BHARATHIAR UNIVERSITY

Coimbatore – 641046

DEPARTMENT OF ELECTRONICS AND INSTRUMENTATION

M.Sc. Electronics & Instrumentation Syllabus

(For the Candidates admitted during the academic year **2017-2018 onwards**)

BHARATHIAR UNIVERSITY: COIMBATORE – 641 046
SCHOOL OF PHYSICAL SCIENCES

DEPARTMENT OF ELECTRONICS & INSTRUMENTATION (DEI)

M.Sc., ELECTRONICS AND INSTRUMENTATION

ELIGIBILITY CONDITIONS FOR STUDENTS

(For the Candidates admitted during the academic year **2017-2018 onwards**)

THE ELIGIBILITY CONDITIONS FOR ADMISSION TO M.Sc. ELECTRONICS & INSTRUMENTATION SHALL BE AS FOLLOWS:

1. A PASS IN B.Sc. ELECTRONICS / INDUSTRIAL ELECTRONICS/ ELECTRONIC SCIENCE / ELECTRONICS AND COMMUNICATION SYSTEMS/ B.Sc. HONS/ B.Sc. ELECTRICAL EQUIPMENT MAINTENANCE, INSTRUMENTATION / B.E.S.
2. A PASS IN TRIPLE MAJOR (MATHS, PHYSICS & ELECTRONICS) OR (MATHS, ELECTRONICS & COMPUTER SCIENCE).
3. A PASS IN B.Sc. ELECTRONICS WITH COMPUTER HARDWARE, TECHNOLOGY OF APPLIED SCIENCE, B.SC COMPUTER TECHNOLOGY, B.E WITH ECE, EEE, EIE, AND A.M.I.E IN RESPECTIVE BRANCHES IS ALSO ELIGIBLE FOR JOINING THE ABOVE SAID COURSES.

ALL THE ABOVE CHANGES SHALL TAKE EFFECT FOR THE STUDENTS ADMITTED DURING THE ACADEMIC YEAR 2017-2018 AND ONWARDS.

DEPARTMENT OF ELECTRONICS AND INSTRUMENTATION

M.Sc. Electronics and Instrumentation

Scheme of Examination

Sem	Code No.	Subject	Class Hours	University Examination			
				Internal (%)	External (%)	Total	Credit
I		Sensors and Transducers	4	25	75	100	4
		Analog and Digital Electronics	4	25	75	100	4
		Circuit Theory	4	25	75	100	4
		Electro Magnetic theory	4	25	75	100	4
		Analog and Digital Electronics Laboratory	3	25	50	75	3
		Circuit Theory Laboratory	3	25	50	75	3
		Elective – I	4	25	75	100	4
		Supportive – I	2	12	38	50	2
II		Control Systems	4	25	75	100	4
		Embedded Systems	4	25	75	100	4
		Intelligent Instrumentation	4	25	75	100	4
		Bio-Medical Instrumentation	4	25	75	100	4
		Embedded Systems Laboratory	3	25	50	75	3
		Intelligent Instrumentation and Medical Electronics Laboratory	3	25	50	75	3
		Elective II	4	25	75	100	4
		Supportive – II	2	12	38	50	2
III		Process Control	4	25	75	100	4
		Digital Signal Processing	4	25	75	100	4
		VLSI System Design	4	25	75	100	4
		Digital Signal Processing Laboratory	3	25	50	75	3
		VLSI Laboratory	3	25	50	75	3
		Elective- III	4	25	75	100	4
		Supportive – III	2	12	38	50	2
IV		PLC and its applications	4	25	75	100	4
		PLC, SCADA and Instrumentation Laboratory	3	25	50	75	3
		Project, Viva-Voce and Industrial Visit	3	---	75	75	3
Total Marks: 2250				**Credits: 90**			

M.Sc., ELECTRONICS AND INSTRUMENTATION

List of Electives:

Elective I (Semester I)

1. Electronic Test Instruments
2. Measurements Techniques and its Applications.
3. Analytical Instrumentation

Elective II (Semester II)

1. Data Communication Networks
2. Computer Aided Instrumentation.
3. Microwave Theory and Techniques.

Elective III (Semester III)

1. Ocean Electronics and Marine Instrumentation.
2. Communication System and Fiber Optics.
3. Power Plant Instrumentation.

Supportive Papers offered at Electronics & Instrumentation Department for other students.

