hours**	**:**	**03**
Total Hrs	**:**	**42**	**Exam Marks**	**:**	**50**

1. Verify the Sampling theorem.
2. Determine linear convolution, Circular convolution and Correlation of two given sequences. Verify the result using theoretical computations.
3. Determine the linear convolution of two given point sequences using FFT algorithm.
4. Determine the correlation using FFT algorithm.
5. Determine the spectrum of the given sequence using FFT.
6. Design and test FIR Filter using Windowing method (Hamming window and Kaiser window) for the given order and cut – off frequency.
7. Design and test FIR filter using frequency sampling method.
8. Design and test Butterworth 1st and 2nd order low pass filter.
9. Design and test Butterworth 1st and 2nd order high pass filter.
10. Design and test Chebyshev 1st and 2nd order low pass filter.
11. Design and test Chebyshev 1st and 2nd order high pass filter.
12. Generate and detect DTMF signal using MATLAB software only.

NOTE: Experiments 1-11 must be conducted using Matlab and TMS processor.

INSTRUMENTATION AND CONTROL LAB

Sub Code	**:**	**10 EIL 68**	**IA Marks**	**:**	**25**
Hrs/Week	**:**	**03**	**Exam Hours**	**:**	**03**
Total Hrs	**:**	**42**	**Exam Marks**	**:**	**50**

1. Measurement of Resistance by.
   (a) Kelvin's Double bridge (b) Wheatstone bridge.
2. Characteristics of Thermistor, RTD, Thermocouple.
3. Characteristics of LVDT
4. Characteristics of LDR, Photo diode & Photo transistor.
5. Measurement of Inductance & capacitance using bridges.
   (i) Maxwell's bridge (ii) Schering bridge
6. Measurement of self inductance using.(i) 3 voltmeter method (ii)VAW method
7. Measurement of strain using strain gauges (quarter, half and full bridge configurations).
8. Calibration of Ammeter, Voltmeter using DC potentiometer.
9. Determine the step response of first order system using RC circuit and to measure time constant for different values of R & C.
10. Determine the response of a second order system, using RLC circuit for step input.
11. Determine the response of Lead, Lag, Lead – Lag network.
12. Design of Relay Driving circuits using photo devices (LDR / optocouplers).

ELECTIVE -1 (GROUP-A)

BIOMEDICAL DSP

Sub Code	**:**	**10 EI 661**	**IA Marks**	**:**	**25**
Hrs/Week	**:**	**04**	**Exam Hours**	**:**	**03**
Total Hrs	**:**	**52**	**Exam Marks**	**:**	**100**

PART –A

UNIT-1

INTRODUCTION TO BIOMEDICAL SIGNALS: Nature of biomedical signals, Examples of biomedical signals - action potential, electromyogram, electrocardiogram, electroencephalogram, phonocardiogram, objectives of biomedical signal analysis, difficulties in biomedical signal analysis, computer aided diagnosis.

6 Hours

UNIT – 2

NEUROLOGICAL SIGNAL PROCESSING -1: Brain and its potentials, electrophysiological origin of brain waves, EEG signal and its characteristics, EEG analysis, Linear prediction theory, Autoregressive (AR) method, Recursive estimation of AR parameters, spectral error measure, Adaptive segmentation. .

7 Hours

UNIT -3

NEUROLOGICAL SIGNAL PROCESSING -2: Transient detection and elimination - The case of epileptic patients, overall performance, sleep EEG, Data acquisition and classifications of sleep stages, Markov models and Markov chains, Dynamics of sleep- wake transitions, Hypnogram model parameters, Event history analysis for modeling sleep. .

7 Hours

UNIT -4

FILTERING FOR REMOVAL OF ARTIFACTS: Problem statement, Random noise, structured noise and physiological interference, Illustration of the problem with case studies, Time domain filters, Frequency domain filters.

6 Hours

PART –B

UNIT -5

ADAPTIVE INTERFERENCE/NOISE CANCELLATION: A review of Wiener filtering problem, Principle of an Adaptive filter, The steepest-descent algorithm, the Widrow - Hoff least mean square adaptive algorithm, Adaptive noise canceller, Cancellation of 60Hz interference in ECG, Cancelling Donor – heart interference in Heart-transplant electrocardiography, Cancellation of ECG signal from the electrical activity of the chest muscles, canceling of maternal ECG in fetal ECG, Cancellation of High frequency noise in Electro – surgery.

7 Hours

UNIT -6

CARDIOLOGICAL SIGNAL PROCESSING: ECG parameters and their estimation. The use of multi-scale analysis for parameter estimation of ECG waveforms, Arrhythmia analysis monitoring, long term continuous ECG recording, ECG rhythm analysis (to measure heart rate and average RR interval).

6 Hours

UNIT – 7

ECG DATA REDUCTION TECHNIQUES: Direct data compression techniques, Direct ECG data compression techniques, Transformation compression techniques, other data compression techniques, Data compression techniques comparison.

7 Hours

UNIT – 8

PRONY'S METHOD: Exponential modeling, Exponential parameter estimation, The original Prony's problem, Least squares Prony's problem method, The covariance method of linear prediction, Prony's method in the presence of noise, clinical application of Prony's method. .

6 Hours

TEXT BOOKS:

1. **Biomedical Signal Processing Principles and Techniques** – by D C Reddy, The McGraw –Hill publications, 2005.
2. **Biomedical Signal Analysis a case study approaches** - by Rangaraj M. Rangayyan ,The John Wiley Publications, 2001.

REFERENCE BOOK:

1. **Biomedical Digital Signal Processing** – by Willis J Tompkins, PHI, 2003.

PNEUMATIC INSTRUMENTATION

Sub Code	**:**	**10 EI 662**	**IA Marks**	**:**	**25**
Hrs/Week	**:**	**04**	**Exam Hours**	**:**	**03**
Total Hrs	**:**	**52**	**Exam Marks**	**:**	**100**

PART – A

UNIT – 1

BASICS OF PNEUMATICS : Definition of pneumatics, characteristics of pneumatics, applications of pneumatics, basic pneumatic elements, steady flow of ideal Gases, Orifice, Nozzle, valve flow calculations, Numerical value of discharge coefficient.

7 Hours

UNIT – 2

STEADY STATE ANALYSIS OF PNEUMATIC COMPONENTS: Multiple restriction and volume calculations, Sensing chambers, Gain in sensing chambers, valves, Single Acting Actuator, valves, Ideal poppet valve, Areas, conical poppet, Ideal Butterfly valve area.

7 Hours

UNIT – 3

TRANSIENTS IN PNEUMATIC SYSTEMS: Linear pneumatic spring Rate, pneumatic Transmission Lines, Linear pneumatic Damping, Non – linear spring and dampers.

6 Hours

UNIT – 4

PNEUMATIC CONTROLLERS: Pneumatic Feedback systems, controller Actions, Alignments, controller tuning, pneumatic controllers (P and PI).

6 Hours

PART – B

UNIT - 5

PNEUMATIC POSITIONERS AND RECORDERS: Self – Balancing instruments, pilots and Relays, Mason – Neilan – Valve positioners, Taylor – Transmitter, Taylor – set point Recorders.

7 Hours

UNIT – 6

MOTION – BALANCE PRINCIPLE AND APPLICATIONS: Motion – balance mechanism, Angular Motion-balance Transmitters, Motion – Balance Level Mechanisms.

6 Hours

UNIT -7

CONTROL VALVES: Different types of control valves, plug and seat, construction details, control valve, adjustments, control valve sizing and maintenance.

6 Hours

UNIT – 8

GAIN MECHANISMS: Gain feedback Bellows, Detector Range and gain, Adjustable gain Mechanisms, operation of parallel lever mechanism, Angle – gain mechanism.

7 Hours

TEXT BOOKS:

1. **Analysis and Design of Pneumatic Systems** – Anderson B.W.John Wiley & Sons, 1976.
2. **Instrumentation Training course** – Sams H.S, Howard Sons & Co, New York, 1976.

OPERATING SYSTEMS

Sub Code	**:**	**10 EI 663**	**IA Marks**	**:**	**25**
Hrs/Week	**:**	**04**	**Exam Hours**	**:**	**03**
Total Hrs	**:**	**52**	**Exam Marks**	**:**	**100**

PART - A

UNIT -1

INTRODUCTION TO OPERATING SYSTEMS AND CLASSIFICATION: What is an operating system?, Mainframe systems, Desktop systems, multiprocessor system, Distributed system, Clustered system, Real time system, Handled system, Feature migration, computing environments. Operating system structures: System components, OS Services, System calls, System programs, System structure, Virtual machines.

7 Hours

UNIT-2

PROCESS, INTER PROCESS COMMUNICATION, THREADS & CPU SCHEDULING: Process concept, Process scheduling, Operation on processes, Co-operating processes, Inter process communication. Threads – overview, Multithreading models, Threading issues, P threads, Java threads, CPU scheduling – Basic concepts, Scheduling criteria, Scheduling algorithms, multiple processors scheduling, real time scheduling.

7 Hours

UNIT-3

PROCESS SYNCHRONIZATION AND HANDLING DEADLOCKS: The critical section problem, Synchronization hardware, Semaphores, Classical problems of synchronization, critical regions, monitors.

6 Hours

UNIT -4

DEADLOCK – System model, deadlock characterization, Methods for handling deadlocks – deadlock prevention, deadlock avoidance, deadlock detection and recovery from deadlock.

6 Hours

PART –B

UNIT – 5

STORAGE MANAGEMENT: Main memory management – Background, Swapping, Contiguous, allocation, Paging, Segmentation, Segmentation with paging, Virtual memory – Background, Demand paging, Process creation, Page replacement algorithms, Allocation of frames, Thrashing.

7 Hours

UNIT -6

FILE SYSTEM INTERFACE : File concept, Access methods, Directory structure, File system mounting, File system implementation, Directory implementation, Allocation methods, free space management, Mass storage structures – Disk structure, Disk scheduling methods, Disk management, Swap space management.

7 Hours

UNIT – 7

PROTECTION AND SECURITY - 1: Goals of protection, domain of protection, access matrix, implementation of access matrix, Revocation of access rights.

6 Hours

UNIT – 8

PROTECTION AND SECURITY – 2: The security problem, Authentication, Program threats, System threats, Security systems and facilities, Intrusion detection, introduction to cryptography, basics of Linux operating system.

6 Hours

TEXT BOOK:

1. **Operating System Concepts** – by Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, 6th edition, John Wiley & Sons, 2003.

REFERENCE BOOKS:

1. **Operating system concepts and design –** Milan Milankovic 2nd Edition, McGraw Hill, 1992.
2. **Operating systems** – Harvey M Deital Addison Wesley, 1990.
3. **Operating Systems concepts based approach,** D. M. Dhamdhere, Tata McGraw Hill, 2002.