Paper I : Digital Electronics and Microprocessor.

Paper II : Biomedical Instrumentation.

Paper III : Analytical Instrumentation.

1. SENSORS AND TRANSDUCERS **Semester I**

UNIT I: SCIENCE OF MEASUREMENTS AND INSTRUMENTATION OF TRANSDUCERS

Units and Standards-Calibration Methods-Static Calibration-Classification of Errors –Error Analysis- Statistical Methods-Odds and Uncertainty-Classification of Transducers-Selection of Transducers.

CHARACTERISTICS OF TRANSDUCERS: Static characteristics Accuracy, precision, Resolution, Sensitivity, Linearity, Threshold Resolution, Hysteresis and Dead Space, Dynamic Characteristics - Mathematical model of Transducer-Zero, II order Transducers and I. Response to Impulse, Step, Ramp and Sinusoidal Inputs.

UNIT II: RESISTANCE, INDUCTANCE AND CAPACITANCE TRANSDUCERS

Principle of operation, construction details, Characteristics and application of resistance potentiometer, Strain Gauge, Resistance Thermometer, Thermistor, Hotwire Anemometer, Piezeoresistive Sensor and Humidity Sensor. Induction potentiometer-Variable Inductance Transducers- EI picks up LVDT-Capacitive transducer and types-Capacitor Microphone-Frequency response.

UNIT III: TRANSDUCERS

Piezoelectric transducer, Magnetostrictive - IC sensor-Digital Transducers-Smart sensor- Fibre optic sensors, SQUID sensors, Film sensors. Ultrasonic sensors – IR sensors.

UNIT IV: MEMS

Overview of MEMS and Microsystems-Working principles of Microsystems: Micro sensors-Microactutation-MEMS with Microactuators- Microaccelerometers

UNIT V : MICROSYSTEMS FABRICATION PROCESSES

Introduction- Photolithography-Ion Implementation-Diffusion-Oxidation-Chemical vapor deposition- Physical vapor deposition- Deposition by Epitaxy-Etching.

OVERVIEW OF MICRO MANUFACTURING: Bulk Micro manufacturing-Surface Micromachining-The LIGA Process.

TEXT BOOKS

1. A.K.Sawhney, “A course in Electrical & Electronic Measurement and Instrumentation” Dhanpat Raj and Co (P) Ltd.2004
2. E.O.Doebelin, “Measurement Systems-Applications and Design”,Tata McGraw Hill, New Work, 1990
3. D.V.S Murthy, “Transducer and Instrumentation”, Prentice Hall of India, 1995.
4. Tai-Ran Hsu **“**MEMS and microsystems: design and manufacture”McGraw-Hill, 2002.

REFERENCE BOOKS

1. D.Patranabis, “Sensors and Transducers”, Prentice Hall of India, 1999.
2. John P.Bentley, “Principles of Measurement Systems”,III Edition, Pearson Education, 2000.
3. Hermann K.P.Neubert, “Instrument Transducers”, Oxford University Press, 2000.
4. D.V.S.Murthy, “Transducers and Instrumentation”, Prentice Hall of India, 2001.
5. S.Ranganathan, “Transducer Engineering”, Allied Publishers Pvt.Ltd.2003.
6. AlSulko and J.D.Fault, “Industrial Instrumentation”, Vikas Publications, Delhi, 1996

2. ANALOG AND DIGITAL ELECTRONICS **Semester I**

UNIT I: DEVICES AND CIRCUITS

Passive and Active components.PN junction diode, LED, Zener diode, Varactor Diode. BJT, Transistor Configuration, CE Transistor Amplifier and Power Amplifier. Concept of feedback. LC Oscillator and RC Phase shift oscillator.UJT, JFET and MOSFET. SCR, DIAC and TRIAC.

UNIT II: OPERATIONAL AMPLIFIERS

IC741 block diagram and ideal OpAmp Characteristics - Inverting and Non-Inverting amplifiers, Voltage Follower, Summing Amplifier, Difference Amplifier, Differentiator, Integrator, Comparator and Schmitt trigger.

UNIT III: LINEAR INTEGRATED CIRCUITS

First order Butterworth Low Pass filter, High Pass filter, Band Pass filter, Band Reject and Notch filter. Square Wave Generator, Triangular Wave Generator and Phase Shift Oscillator. Timer IC 555: Block diagram, Astable and Monostable multivibrator. Voltage Controlled Oscillator (VCO), Phase Locked Loop (PLL).