MECHATRONICS

Sub Code	**:**	**10 EI 664**	**IA Marks**	**:**	**25**
Hrs/Week	**:**	**04**	**Exam Hours**	**:**	**03**
Total Hrs	**:**	**52**	**Exam Marks**	**:**	**100**

PART - A

UNIT - 1

INTRODUCTION: What is Mechatronics?, Systems, Measurement systems, Control systems, Microprocessor-based controllers, response of systems, The mechatronics approach.

6 Hours

UNIT - 2

SENSORS AND TRANSDUCERS: Sensors and transducers, Performance terminology, Displacement, position and proximity, Velocity and motion, Force, Fluid pressure, Liquid flow, Liquid level, Temperature, Light sensors, Selecting of sensors, Inputting data by switches.

7 Hours

UNIT – 3

PNEUMATIC AND HYDRAULLC ACTUATION SYSTEMS: Actuation systems, Pneumatic and hydraulic systems, Directional control valves, Pressure control valves, Cylinders, Process control valves, Rotary actuators.

6 Hours

UNIT - 4

MECHANICAL ACTUATION SYSTEMS: Mechanical systems, Types of motion, Kinematic chains, Cams, Gear trains, Ratchet and pawl, Belt and chain drives, Bearings, Mechanical aspects of motor selection.

7 Hours

PART-B

UNIT - 5

ELECTRICAL ACTUATION SYSTEMS: Electrical systems, Mechanical switches, Solid-state switches, Solenoids, D.C. motors, A.C. motors, Stepper motors.

6 Hours

UNIT - 6

PRINCIPLES OF FEEDBACK AND INTELLIGENT CONROL: Introduction, Control Systems, Open loop control systems, Closed loop control systems, The controllers, More about automatic control, Defining automatic control methods, Artificial Neural Network, Fuzzy Logic, Diagnostics, Analog Versus Digital Control.

7 Hours

UNIT - 7

INTEGRATION: Introduction, Background, Advanced actuators, Consumer mechatronic products, Hydraulic fingers, Surgical equipment, Industrial Robot, Autonomous Guided Vehicle (AGV), Drilling machine.

7 Hours

UNIT - 8

FAULT FINDING: Fault-detection techniques, Watchdog timer, Parity and error coding checks, Common hardware faults, Microprocessor systems, Emulation and simulation, PLC systems.

6 Hours

TEXT BOOKS:

1. **Mechatronics** – W. Bolton, Pearson Education Asia -3rd Edition (Unit 1-5, and 8) 1999.
2. **Mechatronics: Principles, Concepts and applications** – Nitaigour and Premchand, Mahilik – TMH, 2003 (unit 6 & 7).

REFERENCE BOOKS:

1. **Introduction to mechatronics and measurement systems** –David G. Alciatore & Michel BiHistand, Tata McGraw Hill –2000
2. **Mechatronics** – H.D. Ramachandra – Sudha Publication -2003 **Mechatronics** by HMT Ltd. – Tata McGraw-Hill, 2000.
3. **Mechatronics System design** by Devadas Shetty and Richard A. Kark, Thomas Learning, 1997.
4. **Mechatronics an Introduction** by Robert H Bishop, CRC,2005.
5. **Mechatronics Systems Fundamentals** by Rolf Isermann, Springer, 2005

VII SEMESTER

VLSI DESIGN

Sub Code	**:**	**10 EI 71**	**IA Marks**	**:**	**25**
Hrs/Week	**:**	**04**	**Exam Hours**	**:**	**03**
Total Hrs	**:**	**52**	**Exam Marks**	**:**	**100**

PART –A

UNIT -1

INTRODUCTION TO MOS TECHNOLOGY: Moore's law, speed power performance, nMOS fabrication, CMOS fabrication: n-well, p-well processes, BiCMOS, Comparison of bipolar and CMOS.

6 Hours

UNIT – 2

BASIC ELECTRICAL PROPERTIES OF MOS AND BiCMOS CIRCUITS : Drain to source current versus voltage characteristics, threshold voltage, transconductance, nMOS inverter, Determination of pull up to pull down ratio, nMOS inverter driven through one or more pass transistors, alternative forms of pull up, CMOS inverter, MOS transistor circuit model, BiCMOS inverters, latch up.

7 Hours

UNIT-3

BASIC CIRCUIT CONCEPTS: Sheet resistance, area capacitance calculation, Delay unit, inverter delay, estimation of CMOS inverter delay, driving of large capacitance loads, super buffers, BiCMOS drivers, propagation delays and wiring capacitances.

7 Hours

UNIT 4

MOS AND BICMOS CIRCUIT DESIGN PROCESSES: MOS layers, stick diagrams, nMOS design style, CMOS design style, design rules and layout, λ - based design, scaling of MOS circuits, scaling factors for device parameters, limitations of scaling.

6 Hours

PART – B

UNIT 5

SUBSYSTEM DESIGN AND LAYOUT -1 : Switch logic pass transistor, Gate logic inverter, NAND gates, NOR gates, pseudo nMOS, Dynamic CMOS, example of structured design, Parity generator, Bus arbitration, multiplexers, logic function block, code converter.

6 Hours

UNIT 6

SUBSYSTEM DESIGN AND LAYOUT -2 : Clocked sequential circuits, dynamic shift registers, bus lines, subsystem design processes, General considerations, 4-bit arithmetic processes, 4-bit shifter.

6 Hours

UNIT -7

DESIGN PROCESS – COMPUTATIONAL ELEMENTS: Regularity, design of ALU subsystem, ALU using adders, carry look ahead adders, Multipliers, serial parallel multipliers, Braun array, Bough – Wooley multiplier, pipelined multiplier array, modified Booth's algorithm, Wallace tree multiplier.

7 Hours

UNIT -8

MEMORY, REGISTER AND ASPECTS OF TIMING: Three Transistor Dynamic RAM cell, Dynamic memory cell, Pseudo- Static RAM, JK Flip-flop, D Flip-flop circuits, RAM arrays, practical aspects and testability: Some thoughts of performance, optimization and CAD tools for design and simulation.

7 Hours

TEXT BOOK:

1. **Basic VLSI Design** -3rd Edition Douglas A Pucknell, Kamaran Eshraghian, Prentice Hall of India publication, 2005.

REFERENCE BOOKS:

1. **CMOS Digital Integrated Circuits, Analysis And Design**, 3rd Edition, Sung – Mo (Steve) Kang, Yusuf Leblbici, Tata McGraw Hill, 2002.
2. **VLSI Technology -** S.M. Sze, 2nd edition Tata McGraw Hill, 2003.

POWER & INDUSTRIAL ELECTRONICS

Sub Code	**:**	**10 EI 72**	**IA Marks**	**:**	**25**
Hrs/Week	**:**	**04**	**Exam Hours**	**:**	**03**
Total Hrs	**:**	**52**	**Exam Marks**	**:**	**100**

PART - A

UNIT - 1

INTRODUCTION: Applications of power electronics, power semiconductor devices, control characteristics, types of power electronic circuits, peripheral effects, Power BJTs, switching characteristics, switching limits, base-drive control, introduction to IGBTs, isolation of gate and base drives.

7 Hours

UNIT - 2

THYRISTORS: Introduction, characteristics, two transistor model, turn-on and turn off methods, di/dt and dv/dt protection, thyristor types, series and parallel operation of thyristors, thyristor firing circuits.

7 Hours

UNIT - 3

COMMUTATION TECHNIQUES: Introduction, natural commutation, forced commutation: self-commutation, impulse commutation, resonant pulse commutation and complementary commutation.

6 Hours

UNIT - 4

AC VOLTAGE CONTROLLERS: Introduction, principle of ON-OFF and phase control, single-phase bidirectional controllers with resistive and inductive loads. Single phase Transformer connection changers. Single phase Cycloconverter

6 Hours

PART – B

UNIT - 5

CONTROLLED RECTIFIERS: Introduction, principle of phase controlled converter operation, single-phase semi converters, full converters and dual converters. Principle of Three phase half wave converter.

7 Hours

UNIT - 6

DC CHOPPERS: Introduction, principle of step-down operation, step-down chopper with RL loads, Principle of step-up operation, step-up chopper with Resistive load, performance parameters, Chopper classification (Class A to Class E).

6 Hours

UNIT – 7

DC DRIVES: Introduction, Basic Characteristics of DC Motors, Operating modes, Single phase Drives. Stepper motor drive, Permanent Magnet stepper motors (bipolar and unipolar motor drive sequence) and Stepper Motor characteristics.

6 Hours

UNIT - 8

INVERTERS: Introduction, principle of operation, performance parameters, single phase bridge inverters, Three phase inverters, voltage control of single phase inverters, current source inverter, variable DC link inverter, principles of switched mode power supply (SMPS).

7 Hours

TEXT BOOK:

1. **Power Electronics** - M. H. Rashid, Prentice Hall of India Pvt. Ltd., (Pearson (Singapore -Asia)) New Delhi, 2002.

REFERENCE BOOKS:

1. **Power Electronics**- M. D. Sing and Khanchandani K. B., Tata McGraw Hill Publishing Company Limited, Reprint 2001.
2. **Power Electronics** - Cyril W.Lander, 3rd Edition, McGraw Hill, 1993.
3. **Modern Power Electronics** – P.C. Sen, 2nd Edition S.Chand, 2000.

AUTOMATION IN PROCESS CONTROL

Sub Code	**:**	**10 EI 73**	**IA Marks**	**:**	**25**
Hrs/Week	**:**	**04**	**Exam Hours**	**:**	**03**
Total Hrs	**:**	**52**	**Exam Marks**	**:**	**100**

PART –A

UNIT -1

PROCESS CONTROL PROGRAMMING: Types of programs, Features of process control Programs, programming languages for process control, Recent developments, Algorithms: Position algorithm, Velocity algorithm and their comparison.

6 Hours

UNIT -2

COMPUTER HIERARCHICAL CONTROL: Hierarchy levels, Early computer control systems, Centralized computer systems, Concept of distributed control systems, Hierarchical control: duties and responsibilities at each hierarchical levels with examples.

7 Hours

UNIT -3

DCS – BASIC PACKAGE: Analog control, Direct digital control, Distributed process control, Main components of distributed control systems, All types of DCS displays, Software configuration, Controller function configuration. Algorithm libraries, Communication between components, Local control units, Dedicated card controllers and Unit operations controllers.

7 Hours

UNIT -4

DCS – DATA HIGHWAYS, FIELD BUSES, MULTIPLEXERS AND REMOTE TERMINAL UNITS: International field bus standards, Multiplexing and party line systems, Multiplexing and scanning, Multiplexer designs, Multiplexing of analog signals, Alternative system configurations, Remote stations, Digital signal transmission.

6 Hours

PART –B

UNIT -5

INTRODUCTION TO PROGRAMMABLE LOGIC CONTROLLER: Programmable Logic Controllers, Evolution of PLC, PLC Architecture, Basic Structure, PLC Programming, Ladder Diagram, its Symbols and Circuits, PLC Selection, PLC Installation, Advantages of using PLC .

6 Hours

UNIT -6

DCS – SYSTEM INTEGRATION WITH PLC'S AND COMPUTERS: Man–Machine Interface (MMI), Integration with PLC's, Integration with computers, Integration with direct I/O, Network linkages, Advantages of DCS integration with PLC's and computers, MAP/TOP protocol, Interfacing to the field instruments, Adapting fiber optics to MAP /TOP protocols.

6 Hours

UNIT -7

BUILDING BLOCKS OF AUTOMATION SYSTEMS: Multi-microprocessor systems, Microprocessor interconnections, Concept of shared bus local area networks, Ethernet Loop (ring) system, Analog and digital I/O Modules, Supervisory Control and Data acquisition systems (SCADA).

7 Hours

UNIT -8

INTELLIGENT CONTROLLERS: Introduction, Model based controllers, Predictive control, Artificial intelligent based systems, Expert controller, Fuzzy logic system, Fuzzy controller, Artificial Neural networks, Neural controllers.

7 Hours

TEXT BOOKS:

1. **Instrument Engineers Hand Book**, third edition "Process Control" by B.G.Liptak – Chiltan book company Radnor Pennsylvania,1995.
2. **Computer Based Industrial Control** by Krishna Kant, PHI New Delhi, 2004.
3. **Computer Aided Process Control** by S.K.Singh, PHI New Delhi, 2003.

REFERENCE BOOKS:

1. **Process /Industrial Instrument and Control Handbook** by D M Considine, 4th Edition, McGraw Hill international edition, 2000.
2. **Programmable Controller by Thomas A. Hughes, 4th E**dition ISA Publications, 2005.
3. **Programmable Logic Controllers and Industrial Automation: An Introduction** by M Mitra and S.S. Gupta, PIP (India) Pvt. Ltd. Mumbai, 2005.

DIGITAL IMAGE PROCESSING

Sub Code	**:**	**10 EI 74**	**IA Marks**	**:**	**25**
Hrs/Week	**:**	**04**	**Exam Hours**	**:**	**03**
Total Hrs	**:**	**52**	**Exam Marks**	**:**	**100**

PART – A

UNIT -1

FUNDAMENTALS: Introduction, Fundamental steps in digital image processing (DIP), components of DIP system, A simple image formation model, Image sampling and quantization, Basic relationship between pixels, Color image processing fundamentals and models.

6 Hours

UNIT – 2

IMAGE TRANSFORMS: Basic theory, Fourier transforms, Hadamard transform, Discrete cosines transforms, Application of discrete image transforms.

6 Hours

UNIT – 3

IMAGE ENHANCEMENT IN SPATIAL DOMAIN: Background, Point processing – Image negatives, Log transformations, Power law transformations, Contrast stretching, Gray level slicing, Bit plane slicing, Histogram processing – Histogram equalization, Histogram matching (specification), Local enhancement, Arithmetic/Logic operations – Image subtraction, Image averaging, Basics of spatial filtering, Smoothing spatial filters – Smoothing linear filters, order statistics filters , sharpening spatial filters – Foundation, Laplacian and gradient.

7 Hours

UNIT – 4

IMAGE ENHANCEMENT IN FREQUENCY DOMAIN: Background, Basic properties of the frequency domain, Basic filtering in the frequency domain, Basic filters and their properties, Smoothing frequency domain filters – ideal low – pass filters, Butterworth low – pass filters, Gaussian low – pass filters, Sharpening frequency domain filter – Ideal high – pass filters, Butterworth high – pass filters, Gaussian high – pass filters, Homomorphic filtering.

7 Hours

PART –B

UNIT -5

IMAGE RESTORATION: Image degradation and restoration models, noise models, restoration using spatial filtering – mean filter, geometric mean filter, harmonic mean filter, median filter, min-max filters, midpoint filter.

6 Hours

UNIT – 6

NOISE FILTERING BY FREQUENCY DOMAIN FILTERING: Band reject filter, band pass filter, notch filter, inverse filtering, minimum mean square error (Wiener) filtering.

6 Hours

UNIT – 7

IMAGE COMPRESSION: Fundamentals, variable length coding, LZW coding, bit plane coding, constant area coding, run length coding, lossless predictive coding, lossy predictive coding, transform coding, image compression standards: basics, JPEG.

7 Hours

UNIT – 8

IMAGE SEGMENTATION: Introduction, Thresholding: threshold detection methods, optimal thresholding, multi-spectral thresholding. Edge-based segmentation: edge image thresholding, border tracing, Hough transform. Region- based segmentation: region growing, region merging, region splitting, splitting & merging. Matching criteria.

7 Hours

TEST BOOKS:

1. **Digital Image Processing –** Rafael C. Gonzalez & Richard E. Woods, Second Edition. Pearson Education Inc, 2002.
2. **Digital Image Processing, analysis and computer Vision – First** edition, Milan Sonka, Cenage Learning, 2008.

REFERENCE BOOK:

1. **Fundamentals of Digital Image Processing** – Anil K. Jain, 2nd Edition, Prentice Hall of India, 1989.
2. **Digital image processing, First edition,** S. Jayaraman, S. Esakkirajan, J.Veerakumar, TMH, 2008.

POWER ELECTRONICS AND DATA CONVERSION LAB

Sub Code	**:**	**10 EIL 77**	**IA Marks**	**:**	**25**
Hrs/Week	**:**	**03**	**Exam Hours**	**:**	**03**
Total Hrs	**:**	**42**	**Exam Marks**	**:**	**50**

1. Static VI characteristics of SCR.
2. Static VI characteristics of Triac.
3. Controlled Half wave rectifier using R & RC triggering.
4. Controlled Half wave rectifier using UJT triggering circuit.
5. AC voltage controller using Triac & Diac.
6. Full wave ac voltage controller using two SCR's and UJT firing circuit
7. Study of half controlled & full controlled bridge converters, DC chopper and parallel inverter using modules.
8. Sample and Hold circuits using discrete components and IC.
9. Multiplexing of 8 - analog inputs (unipolar / bipolar) using a monolithic Analog Multiplexer.
10. Realize a 4 – bit R-2R DAC using discrete components.
11. Realize an 8 – bit DAC using 0800.

12. Realize programmable gain amplifier using a monolithic DAC 0800.
13. Realize an 8 bit successive approximation ADC 0809.
14. Realize a 3 bit flash ADC.

PROCESS CONTROL LAB

Sub Code	**:**	**10 EIL 78**	**IA Marks**	**:**	**25**
Hrs/Week	**:**	**03**	**Exam Hours**	**:**	**03**
Total Hrs	**:**	**42**	**Exam Marks**	**:**	**50**

1. Rig up and test the circuit to display temperature using **RTD** with suitable signal conditioning circuit.
2. Rig up and test the circuit to display temperature using **Thermistor** with suitable signal conditioning circuit.
3. Rig up and test the circuit to display temperature using **Thermocouple** with suitable signal conditioning circuit.

4. Rig up and test the circuit to display temperature using **IC AD590** with suitable signal conditioning circuit.

5. Study and demonstration of PC based Pressure control system and hence to plot the graph of continuous and discontinuous modes of control.

6. Study and demonstration of PC based temperature control system and hence to plot the graph of continuous and discontinuous modes of control.

7. Study and demonstration of PC based level control system and hence to plot the graph of continuous and discontinuous modes of control.

8. Study and demonstration of PC based flow control system and hence to plot the graph of continuous and discontinuous modes of control.

9. Realize **OPAMP** based analog controller for the following pure modes of control actions Proportional, Integral and Derivative controller response.

10. Realize OPAMP based PI composite mode of analog controller.
11. Realize OPAMP based PD composite mode of analog controller.
12. Using Lab view – virtual instrumentation software, conduct the following experiments.\
    i) Basic operations: simple programming structure.
    ii)Creations of CRO and measurement of frequency and amplitude.
    iii)Realization of function generator.

13. Study and demonstration of programmable logic controller and realize some basic experiments using PLC's

ELECTIVE –II (GROUP-B)

MEDICAL IMAGING TECHNIQUES

Sub Code	**:**	**10 EI 751**	**IA Marks**	**:**	**25**
Hrs/Week	**:**	**04**	**Exam Hours**	**:**	**03**
Total Hrs	**:**	**52**	**Exam Marks**	**:**	**100**

PART- A

UNIT 1

X-RAY IMAGING: Fundamentals of X-ray – Electromagnetic radiation, Interactions between X-rays and matter, Intensity of X-ray beam, Attenuation, Generation and Detection of X-rays – X-ray generation, X-ray generators, Filters, Beam restrictors and grids, Intensifying screens, fluorescent screens, and image intensifiers, X-ray detectors, Biological effects of ionizing radiation.

6 Hours

UNIT 2

X-RAY DIAGNOSTIC METHODS: Conventional X-ray radiography, Fluoroscopy, Angiography, Mammography and Xeroradiography, Image subtraction.

COMPUTED TOMOGRAPHY: Conventional tomography, Computed tomography – Projection function, Algorithms for image reconstruction, CT number, Image artifacts, Spiral CT. Recent developments – Digital radiography, Digital subtraction angiography (DSA), 3D reconstruction, Dynamic spatial reconstructor (DSR).

7 Hours

UNIT 3

ULTRASOUND IMAGING: Fundamentals of acoustic propagation - Characteristic impedance, Intensity, Reflection and refraction, Attenuation, absorption & scattering, Doppler effect, Generation and detection of Ultrasound-Piezoelectric effect, Ultrasonic transducers, Transducer beam characteristics-Huygens's principle, Axial and Lateral resolution, Focusing, Arrays.

7 Hours

UNIT 4

ULTRASONIC DIAGNOSTIC METHODS: Pulse echo systems- Amplitude mode (A-mode), Brightness mode (B-mode), Motion mode (M-mode), Constant depth mode (C-mode), Doppler methods, Duplex imaging, Tissue characterization, Colour Doppler flow imaging, Image characteristics – Ultrasonic texture or speckle, Speckle reduction, Compensation of phase aberration, Biological effects of ultrasound.

6 Hours

PART- B

UNIT 5

RADIONUCLIDE IMAGING: Introduction, Fundamentals of Radioactivity – Nuclear particles, Nuclear activity and half-life, Units of measuring nuclear activity, Specific activity, Interaction of nuclear particles and matter, Attenuation of Gamma radiation, Radionuclides, Generation & Detection of Nuclear Emission – Radionuclide generators, nuclear radiation detectors, Collimators, Diagnostic methods using radiation detector probes – Thyroid function test, Renal function test, Blood volume measurement, Radionuclide imaging systems- Rectilinear scanner, Scintillation camera, SPECT, PET.

7 Hours

UNIT 6

BASICS OF MAGNETIC RESONANCE IMAGING: Fundamentals of nuclear magnetic resonance- Angular momentum, magnetic dipole moment, magnetization, Larmor frequency, Rotating frame of reference and RF magnetic field, Free induction decay (FID), Fourier spectrum of the NMR signal, Spin density, Relaxation times, Pulse sequences.