UNIT IV: NUMBER SYSTEM AND LOGIC OPERATIONS

Review of number system and coding, Code conversion, Logic gates and Logic operations. Boolean expression - laws and rules – Demorgan‟s theorem. Minimizing techniques – Kmap. Logic families: TTL, ECL, CMOS– comparison

UNIT V: DIGITAL CIRCUITS

Adders, subtractors, flip-flops, Shift registers - serial& parallel, counters- up, down, ring and decade. ADC and their types- successive approximation, flash ADC, dual slope, sigma delta. DAC - different types: weighted resistors, R2R. Mealy moore models, state machine notation, state diagram, state table, transition table, excitation table and equations-Analysis of synchronous and asynchronous sequential circuits.

TEXT BOOKS:

1. R S Sedha, “A Textbook of Applied Electronics”, S. Chand and Company Ltd.
2. Ramakant A Gayakwad, “Op-amp and Linear Integrated Circuits”, Prentice-Hall of India Pvt., Ltd.
3. Thomas L. Floyd, “Digital fundamentals”, Pearson Education, 8th Edition.
4. M. Morris Mano, “Digital Design”, Pearson Prentice Hall, 2003

REFERENCE BOOKS

1. K.R. Botkar, “Integrated Circuits”, Khanna Publishers.
2. Millman&Halkias, “Integrated Electronic”, Tata McGraw-Hill Publishing Ltd.
3. Herbert Taub & Donald L. Schilling, “Digital Integrated circuits”, McGraw-Hill.
4. Albert Paul Malvino& Donald P. Leach, “Digital principles and applications”, McGraw-Hill

3. CIRCUIT THEORY **Semester I**

UNIT-I: BASIC COMPONENTS

Introduction, Systems of units, Charge and current, Voltage, Power and Energy, Circuit elements: Resistors, Applications. Basic Laws: Ohm's Law, Nodes, Branches and Loops, Kirchhoff's Law, Series resistors and voltage division, Parallel resistance and current division, Wye-Delta transformations, Applications. Capacitor,Serial and Parallel Capacitor. Inductor, Serial and Parallel Inductor.

UNIT-II: METHODS OF ANALYSIS

Introduction, Nodal Analysis, Nodal Analysis with voltage sources, Mesh analysis, Mesh analysis with current sources, Nodal and Mesh analysis by inspection, Nodal Vs. Mesh analysis, Applications.

UNIT-III: CIRCUIT THEOREM

Introduction, Linearity property, Superposition theorem, Source transformation, Thevenin‟s theorem, Norton‟s theorem, Reciprocity theorem, Millman‟s theorem, Maximum power transfer theorem, Applications.

UNIT-IV: DC TRANSIENT ANALYSIS

Initially charged RC circuit, RL circuit with initial current, time constant, RL and RC circuits with sources, DC response of series RLC circuits (using differential equations).

UNIT-V: AC CIRCUIT ANALYSIS

Sinusoidal voltage and current, Definition of instantaneous, peak, peak to peak, root mean square and average values. Voltage-current relationship in resistor, inductor and capacitor. Phasor, complex impedance, power in AC circuits: instantaneous power, average power, reactive power, power factor. Sinusoidal circuit analysis for RL, RC and RLC circuits. Mesh analysis, node analysis and network theorems for AC circuits.

TEXT BOOKS:

1. Alexander and Sadiku," Fundamentals of Electric Circuits", Tata McGraw Hill, 3rd Edition.
2. Roy D.Choudhury, "Networks and Systems", New age international Publishers, 2005.

REFERENCE BOOKS:

1. W.H Hayt, J.E. Kemmerly, S.M. Durbin, "Engineering Circuit Analysis", Tata McGraw Hill, 2005.

4. ELECTRO MAGNETIC THEORY **Semester I**

UNIT-I: FUNDAMENTAL MATHEMATICS

Fundamental vector operations, Coordinate systems and transformation, Integrals of vector functions, Gradient of a scalar field, Divergence of a vector field, Divergence theorem, Curl of a vector field, Stokes's theorem, Physical Interpretation of Gradient, divergent and curl.