6 Hours

UNIT 7

MRI SYSTEM & IMAGING METHODS: Introduction, Magnet, Room temperature and magnetic field gradients, NMR Coil/Probe, Transmitter, Receiver, Data acquisition. Imaging Methods- Introduction, slice selection, frequency encoding, phase encoding, Spin-Echo imaging- Gradient echo imaging. Biological effects of magnetic fields- Static magnetic fields, Radio-frequency fields, Gradient magnetic fields.

7 Hours

UNIT 8

THERMAL IMAGING & ADVANCES IN MEDICAL IMAGING: Medical thermography, Physics of thermography, Infrared detectors, Thermographic equipment, Quantitative medical thermography, Pyroelectric vidicon camera.

IMAGE GUIDED INTERVENTION: Introduction, Stereotactic neurosurgery, Stereotactic neurosurgery based on digital image volumes- image acquisition, planning and transfer.

6 Hours

TEXTBOOKS:

1. **Principles of Medical Imaging -** by Kirk Shung, Michael B. Smith and Banjamin Tsui, Academic Press, 1992.
2. **Handbook of Biomedical Instrumentation** – by R.S.Khandpur, 2nd Edition, Tata McGraw Hill, 2003.
3. **Fundamentals of Medical Imaging -** by Paul Suetens, Cambridge University Press, 2002.

AERONAUTICAL INSTRUMENTATION

Sub Code	**:**	**10 EI 752**	**IA Marks**	**:**	**25**
Hrs/Week	**:**	**04**	**Exam Hours**	**:**	**03**
Total Hrs	**:**	**52**	**Exam Marks**	**:**	**100**

PART - A

UNIT - 1

AIR DATA INSTRUMENTS: Pneumatic type and air data computers, International Standard Atmosphere (ISA). Basic pneumatic air data system: basic air data system, basic form of pitot-static probe, combined pitot-static probe, pitot pressure, heating circuit arrangements, position error. Machmeter, mach/airspeed indicator, indicated/computed airspeed indicator.

7 Hours

UNIT - 2

AIR DATA INSTRUMENTS: Altimeter: barometric pressure setting: effect of atmospheric temperature, relation between various altitudes, principle of barometric pressure setting, altitude and elevation and height. Principle of vertical speed indicator, instantaneous vertical speed indicator. AIR DATA WARNING SYSTEM**:** Mach warning system, altitude alert system, angle of attack and stall warning system.

6 Hours

UNITS - 3 & 4

ENGINE INSTRUMENTS: pressure measurement: synchronous transmission type and servo operated pressure indicating system, pressure transmitter, pressure switches. Temperature measurement: variable resistance systems: Wheatstone bridge systems, ratio meter systems. Capacitance type systems: basic indicating system, densitometer, measurement of fuel quantity by weight. RPM measurement: servo operated indicators, torque monitoring. Exhaust gas temperature: types of probes, indicators. Engine pressure ratio measurement. Fuel flow measurements: basic system, integrated flow meter system and electronic integrated flow meter system, engine vibration monitoring.

12 Hours

PART - B

UNIT - 5

Directional Systems: Earth's total magnetic field, horizontal and vertical components of total field, direct reading compass and its limitations, fluxgate detector units. Gyro stabilized direction indicating systems.

7 Hours

UNIT - 6

GYROSCOPIC FLIGHT INSTRUMENTS: Basic mechanical gyro and its properties - rigidity and precision, reference established by gyroscope, limitations of free gyroscope. Gyro horizon: principle of gyro horizon, ball type erection unit. Turn and bank indicator: rate gyroscope bank indication, turn co-coordinator.

7 Hours

UNIT - 7

FLIGHT CONTROL SYSTEMS: Introduction, Principles of Flight Control, Flight Control Surfaces, Primary Flight Control, Commercial Aircraft, Secondary Flight Control. Flight Control Actuation: Simple Mechanical/Hydraulic Actuation, Mechanical Actuation with Electrical Signaling, Multiple Redundancy Actuations. Advanced Actuation Implementations, Fly-By-Wire Control Laws, Interrelationship of Flight Control, Guidance and Flight Management

7 Hours

UNIT - 8

ENGINE AND FUEL CONTROL SYSTEMS: Engine systems: Introduction, Engine/Airframe Interfaces, Engine Technology and Principles of Operation. The Control Problem: Fuel Flow Control, Air Flow Control, Control Systems, Control System Parameters, Input Signals, Output Signals, Design Criteria. Engine Starting: Fuel Control, Ignition Control, Engine Rotation, Throttle Levers, Starting Sequence. Engine Oil Systems, Engine Off takes, Reverse Thrust. **Fuel Systems:** Fuel Quantity Measurement Systems. Fuel Tank Safety: Principles of Fuel Inserting, Air Separation Technology, Typical Fuel Inserting System.

7 Hours

TEXT BOOK:

1. **Aircraft Instruments and Integrated Systems**- EHJ Pallet, Longman Scientific & Technical, 1992.
2. **Aircraft Systems: Mechanical, electrical, and avionics subsystems integration -** Ian Moir and Alla Seabridge, Third Edition, John Wiley & Sons, Ltd., 2008.

REFERENCE BOOKS:

1. **Aircraft Instruments**- C A Williams Galgotia Publications, New Delhi, 1973.

MOBILE COMMUNICATION

Sub Code	**:**	**10 EI 753**	**IA Marks**	**:**	**25**
Hrs/Week	**:**	**04**	**Exam Hours**	**:**	**03**
Total Hrs	**:**	**52**	**Exam Marks**	**:**	**100**

PART –A

UNIT -1

WIRELESS TRANSMISSION: Frequencies for radio transmission, signals, antennas, signal propagation, multiplexing, modulation, spread spectrum.

6 Hours

UNIT -2

MEDIUM ACCESS CONTROL: Motivation for a specialized MAC, SDMA, FDMA, TDMA, fixed TDM, Classical aloha, slotted aloha carrier sense multiple access, PRMS packet reservation multiple access, Reservation TDMA, multiple access with collision avoidance, polling inhibit sense multiple access, CDMA, spread aloha multiple access, Comparison.

7 Hours

UNIT -3

TELECOMMUNICATIONS SYSTEMS: GSM, mobile services, system architecture, radio interface, protocols, localization and calling, handover, security, new data services, DECT, system architecture TETRA, UMTS and IMT-2000, UMTS releases and standardization, architecture, radiointerface, UTRAN, core network.

7 Hours

UNIT -4

SATELLITE SYSTEMS: Basics of GEO, LEO, MEO, Routing, localization, and handover.

BROADCAST SYSTEMS: Cyclic repetition of data, digital audio broadcasting, digital video broadcasting, convergence of broadcasting and mobile communications.

6 Hours

PART – B

UNIT -5

WIRELESS LAN: Infrared Vs radio transmission, infrastructure and ad-hoc network, IEEE802.11, HIPERLSN, Blue tooth.

6 Hours

UNIT -6

MOBILE NETWORK LAYER: Mobile IP, Goals, assumptions and requirements, entities and terminology, IP packet delivery, agent discovery, registration, tunneling and encapsulation, optimizations, reverse tunneling, PIV6 343, IP micro-mobility support.

7 Hours

UNIT -7

Dynamic host configuration, protocol, mobile ad-hoc networks routing, destination sequence distance vector, Dynamic source routing, alternative metrics, overview.

6 Hours

UNIT -8

MOBILE TRANSPORT LAYER: Traditional TCP, Congestion control, slow start, fast retransmit/fast recovery, implications of mobility, Classical TCP in improvements, indirect TCP, Snooping, mobile, Fast retransmit/fast recovery, Transmission/Time-out freezing, selective retransmission, Transaction – oriented TCP,TCP over 2.5/3G wireless networks.

7 Hours

TEXT BOOK:

1. **Mobile Communications** - 2nd Edition, JOCHEN SCHILER, Pearson Education.2003.

REFERENCE BOOKS:

1. **Mobile Communications Engineering, Theory and applications**-2nd Edition, WILLIM C.Y. LEE, McGraw-Hill, 1997, Singapore.
2. **Introduction to wireless and Mobile Systems**- Second edition, Dharma Prakash Agarwal, Qing An Zeng, 2nd Edition, THOMSON, 2007.
3. **Electronic Communications systems Fundamentals through advanced**-5th Edition, Wayne Tomasi, Pearson education 2007.

ARM PROCESSOR

Sub Code	**:**	**10 EI 754**	**IA Marks**	**:**	**25**
Hrs/Week	**:**	**04**	**Exam Hours**	**:**	**03**
Total Hrs	**:**	**52**	**Exam Marks**	**:**	**100**

PART – A

UNIT -1

Introduction to embedded systems, ARM embedded system, ARM processor fundamentals: Registers, Current program status register.

7 Hours

UNIT -2

Pipeline, exceptions, Interrupts, the Vector table, Core extensions, ARM processor families

7 Hours

UNIT -3

INTRODUCTION TO ARM INSTRUCTION SET: Data processing instructions, Branch instructions, load – store instructions, software interrupt instructions, program status register instructions, Co-processor instructions.

6 Hours

UNIT -4

INTRODUCTION TO THUMB INSTRUCTION SET: Thumb programmer's model, Thumb branch instructions, data processing instructions, Single register load – store instruction, multiple-register load store instruction, Stack instruction, Software interrupt instruction.

6 Hours

PART-B

UNIT-5

ARM assembly language Programming: Data processing instructions, data transfer instructions, control flow instructions, writing simple assembly language programs, examples and exercises.

7 Hours

UNIT -6

ARCHITECTURAL SUPPORT FOR HIGH – LEVEL LANGUAGES: Data types, Floating – point data types, The ARM floating point architecture, Expressions, Conditional statements, Loops, functions and procedures.

6 Hours

UNIT -7

Introduction to DSP on the ARM, FIR filters, IIR filters, DFT.

7 Hours

UNIT -8

Embedded operating systems: Fundamental components, example: simple little operating system

6 Hours

TEXT BOOKS:

1. **ARM system developers guide**, Andrew N Sloss, Dominic Symes and Chris Wright, Elsevier, Morgan Kaufman publishers, 2008.
2. **Arm- System - On - Chip - Architecture:** By Steve Furber- Pearson, 2000.

REFERENCE BOOKS:

1. **"Embedded system design",** Frank Vahid and Tony Givargis, John Wiley & Sons, 2003.
2. **"Embedded/Real time systems, Real – Time systems",** Dr. K.V.K. K Prasad, Dreamtech Press, 2004.

ELECTIVE –III (GROUP-C)

REMOTE SENSING & TELEMETERY

Sub Code	**:**	**10 EI 761**	**IA Marks**	**:**	**25**
Hrs/Week	**:**	**04**	**Exam Hours**	**:**	**03**
Total Hrs	**:**	**52**	**Exam Marks**	**:**	**100**

PART – A

UNIT -1

INTRODUCTION: Sun and Atmosphere, concept of signatures, remote sensing system, why observe earth from space? remote sensing – A Historic perspective, Indian remote sensing programme , the earth observation evolution – the paradigm shift legal and ethical aspects, electromagnetic radiation, velocity of EM radiation polarization coherent radiation, propagation of EM waves from one medium to another, attenuation, quantum of EM radiation ,thermal radiation, source of EM Radiation for remote sensing.

7 Hours

UNIT – 2

FUNDAMENTALS OF RADIOMETRY: Measurement geometry – concept of the solid angle, radiometric quantities, surface characteristics for radiometric measurements, observation geometry in remote sensing , radiometric measurement , scene reflectance measurement. Physical basis of signatures, signature in the reflective OIR region, thermal infrared (TIR), microwave region,

6 Hours

UNIT -3

REMOTE SENSORS – AN OVERVIEW: Classification of remote sensors, selection of sensor parameters, spatial resolution, spectral resolution, temporal resolution, optical – infrared sensors, quality of image in optical systems, imaging mode, photographic camera, television cameras, opto - mechanical scanners, opto-mechanical scanners operated from satellites, pushbroom cameras, hyper-spectral imager, measuring the third dimension, image quality aspects.

7 Hours

UNIT -4

MICROWAVE SENSORS: Antenna, passive microwave sensors, active microwave sensors, side looking radar, scatterometer , platforms, principles of satellite motion, locating a satellite in space, types of Orbit, Orbital perturbations, the spacecraft, global positioning system(GPS)

6 Hours

PART -B

UNIT – 5

DATA RECEPTION AND DATA PRODUCTS: Data formats, ground segment organization, data product generation, referencing scheme, data products output medium, IRS data products, special processing, data analysis, visual image analysis, digital classification, classification accuracy.

6 Hours

UNIT-6

APPLICATIONS OF REMOTE SENSING FOR EARTH RESOURCES MANAGEMENT: Agriculture, forestry application, land cover/land use mapping water resources, snow and glacier, wetland management, marine fisheries, remote sensing for earth system science studies, geographical information system(GIS), date model, data entry data analysis example – urban land use suitability, spatial data infrastructure.

7 Hours

UNIT -7

TELEMETRY SYSTEM 1: Introduction, fundamental of RF telemetry, basic telemetry, system components of coding resolution, pulse code modulation, PCM multiplexing and conversion, PCM data transmission, PCM PSD system.

7 Hours

UNIT -8

TELEMETRY SYSTEM 2: Theoretical comparison of telemetry systems, sub modulation methods, power efficiency of combined systems, practical constraint of telemetry methods optimized power efficiency.

6 Hours

TEXT BOOK:

1. **Fundamentals of Remote Sensing** – by George Joseph, second Edition, Universities press, 2005.

REFERENCE BOOKS:

1. **Advanced Remote Sensing -** Liang, Shunlin, Academic Press (an imprint of Elsevier), 2012.

ROBOTICS AND CONTROL

Sub Code	**:**	**10 EI 762**	**IA Marks**	**:**	**25**
Hrs/Week	**:**	**04**	**Exam Hours**	**:**	**03**
Total Hrs	**:**	**52**	**Exam Marks**	**:**	**100**

PART - A

UNIT - 1

ROBOT ARM KINEMATICS: Introduction, The direct Kinematics Problem, Rotation Matrices, Composite Rotation Matrix, Rotation matrix about an arbitrary axis, Rotation matrix with Euler angle representation, Geometric interpretation of Homogeneous transformation matrices, composite homogeneous transformation matrix.

7 Hours

UNIT - 2

Links, joints and their parameters, The Denavit Hartenberg representation, Kinematic equations for manipulators, Other specifications of the locations of the end-effector, The inverse Kinematics problem, Inverse Transform Technique for Euler Angles Solution, Definition of various arm configurations.

7 Hours

UNIT - 3

PLANNING OF MANIPULATOR TRAJECTORIES: Introduction, General considerations on Trajectory planning, joint-interpolated Trajectories, calculation of a 4-3-4 Joint trajectory, Cubic Spline Trajectory. SENSING: Range sensing, Triangulation, Structured Lighting Approach, Time-of-Flight range finders.

6 Hours

UNIT - 4

SENSING**:** Proximity sensing, Inductive sensors, Hall effect sensors, Capacitive Sensors, Ultrasonic sensors, Optical Proximity Sensors, Touch sensors, Binary sensors, Analog sensors, Force and Torque sensing, Elements of a Wrist sensor.

6 Hours

PART – B

UNIT - 5

LOW-LEVEL VISION: Image acquisition, illumination Techniques, imaging geometry, some basic transformations, perspective transformations, Camera model, camera calibration.

7 Hours

UNIT - 6

Stereo imaging, some basic relationships between pixels, Neighbors of a Pixel, connectivity, distance measures, Preprocessing, Spatial-Domain methods, Frequency-Domain methods, Smoothing, Enhancement, Edge detection, Thresholding.

7 Hours

UNIT - 7

HIGH LEVEL VISION: Segmentation, Edge Linking and Boundary detection, Thresholding, Region-oriented segmentation.

6 Hours

UNIT - 8

The use of motion, description, Boundary descriptors, Regional descriptors.

6 Hours

TEXT BOOK:

1. **Robotics control sensing Vision and Intelligence**- K.S.Fu, R.C.Gonzalez, C.S.G. Lee, McGraw Hill, 1987.

REFERENCE BOOK:

1. **Introduction to Robotics Mechanics and control**– John J. Craig, 2nd Edition, Pearson education, 2003.

VIRTUAL INSTRUMENTATION

Sub Code	**:**	**10 EI 763**	**IA Marks**	**:**	**25**
Hrs/Week	**:**	**04**	**Exam Hours**	**:**	**03**
Total Hrs	**:**	**52**	**Exam Marks**	**:**	**100**

PART -A

UNIT-1

GRAPHICAL SYSTEM DESIGN :Introduction, Graphical system design model, Design flow with GSD , Virtual Instrumentation, Virtual instrument and traditional instrument, Hardware in virtual instrumentation, Virtual instrumentation for Test, control & design, virtual instrumentation in Engineering process, virtual instruments beyond personal computer , Graphical system design using LABVIEW, Graphical programming & textual programming

6 Hours

UNIT-2

INTRODUCTION TO LABVIEW: Introduction, advantages of LABVIEW software environment, palettes, front panel controls & indicators, Block diagram, Data flow program, arranging objects, colour coding, creating sub – VI's.

6 Hours

UNIT -3

REPETITION AND LOOPS: For loops, while loops, structure tunnels, terminals inside or outside loops, shift registers, feed-back nodes, control timing, communicating among multiple-loops, local variables, Global variables, case structure, formula node.

7 Hours

UNIT-4

ARRAYS: Introduction, arrays in LABVIEW, creating one - dimensional array controls, indicators and constants. creating two dimensional arrays, creating multidimensional arrays, initializing array, deleting, inserting, and replacing elements, rows, columns, and pages with in arrays, arrays functions, auto indexing, creating 2-dimensional array using loops, identification of data structure (scalar and arrays) using wire, using auto-indexing to set the FOR loop count matrix operation with arrays, polymorphism.

7 Hours

PART –B

UNIT -5

PLOTTING DATA: Types of waveforms, waveform graphs, waveform charts, XY graphs, Intensity graphs & charts, Digital waveform graphs, 3D graphs, customizing graphs & charts, configuring a graph or chart, Displaying special planners on the XY graph.

6 Hours

UNIT -6

FILE INPUT/ OUTPUT: File formats, fill I/O functions, path function sample VI's to demonstrate file write & read, generating filenames automatically, String handling: string functions, LABVIEW string formats, examples, parsing of strings.

6 Hours

UNIT -7

INTSRUMENT CONTROL: Introduction, GPIB communication, Hardware specification, software architecture, Instrument I/O assistant, VISA, Instrument drivers, serial port communications, using other interfaces.

7 Hours

UNIT -8

DATA ACQUISITION: Introduction, signal conditioning, DAQ hardware configuration, analog inputs, counters, Digital I/O (DIO), DAQ software architecture, DAQ Assistant, channels & Task configuration, selecting & configuring a data acquisition device, components of computer based measurement system

7 Hours

TEXT BOOK:

1. Virtual Instrumentation using LABVIEW- Jovitha Jerome, PHI , 2011
2. Virtual Instrumentation using LABVIEW – Sanjay Gupta, Joseph John, TMH , McGraw Hill Second Edition, 2011

REFERENCE BOOK:

1. S. Gupta and J P Gupta, ‘‘PC Interfacing for Data Acquisition and Process Control”, Instrument Society of America, 1994.
2. Robert H. Bishop ‘‘Learning with Lab –View” Prentice Hall, 2009.

NEURAL NETWORK & FUZZY LOGIC SYSEMS

Sub Code	**:**	**10 EI 764**	**IA Marks**	**:**	**25**
Hrs/Week	**:**	**04**	**Exam Hours**	**:**	**03**
Total Hrs	**:**	**52**	**Exam Marks**	**:**	**100**

PART - A

UNIT -1

INTRODUCTION: What is neural network? Human brain, models of a neuron, neural network viewed as directed graphs, feedback, Network architectures, knowledge representation, artificial intelligence and Neural Networks.

6 Hours

UNIT -2

LEARNING PROCESSES: Introduction, error correction algorithm, memory based learning, Hebbian learning, competitive learning, Boltzmann learning, learning with a teacher , learning without a teacher, Learning tasks, memory, adaptation.

6 Hours

UNIT – 3

SINGLE LAYER PERCEPTRONS: Introduction, perceptron, and perceptron convergence theorem, examples, multilayer perceptron – introduction and some preliminaries.

7 Hours

UNIT -4

Back propagation algorithm, summary of the Back propagation algorithm, XOR Problem, and Heuristics for making the Back propagation algorithm to perform better.

7 Hours

PART –B

UNIT – 5

RADIAL BASIS FUNCTION NETWORKS: Architecture, learning algorithms, applications, Hopfield networks – Architecture, capacity of Hopfield models, energy analysis of Hopfield networks.

7 Hours

UNIT- 6

FUZZY LOGIC: Uncertainty and imprecision, state and random processes, Uncertainty in information, fuzzy sets and classical sets, properties, mapping of classical sets to function, fuzzy set operation, properties of Fuzzy sets, sets as points in Hypercubes.

6 Hours

UNIT -7

CLASSICAL RELATIONS AND FUZZY RELATIONS: Cartesian product, crisp relations, fuzzy relations, tolerance and equivalence relations, fuzzy tolerance, value assignments.

6 Hours

UNIT -8

MEMBERSHIP FUNCTIONS: Features of membership functions, standard forms and boundaries, fuzzification, membership value assignment, Fuzzy to crisp conversions: lambda cuts for fuzzy sets, lambda cuts for fuzzy relations, defuzzification methods.