UNIT-II: ELECTROSTATICS

Electric charge and fields, Postulates of electrostatics, Conductor, Insulator, Triboelectricity, Electric potential, Electric flux, Electrostatic induction, dielectrics, Electric dipole moment, Polarization density, Coulomb's law, Gauss's law and applications, Electrostatic energy and forces, Poisson's and Laplace's equations, Uniqueness theorem, Electrostatic Boundary value problems.

UNIT-III: MAGNETOSTATICS

Electric Currents, current density and ohms law, Electromotive force and Kirchoffs voltage law, Equation of continuity and Kirchhoff's current law, Biot-Savart Law, Gauss and Ampere's Law, Magnetic dipole, Boundary conditions for magnetostatic fields, Magnetic energy, Energy stored in magnetic field.

UNIT-IV: ELECTROMAGNETIC FIELDS AND WAVES

Faraday's law of electromagnetic induction, Inconsistency of Amperes law, Maxwell's equations , Integral and differential forms, conduction current and displacement current, Boundary conditions for Electromagnetic fields, Helmholtz wave equation, Wave polarisation, Poynting vector and powerflow in EM field.

UNIT-V: ANTENNAS & RADIATING SYSTEMS

Radiation fundamentals, Antenna parameters, Hertz dipole, Wire antennas, Loop antennas, Introduction of Antenna arrays. Printed microstrip antennas: Basic characteristics, types and feeding methods of microstrip antennas, Introduction to Photolithography, Anechoic chamber and RF Network Analyzer.

TEXT BOOKS:

1. R. K. Shevgaonkar, "Electromagnetic Waves", McGraw Hill, 2006.
2. Haytt "Engineering Electromagnetics", McGraw-Hill Education
3. G. S. N. Raju,"Electromagnetic Field Theory and Transmission Lines",Pearson Education.
4. Elements of Electromagnetics; M. N. O. Sadiku: Oxford University Press, 2000.

REFERENCE BOOKS:

1. C. A. Balanis "Antenna Theory: Analysis and Design", John Wiley, 2005,.
2. D. K. Cheng, "Field and Wave Electromagnetics", Pearson, 2001.
3. N. Ida, "Engineering Electromagnetics", Springer, 2000.
4. J. Griffiths, "Introduction to Electrodynamics", PHI, 1999.
5. B. S. Guru & H. R. Hiziroglu, "Electromagnetic Field Theory Fundamentals", Thomson, 1997.

ANALOG AND DIGITAL ELECTRONICS LABORATORY **Semester I**
(Any 12 Experiments)

1. Rectifier circuits and Filter designing
2. IC fixed voltage regulation and its characteristics
3. Series Voltage Regulator
4. IC 723 variable voltage regulator
5. RC coupled Amplifier using BJT
6. UJT relaxation oscillator
7. Astable and Monostable Multivibrator using BJT
8. Inverting and Non – inverting Op-amp configuration
9. Voltage follower and Instrumentation Amplifier
10. Differentiator, Integrator, Summing and Difference amplifier using Op-Amp
11. Symmetrical and Asymmetrical square wave generation using IC 555
12. DIAC and TRIAC characteristics.
13. Half adder, Full adder, Half subtractor and Full subtractor using Logic gates.
14. SR & JK flip flops using logic gates.
15. Johnson counter, Ring counter and Up/Down Counter.
16. MUX and DEMUX using NAND gate.

CIRCUIT THEORY LABORATORY **Semester I**

(Any 12 Experiments)

1. Verification of Ohm's and Kirchhoff's laws
2. Verification of Superposition Theorem.
3. Verification of Thevenin's Theorem.
4. Verification of Norton's theorem.
5. Verification of Millman's' theorem
6. Verification of Maximum power transfer theorem.
7. To plot frequency response of a series resonant circuit.
8. To plot frequency response of a parallel resonant circuit.
9. To measure input impedance and output impedance of a given two port network.
10. To design a ∏ attenuator which attenuate given signal to the desired level.
11. Three phase power measurement by two wattmeter method.
12. Calculate parameters of Two Port Network.
13. Analyse time response of R-C circuit to a step D.C. voltage input.
14. Analyse time response of R-L circuit to a step D.C. voltage input.
15. Transient analysis of RLC circuit.
16. Design low pass, High pass and band-pass filter using passive components.

1. CONTROL SYSTEMS **Semester - II**

UNIT I: SYSTEMS AND THEIR REPRESENTATION

Basic elements in control systems – Open and closed loop systems – Mathematical modelling of Physicalparameters-Electrical analogy of mechanical and thermal systems – Transfer function – Synchros – ACand DC servomotors – Block diagram reduction techniques – Signal flow graphs.