7 **Hours**

TEXT BOOKS :

1. **Neural Networks: A comprehensive foundation by Simon Haykin,** McMillan college public company, Newyork, 1994.
2. **Neural Networks** by **Satish Kumar,** Tata McGraw Hill, 2009.
3. **Fuzzy logic with engineering applications** – Timothy. J. Ross, McGraw Hill International Edition, 1997.

REFERENCE BOOKS:

1. **Introduction to Artificial Neural Systems**- Jacek M. Zurada Jaico publishing House 2012.
2. **Artificial neural networks** – B. Yegnanarayana prentice hall of India 1999.
3. **Neural network design** – Martin T. Hagan, Cengage learning,2009
4. **Neural network and Fuzzy Systems, A Dynamical systems approach to machine intelligence** – Bart Kosko, Prentice Hall of India publications, 2006
5. **Neural networks using MATLAB 6.0** – S.N. Shivanandam , S.Sumathi and S.N. Deepa Tata Mcgarw - Hill 2009.
6. **Fuzzy Logic, Intelligence, Control, and Information** –John Yen, Rena Langari, Pearson Education 2005.

VIII SEMESTER

LASERS & OPTICAL INSTRUMENTATION

Sub Code	**:**	**10 EI 81**	**IA Marks**	**:**	**25**
Hrs/Week	**:**	**04**	**Exam Hours**	**:**	**03**
Total Hrs	**:**	**52**	**Exam Marks**	**:**	**100**

PART -A

UNIT - 1

FUNDAMENTALS OF LASERS: Emission and absorption of radiation, Einstein relations, absorption of radiation, population inversion, optical feedback, threshold conditions-laser losses, line shape function, laser modes.

6 Hours

UNIT - 2

DOPED AND SEMICONDUCTOR LASERS: Properties of laser light, Classes of laser, Doped insulator lasers – Nd:YAG laser, Ruby laser, Semiconductor lasers – basics, threshold current density for semiconductor lasers, power output of semiconductor lasers, heterojunction lasers, quantum well lasers,

7 Hours

UNIT - 3

GAS, ION AND MOLECULAR LASERS: Gas lasers: Atomic lasers- He-Ne laser, Ion laser-Argon laser, Molecular laser-CO_2 laser, other molecular lasers, liquid dye lasers, Single mode operation, frequency stabilization, mode locking, Q-switching.

7 Hours

UNIT - 4

LASER APPLICATIONS: Measurement of distance - Interferometric methods, beam modulation telemetry, pulse echo techniques. Holography-principle, applications of holography, holographic computer memories. Laser induced nuclear fusion.

6 Hours

PART-B

UNIT -5

SINGLE OPTICAL FIBERS: Introduction, optical fibers-fundamentals, light transmission in optical fibers-principles, optical properties of optical fibers-advances, fabrication of optical fibers-principles, optical fibers for UV, visible, IR light-principles, power transmission through optical fibers-principles, modified fiber ends and tips-principles, fiber lasers-advances.

7 Hours

UNIT -6

OPTICAL FIBER BUNDLES: Introduction, non-ordered fiberoptic bundles for light guides-fundamentals & principles, ordered fiberoptic bundles for imaging devices-fundamentals & principles, fiberscopes and endoscopes-fundamentals, fiber optic imaging systems-advances.

6 Hours

UNIT -7

OPTICAL FIBER SENSORS: Phase and polarization fiber sensors, ring interferometer with multiturn fiber coil, optical fluid level detector, optical fiber flow sensors, optical displacement sensors, optical displacement Moire fringe modulation sensors, microbend optical fiber sensors, intrinsic fiber sensors measurement, current measurement by single-mode optical fiber sensors, fluro-optic temperature sensors, photoelastic pressure sensors, laser Doppler velocimeter using optical fiber.

6 Hours

UNIT -8

APPLICATIONS OF FIBER OPTIC LASER SYSTEMS IN MEDICINE: Introduction, Fiberoptic laser systems in cardiovascular disease-Endoscopic laser systems in cardiology, Fiberoptic laser therapy-angioplasty, Endoscopic Nd:YAG Laser therapy in gastroenterology, Laproscopic laser surgery, photodynamic therapy in oncology, ophthalmological applications of laser-fiber systems, arthroscopic surgery in orthopedics, laser lithotripsy, flowchart diagrams for clinical applications of laser-fiber systems-advances.

[From Textbook 3: Unit 9.1, 9.2, 9.2.1, 9.2.2, 9.2.5, 9.3.4, 9.5.2.3, 9.7.3, 9.8.2, 9.9.2, 9.11.4.3]

7 Hours

TEXT BOOKS:

1. Optoelectronics: An Introduction - Wilson and Hawkes, 2nd Edition, Prentice-Hall of India, 2001.
2. Optoelectronics and Fiber Optics Communication – C.K.Sarkar and D.C. Sarkar, New Age Int. Pub., 2004.
3. Lasers and Optical Fibers in Medicine - by Abraham Katzir, Academic Press, 1998.

REFERENCE BOOKS:

1. Essentials of Opto Electronics with Applications - A.J. Rogers, CRC press 1997.
2. Principles of optical communication & opto Electronics - I. Ravi Kumar, Bala N.Saraswathi, Lakshmi Publications 2nd edition 2007.
3. Optoelectronic Devices and systems - Guptha, Prentice Hall of India 2005.

EMBEDDED SYSTEM DESIGN

Sub Code	**:**	**10 EI 82**	**IA Marks**	**:**	**25**
Hrs/Week	**:**	**04**	**Exam Hours**	**:**	**03**
Total Hrs	**:**	**52**	**Exam Marks**	**:**	**100**

PART –A

UNIT -1

INTRODUCTION TO EMBEDDED SYSTEMS: An embedded system, Processor in the system, Other Hardware units, Software Embedded into a system, Exemplary Embedded Systems, Embedded System - on - chip (SOC) and in VLSI circuit.

6 Hours

UNIT -2

PROCESSOR AND MEMORY ORGANIZATION: Structural Units in a Processor, Processor selection for an Embedded System, Memory Devices, Memory Selection for an Embedded System, Allocation of Memory to Program segments and Blocks and Memory Map of a system, Direct Memory Access, Interfacing Processor, Memories and Input output Devices.

7 Hours

UNIT -3

DEVICES AND BUSES FOR DEVICE NETWORKS: Input Output Devices, Timer and Counting Devices, Serial Communication using the 'I^2 C', 'CAN' and Advanced Input and Output Buses between the Networked Multiple Devices, Host system or Computer Parallel Communication between the Networked Input and output multiple devices using the ISA, PCI, PCI-X and Advanced Buses.

6 Hours

UNIT – 4

PROGRAMMING CONCEPTS AND EMBEDDED PROGRAMMING IN C: Software programming in Assembly Language (ALP) and in High Level Language 'C', 'C' Program Elements, Header and Source Files and Preprocessor Directives, **:** Macros and Functions, Program Elements : Data Types, Data Structures, Modifiers, Statements, Loops and Pointers, Queues, Stacks and Ordered Lists, Embedded Programming in C++, Embedded programming in java, 'C' Program, Compiler and cross- compiler, Source Code Engineering Tools for Embedded C/C++, Optimization of Memory Needs.

7 Hours

PART – B

UNIT -5

PROGRAM MODELING CONCEPTS IN SINGLE AND MULTIPROCESSOR SYSTEMS SOFTWARE DEVELOPMENT PROCESS: Modeling Processes for Software Analysis before Software Implementation, Programming Model for Event controlled or Response Time Constrained Real Time Programs, Modeling of Multiprocessor Systems.

6 Hours

UNIT -6

SOFTWARE ENGINEERING PRACTICES IN THE EMBEDDED SYSTEM DEVELOPMENT PROCESS: Software Algorithm Complexity, Software Development Process Life Cycle and its Models, Software Analysis, Software Design, Software Implementation, Software Testing, Validating and Debugging, Real Time Programming Issues during Software Development Process, Software project Management, Software Maintenance, Unified Modeling Language (UML)

7 Hours

UNIT – 7

INTER PROCESS COMMUNICATION AND SYNCHRONIZATION OF PROCESSOR TASKS: Multiple Processes in an Application, Problem of sharing Data by Multiple tasks and Routine, Inter Process Communication.

6 Hours

UNIT – 8

HARDWARE-SOFTWARE CO-DESIGN IN AN EMBEDDED SYSTEM:

Embedded system project management, Embedded system design and Co-design issues in system development process, Design cycle in the development case for an Embedded system, Uses of target system or its emulator and In-Circuit Emulator (ICE), Uses of software tool for development of an Embedded system, Uses of Scopes and Logic analyzers for system hardware tests, Issues in Embedded system Design.

7 Hours

TEXT BOOK

1. **Embedded System architecture, Programming and design** by Rajkamal**,** -TMH 6th edition 2003.

REFERENCE BOOKS:

1. **Embedded Microcomputer System- Real time interfacing** J.W. Valvano**,** Thomson Learning 2000.
2. **Real time systems** by Jane W S Liu, Pearson Education, 2000.

ELECTIVE –IV (GROUP-D)

BIOSENSORS & BIOINSTRUMENTATION

Sub Code	**:**	**10 EI 831**	**IA Marks**	**:**	**25**
Hrs/Week	**:**	**04**	**Exam Hours**	**:**	**03**
Total Hrs	**:**	**52**	**Exam Marks**	**:**	**100**

PART-A

UNIT -1

Introduction: A historical perspective, Bio-analytical sensors & systems, Transduction modes & classifications, Approaches to Immobilization, Basic designs of discrete sensors, calibration & figures of merit

6 Hours

UNIT -2

Chemical measurement: Objectives of chemical Measurement, requirements & limitations in chemical measurement. Chemical measurement, chemical transducer – Electro-chemical transducer, electrical potential & reference electrodes, potentiometric sensors, Amperometric sensors, electrochemical gas sensors, chemical Transducers of acoustic & thermal principles.

6 Hours

UNIT – 3

Biosensors – Enzyme based biosensors, immunosensors, Microbial sensors, continuous measurement of chemical quantities – intravascular measurements, tissue measurements, Measurement - by blood drainage, Measurements by Microdialysis, Measurements by effluent fluid analysis. Transcutaneous Measurements of pO_2, pCO_2. Transcutaneous arterial oxygen saturation monitoring – the basics of oximetry, early oximeters, pulse oximeter, Electronic nose.

7 Hours

UNIT -4

Optically based energy Transduction: Fiber optic devices, Guided waves, Evanescent wave, Fiber optic sensor designs, planar wave guides, near field optical sensing. Surface Plasmon resonance, Thermal sensor.

7 Hours

PART –B

UNIT – 5

Surface Characterization in Biomaterials and Tissue Engineering- Molecules and Biomaterials, Molecules & Tissue Engineering, surface analysis- Transmission electron Microscope, Scanning electron Microscope, scanning Tunneling Microscope, Scanning Force Microscope. Protein Adsorption, Molecular size.

7 Hours

UNIT – 6

Blood cell counters: Blood components & processing, calculation of size of cells, methods of cell counting – microscopic method, automatic optical method, electrical conductivity method. Coulter counters – multiparameter coulter counter, picoscale. automatic recognitions and differential counting of cells

6 Hours

UNIT – 7

Cellular Measurements in Biomaterials and Tissue Engineering: Cell Measurement overview, Light Microscopy, Cell orientation, Cell-rolling velocity, Cell Deformation, Cell proliferation, Cell Differentiation, Cell Signaling & Regulation. Anesthesia machine – Gas supply system, vapour delivery, delivery system, Humidification.

7 Hours

UNIT -8

Body Temperature, Fat & Movement: Regulation of Body Temperature, Infrared Thermometer, Measurement of Body fat, Direct & Indirect Measurement of body fat, Measurements of body Movement. Ventilators, classification of Ventilators .

6 Hours

TEXT BOOK:

1. **Introduction to Bio analytical sensor** by Alice Cunningham, John wiley and sons, 1998.
2. **Biomedical Transducers and Instruments,** Tatsuo Togawa, Toshiyo Tamura, P. AKE Oberg.CRC Press 1997.
3. **Bio-Instrumentation**, John G. Webster, John Wiley India,2003.

REFERENCE BOOKS:

1. **Biosensors and their applications** by Victor yang and That Ngo, Kluwer Academic/ Plenum Publisher, 2000.
2. **Handbook of Biomedical Instrumentation,** R.S. Khandpur second edition, TMH Publication, 2007.

MEMS & MICROSYSTEMS

Sub Code	**:**	**10 EI 832**	**IA Marks**	**:**	**25**
Hrs/Week	**:**	**04**	**Exam Hours**	**:**	**03**
Total Hrs	**:**	**52**	**Exam Marks**	**:**	**100**

PART –A

UNIT -1

OVERVIEW OF MEMS AND MICROSYSTEMS: MEMS & Microsystems, Typical MEMS and Micro system Products, Evolution of Micro fabrication, Microsystems and Microelectronics. The Multidisciplinary nature of Microsystem, Design and Manufacture, Microsystem and Miniaturization, Applications of Microsystems in the Automotive Industry and in other industries.

7 Hours

UNIT -2

WORKING PRINCIPLES OF MICROSYSTEMS: Introduction, Micro sensors, Micro actuation, MEMS with Micro actuators, Micro accelerometers Micro fluids.

6 Hours

UNIT – 3

ENGINEERING SCIENCE FOR MICRO SYSTEM, DESIGN AND FABRICATION: Introduction, Atomic structure of matter, Ions and Ionization, Molecular theory of matter and Intermolecular Forces, Doping of Semiconductors, The Diffusion Process, Plasma Effects, Electrochemistry, Quantum physics.

7 Hours

UNIT – 4

ENGINEERING MECHANICS FOR MICRO SYSTEM DESIGN: Introduction, Static Bending of Thin Plates, Mechanical Vibration, Thermo mechanics, Thin Film Mechanics.

6 Hours

PART –B

UNIT -5

MATERIALS FOR MEMS AND MICROSYSTEMS: Introduction, Substrates and wafers, Active Substrate materials, silicon as a substrate material, silicon compounds, silicon piezoresistors, Gallium Arsenide, Quartz, piezoelectric crystals, Polymers, Packaging Materials.

7 Hours

UNIT – 6

MICROSYSTEMS FABRICATION PROCESS: Introduction, Photolithography, Ion Implantation, Diffusion, Oxidation, Chemical Vapour Deposition, Physical Vapour deposition, Deposition by Epitaxy, Etching.

6 Hours

UNIT – 7

MICROSYSTEMS DESIGN: Introduction, Design considerations, Process Design, Design of a silicon Die for a Micro pressure sensor, Design of Micro fluidic network systems.

6 Hours

UNIT – 8

MICROSYSTEMS PACKAGING: Introduction, Overview of Mechanical Packaging of Microelectronics, Micro system Packaging, Interfaces in Micro system Packaging, Essential Packaging Technologies, Three-dimensional Packaging, Assembly of Microsystems, Selection of Packaging Materials, Signal Mapping and Transduction, Design Case: Pressure Sensor Packaging.

7 Hours

TEXT BOOK:

1. **MEMS & Microsystems Design and Manufacture** – Tai Ran Hsu, TMH 2002.

REFERENCE BOOK:

1. **Fundamentals of BioMEMS and Medical Micro devices -** by Steven S. Saliterman, Wiley-Interscience, 2006

COMPUTER COMMUNICATION NETWORKS

Sub Code	**:**	**10 EI 833**	**IA Marks**	**:**	**25**
Hrs/Week	**:**	**04**	**Exam Hours**	**:**	**03**
Total Hrs	**:**	**52**	**Exam Marks**	**:**	**100**

PART –A

UNIT -1

INTRODUCTION: Uses of computer Networks, Network Hardware, Network Software, Reference Models, Example Networks, Network Standardization.

6 Hours

UNIT -2

THE PHYSICAL LAYER: The Theoretical Basis for Data Communication, Guided Transmission Media, wireless Transmission, Communication Satellites, The Public Switched Telephone Network, The Mobile Telephone System, Cable Television.

7 Hours

UNIT -3

THE DATA LINK LAYER: Date Link Layer Design Issues, Error Detection and Correction, Elementary data Link Protocols, Sliding window Protocols, Protocol Verification, Data Link Protocols.

6 Hours

UNIT -4

THE MEDIUM ACCESS CONTROL SUB LAYER: The Channel Allocation problem, Multiple Access protocols, Ethernet, Wireless LANS, Broadband wireless, Bluetooth, Data Link Layer Switching.

7 Hours

PART –B

UNIT -5

THE NETWORK LAYER-1: Network layer design issues, Routing Algorithms, Congestion Control Algorithms, and Quality of Service.

6 Hours

UNIT -6

THE NETWORK LAYER-2: Internet Working, Network Layer in the Internet.

TRANSPORT LAYER-1: The Transport Service, Elements of Transport protocols.

7 Hours

UNIT -7

TRANSPORT LAYER-2: A simple transport protocol, the internet transport protocols (TCP and UDP), Performance issues.

7 **Hours**

UNIT -8

THE APPLICATION LAYER: Domain name System (DNS), electronic mail, worldwide web, multimedia.

6 Hours

TEXT BOOK:

1**. Computer Networks**: Andrews S. Tanenbaum, 4th Edition, Pearson Education 2002.

REFERENCE BOOKS:

1. ATM Protocol concepts - Hondel and Fluber, Addison Wesley 2011.

2. Data and computer networks – W Stallings 5th Edition, Prentice Hall of India 1998.

SYSTEM MODELLING

Sub Code	**:**	**10 EI 834**	**IA Marks**	**:**	**25**
Hrs/Week	**:**	**04**	**Exam Hours**	**:**	**03**
Total Hrs	**:**	**52**	**Exam Marks**	**:**	**100**

PART-A

UNIT -1

FUNDAMENTAL CONCEPTS IN MATHEMATICAL MODELING: Systems, modeling and analysis. Abstraction. Physical dimensions and units. Linearity and superposition. A gentle introduction to differential equations. Scaling in elementary differential equations. Balance and conservation laws and the system boundary approach: balance equations, conservation laws, examples.

6 **Hours**

UNIT -2

LUMPED–ELEMENT MODELING: introduction, One dimensional translational mechanical systems; the element comprising simple mechanical systems. Translational springs. Translational dampers. Mass elements in translational motion. The ideal force and the ideal displacement inputs. The interrelationship between forces in different elements in a system; Newton's second law. The interrelationship between deformations of different elements in a system: consistency of displacements. Simplifying models through combination of elements. Examples. RLC electrical systems: the interrelationship between the voltage differences across elements in a system. Simplifying models through combination of elements. Examples.

7 **Hours**

UNIT- 3

GENERALIZING LUMPED-ELEMENT MODELING: Introduction. A framework for unifying lumped-element models; some common approaches. Basic linear graph theory. Relating linear graph theory to lumped-element models of physical systems. Manipulation of graph theory rules. Examples. Rotational mechanical systems; the basics of rotational mechanics. Rotational mechanical system elements. Torsional springs. Torsional damper elements. The mass moment of inertia element. The ideal torque and ideal angular displacement inputs. The rules governing rotational mechanical systems. Examples.

7 **Hours**

UNIT- 4

THERMAL AND HYDRAULIC SYSTEMS: Basic physics of incompressible fluids. Hydraulic system elements. The pipe element. The tank element. Ideal flow rate and ideal pressure sources. The rules governing the hydraulic model. Basic concept in heat transfer. Thermal system elements. The thermal resistance element. The thermal mass element. Ideal heat transfer rate and ideal temperature inputs. The rules governing the thermal model. Examples.

6 **Hours**

PART-B

UNIT -5

FIRST ORDER SYSTEM MODELS: Governing equations for first order systems. Canonical form of first order systems. Classifications of responses and systems. Solution of governing equations; free response and forced response. Transient response specifications. Experimental determination of time constant: free response and forced response. Application of superposition in first order system models.

7 **Hours**

UNIT -6

SECOND- ORDER MODELS OF SYSTEMS: Governing equations for second order systems. Canonical form of second-order systems. Classifications of responses and systems. Solution of governing equations; free response and forced response. Transient response specifications. Experimental determination of ζ: using free response and step response.

6 **Hours**

UNIT -7

STATE SPACE FORMULATIONS OF SYSTEMS PROBLEMS: Examples of state variables and state equations. Matrix formulation. Free response and Eigen value problem. Stability. Graphical solution. Forced response and response to step input. Examples. Phase plane and stability considerations.

6 **Hours**

UNIT - 8

RELATING THE TIME DOMAIN, FREQUENCY DOMAIN, AND STATE SPACE: Introduction. The pole-zero plot; relating pole zero plot to transfer function, the governing equation, and state matrix Eigen values. Relating plot location to system parameters. Relating frequency to pole location; the relationship between the T(s) surface and the frequency response function. Higher order systems and dominant poles. Transient response, poles, and frequency response; the relationship between the mathematical form of the free response, pole location, and system parameters. The effect of Non dominant poles on transient behavior. State space trajectories, poles, and transient response. Examples.

7 **Hours**

TEXT BOOK:

1. "**Fundamentals of modeling and analyzing engineering systems"** Philip D. Cha, James J. Rosenberg and Clive L. Dym, First Edition,2000. Cambridge University Press.

REFERENCE BOOKS:

1. **Chemical Process Control an Introduction to theory and practice**, George Stephanopoulos, PHI,1998, Sixth reprint.
2. **Modern Control Engineering,** Roy Choudhury, Prentice Hall India, 2004-reprint.
3. **Digital Control and State variable methods**, Madan Gopal, Second Edition, Prentice Hall India, 2004-reprint.

ELECTIVE –V (GROUP-E)

UNIT OPERATIONS IN INSTRUMENTATION

Sub Code	**:**	**10 EI 841**	**IA Marks**	**:**	**25**
Hrs/Week	**:**	**04**	**Exam Hours**	**:**	**03**
Total Hrs	**:**	**52**	**Exam Marks**	**:**	**100**

PART – A

UNIT -1

INTERACTION AND DECOUPLING OF CONTROL LOOPS: Interaction of control loops**,** Interaction of control loops in STH and CSTR, Relative gain array and the selection of loops with examples, Design of non interacting control loops.

6 Hours

UNIT -2

DRYER CONTROLS: Air as a drying medium, Drying of solids, Dryer types, Control of different types of batch and continuous dryers - atmospheric tray dryer, vacuum dryer, batch fluid bed dryer, Heated-cylinder dryer, Rotary dryer, Turbo dryer, Spray dryer , Continuous fluid bed dryer.

7 Hours

UNIT -3

EVAPORATOR CONTROLS: Evaporator terminology, Types of evaporator, Control system for evaporators - feedback control, cascade control, selective control, feed forward control, Steady state model of an evaporator.

6 Hours

UNIT – 4

FURNACE CONTROL: Control system functions, Combustion air requirements, Control systems and instrumentation for Start-up heaters, fired reboilers, Process heaters and vaporizers, Feed forward control.

7 Hours

PART – B

UNIT – 5

DISTILLATION COLUMN CONTROL: Survey of control schemes, Basic features of composition control scheme, Control of overhead composition, Bottom composition, both product composition, Location of the sensing element, Pressure control, Control of feed temperature.

7 Hours

UNIT – 6

HEAT EXCHANGER CONTROLS: Degrees of freedom, Liquid-to-Liquid heat exchangers, Three-way valves, Cooling water conservation ,Two -Two way valves, Steam heaters and its controls, Condenser controls, Reboilers and vaporizers, Cascade control.

6 Hours

UNIT – 7

CRYSTALLIZER CONTROL: The crystallization process, Control of evaporator Crystallizers, Cooling Crystallizers, classifying crystallizers and vacuum crystallizers.

7 Hours

UNIT – 8

SAFETY IN INSTRUMENTATION AND CONTROL SYSTEMS: Area and material classification, Techniques used to reduce explosion hazards, intrinsic safety, Basic techniques used by manufacturers, Certification of intrinsically safe apparatus, Installation of intrinsically safe systems.

6 Hours

TEXT BOOKS:

1. **Chemical Process Control-George Stephanopoulos** - 4th printing PHI New Delhi 1984.
2. **Instrument Engineers Hand Book - Process Control**, Bela G Liptak ,3rd Edition , Chiltan Book Company Radonor Pennsylvania,1995.
3. **Process Control**-by Peter Harriott TMH New Delhi 1972

REFERENCE BOOK:

1. **Process /Industrial Instrumentation and Controls Handbook**- 4th Edition by D.M. Considine, McGraw Hill International edition

SPEECH SIGNAL PROCESSING

Sub Code	**:**	**10 EI 842**	**IA Marks**	**:**	**25**
Hrs/Week	**:**	**04**	**Exam Hours**	**:**	**03**
Total Hrs	**:**	**52**	**Exam Marks**	**:**	**100**

PART – A

UNIT – 1

INTRODUCTION: Speech signal, signal processing, Digital speech processing, speech communication applications.

DIGITAL MODELS FOR SPEECH SIGNALS: Process of speech production, mechanism of speech production, Acoustic phonetics, Acoustic theory of speech production, Models based upon the Acoustic theory, Digital models for speech signals.

6 Hours

UNIT – 2

TIME DOMAIN MODELS FOR SPEECH PROCESSING: Time dependent processing of speech, Short time Energy and average magnitude, Short time average zero crossing rate, Speech Vs silence discrimination using energy and zero crossing. Pitch period estimation, Short time autocorrelation function, Shot time average magnitude difference function, pitch period estimation using autocorrelation function.

7 Hours

UNIT – 3

DIGITAL REPRESENTATIONS OF THE SPEECH WAVEFORM: Sampling speech signals, Review of the statistical model for speech, Instantaneous Quantization, Adaptive Quantization, General theory of differential quantization, Delta modulation.

6 Hours

UNIT -4

SHORT TIME FOURIER ANALYSIS: Definition and properties, Fourier transform interpretation, Linear filtering interpretation, Filter bank summation method, Overlap addition method, Design of digital filter banks, spectrographic displays, pitch detection.

7 Hours

PART –B

UNIT – 5

LINEAR PREDICTIVE CODING OF SPEECH: Basic principles of linear predictive analysis, Solution of LPC equations, prediction error signal, Frequency domain interpretation. Applications of LPC Parameters.

7 Hours

UNIT – 6

SPEECH SYNTHESIS: Principles of Speech synthesis, synthesis based on waveform coding, analysis synthesis method, speech production mechanism, Synthesis by rule, Text to speech conversion.

6 Hours

UNIT – 7

SPEECH RECOGNITION: Principles of Speech recognition, Speech period detection, Spectral distance measures, Structure of word recognition systems, Dynamic time warping (DTW), Word recognition using phoneme units, HMM.

7 Hours

UNIT – 8

SPEAKER RECOGNITION: Principles of Speaker recognition, Speaker recognition methods, examples of speaker recognition system.

6 Hours

TEXT BOOKS:

1. **Digital Processing of Speech Signals** – L R Rabiner and R W Schafer, Pearson Education 2004.
2. **Digital Speech Processing** –Synthesis and Recognition, Sadoaki Furui, 2nd Edition, Mercel Dekker 2002.

REFERENCE BOOKS:

1. **Introduction to Data Compression** – Khalid Sayood, 3rd Edition, Elsevier Publications 2006.
2. **Digital Speech** – A M Kondoz, 2nd Edition, wiley Publications, 2004.

INDUSTRIAL INSTRUMENTATION

Sub Code	**:**	**10 EI 843**	**IA Marks**	**:**	**25**
Hrs/Week	**:**	**04**	**Exam Hours**	**:**	**03**
Total Hrs	**:**	**52**	**Exam Marks**	**:**	**100**

PART - A

UNIT - 1

MEASUREMENTS OF MOISTURE AND HUMIDITY: Classification of Measurement Techniques, Measurement of Moisture and Humidity in gases, Measurement of Moisture and humidity over liquids, Measurement of Moisture and humidity over solids.

6 Hours

UNIT – 2

MEASUREMENTS OF DENSITY AND VISCOSITY: Newtonian and Non-Newtonian fluids, Classification of Density measurement techniques, Classification of Viscosity Measurement Techniques, Measurement of density, Measurement of Viscosity.

7 Hours

UNIT - 3

MEASUREMENT OF SPEED, ACCELERATION AND VIBRATION: Classification of Tachometers, Revolution counter, Centrifugal force tachometers, Eddy-current tachometers, D.C. Tachogenerator, A.C. Tachogenerator, stroboscopic Tachometer, Seismic Displacement pickups, Seismic velocity Pickup, Piezoelectric accelerometer, Vibration Wedge amplitude indicator, Electromechanical Absolute Vibration pickup.

7 Hours

UNIT – 4

MEASUEMENT OF SOUND: Measurement of sound, Sound parameters, Classification of Sound-Measuring methods**.**

6 Hours

PART - B

UNIT - 5

Food industry instrumentation, Instrumentation in canning industry, dairy industries.

7 Hours

UNIT - 6

Steel production instrumentation, Selection of instruments, black furnace instrumentation, open-hearth process instrument, End product measurement, continuous casting of steel.

6 Hours

UNIT – 7

Steam power plant instrumentation, Instrument selection, primary and secondary plant measurement.

6 Hours

UNIT - 8

Aerospace Instrumentation: Aircraft and aerospace vehicle instrumentation, air flight simulation instrumentation.

7 Hours

TEXT BOOKS:

1. **Principles of Industrial Instrumentation and Control Systems**- Chennakesava R.Alavala, Cengage Learning 1st edition 2009.
2. **Hand book of applied instrumentation**-CONSIDINE and ROSS, Publisher McGraw- Hill 1982.

REFERENCE BOOKS:

1. **Industrial instrumentation-** by DONALD P. ECKMAN, Wiley 1951.
2. **Industrial Instruments**- by K.Krishnaswamy, S.Vijayachitra, Newage International publishers 2005.
3. **Food Processing Principles & Applications**- J.S.Smith, University press (US) 2004.

SMART SENSONRS

Sub Code	**:**	**10 EI 844**	**IA Marks**	**:**	**25**
Hrs/Week	**:**	**04**	**Exam Hours**	**:**	**03**
Total Hrs	**:**	**52**	**Exam Marks**	**:**	**100**

PART - A

UNIT - 1

BASICS OF SMART SENSORS & MICROMACHINING: Introduction, Mechanical-Electronic transitions in sensing, nature of sensors, overview of smart sensing and control systems, integration of micromachining and microelectronics, introduction to micromachining, bulk micromachining, wafer bonding, surface micromachining, other micromachining techniques.

7 Hours

UNIT - 2

SENSOR INFORMATION TO MCU: Introduction, amplification and signal conditioning, separate versus integrated signal conditioning, digital conversion.

6 Hours

UNIT - 3

MCUS AND DSPS TO INCREASE SENSOR IQ: Introduction, MCU control, MCUs for sensor interface, DSP control, Software, tools and support, sensor integration.

6 Hours

UNIT - 4

COMMUNICATIONS FOR SMART SENSORS : Introduction, definitions and background, sources and standards, automotive protocols, industrial networks, office & building automation, home automation, protocols in silicon, other aspects of network communications.

7 Hours

PART -B

UNIT - 5

CONTROL TECHNIQUES: Introduction, state machines, fuzzy logic, neural networks, combined fuzzy logic and neural networks, adaptive control, other control areas.

6 Hours

UNIT - 6

SENSOR COMMUNICATION & MEMS: Wireless zone sensing, surface acoustical wave devices, intelligent transportation system, RF-ID, Microoptics, microgrippers, microprobes, micromirrors, FEDs.

7 Hours

UNIT - 7

PACKAGING, TESTING AND RELIABILITY OF SMART SENSORS: Introduction, Semiconductor packaging applied to sensors, hybrid packaging, packaging for monolithic sensors, reliability implications, testing smart sensors. Unit Standards for Smart Sensors: Introduction, setting the standards for smart sensors and systems, IEEE 1451.1, IEEE 1451.2, IEEE P1451.3, IEEE 1451.4, extending the systems to network**.**

7 Hours

UNIT - 8

IMPLICATIONS OF SMART SENSOR STANDARDS AND RECENT TRENDS: Introduction, sensor plug-and-play, communicating sensor data via existing wiring, automated/remote sensing and web, process control over the internet, alternative standards, HVAC sensor chip, MCU with integrated pressure sensors, alternative views of smart sensing, smart loop.

6 Hours

TEXT BOOK:

1. **Understanding Smart Sensors**- Randy Frank, 2nd Edition. Artech House Publications, 2000.

REFERENCE BOOK:

1. **Smart Sensors**- Paul W. Chapman, ISA Press 1996.