UNIT II: TIME RESPONSE

Time response – Time domain specifications – Types of test input – I and II order System response –Error coefficients – Generalized error series – Steady state error – P, PI, PID modes of feedback control.

UNIT III: FREQUENCY RESPONSE

Frequency response – Bode plot – Polar plot – Constant M an N circles – Nichols chart – Determinationof closed loop response from open loop response – Correlation between frequency domain and timedomain specifications.

UNIT IV: STABILITY OF CONTROL SYSTEM

Characteristics equation – Location of roots in S plane for stability – Routh Hurwitz criterion – Root locus construction – Effect of pole, zero addition – Gain margin and phase margin – Nyquist stability criterion.

UNIT V: COMPENSATOR DESIGN

Performance criteria- Frequency response- LagCompensator- lead Compensator- lag-lead Compensator– Compensator design using bode plots.

TEXT BOOKS:

1. Nagrath, I.J., and Gopal, M., "Control systems Engineering", Wiley Eastern Ltd., 1992. Shanmuga Priya Publishers, 1998.
2. Katsuhiko Ogata, "Modern control Engineering", Fourth Edition, Pearson Education, First Indian Reprint 2002.

REFERENCE BOOKS:

1. Richard C.Dorf and Robert H.Bishop, "Modern control systems", Addison - Wesley, Eight Edition.
2. A. Nagoor Kani, "Control Systems", Second Edition, RBA Publications 2009.

2. EMBEDDED SYSTEMS **Semester II**

UNIT I: INTRODUCTION TO C PROGRAMMING

Structure of C programming - Various data types, C Tokens, Keywords and Identifier, Constants, Variables, Data types, Variable declarations. C-Operators: Arithmetic operators, relational operators, logical operators, assignment operators, increment and decrement operators, conditional operators, special operators, arithmetic expressions, evaluation of expressions, precedence of arithmetic operators.

UNIT II: DECISION MAKING, BRANCHING AND LOOPING

Decision making - IF statement, Switch statement, Conditional operator. Go to statement. Looping: While loop, Do-While, and For Loops - Nesting of loops - skipping of loops (break and continue).

UNIT III: INTRODUCTION TO EMBEDDED SYSTEMS

Embedded Systems –processors embedded into a system, embedded hardware units and devices in system, embedded software in a system – Embedded System on chip – Design process in embedded systems – Examples of embedded system.

UNIT IV: PIC PROGRAMMING

PIC 16F877 – Features – Device overview and Architecture – WREG register – File Registers – access bank – Status Register – Data types and directives – I/O Ports.Introduction to PIC assembly programming – Assembling and linking – Program counter and program ROM space – RISC architecture –Instruction set

UNIT V: PIC PERIPHERALS

Timers – Capture/ Compare/PWM Module - MSSP: SPI – I^2C – USART - Analog to Digital Converter Module – CPU Special features – Interrupts – WDT.LCD and Keyboard interfacing – ADC, DAC, Stepper motor and 7 Segment display interfacing

TEXT BOOKS:

1. Yashavant P. Kanetkar, “Let Us C”, BPB publications, 5th Edition.
2. Brian W. Kernighan & Dennis M. Ritchie, “The C Programming Language”, Prentice Hall, 2nd Edition.
3. Raj Kamal, “Embedded Systems Architecture, Programming and Design”, Tata McGraw Hill publishing – 2nd Edition.
4. Muhammed Ali Mazidi, “PIC microcontroller and Embedded Systems Using assembly and C for PIC 18”, Pearson Education

REFERENCE BOOKS:

1. E. Balaguruswamy, “Programming in ANSI C”, Tata McGraw-Hill, 5th Edition.
2. V Rajaraman, “Computer Programming in C”, Prentice Hall India.
3. PIC16F87X datasheet
4. John B Peatman, “Design with PIC microcontrollers”, Pearson Education

3. INTELLIGENT INSTRUMENTATION **Semester II**

UNIT I: **INTRODUCTION**

Virtual Instrumentation- Virtual Instrument and Physical Instrument- Hardware and software in Physical Instrumentation- Virtual Instrumentation for Test, Control, and Design- Virtual Instrumentation in the Engineering Process- Graphical system design using LabVIEW, Graphical programming and Textual Programming.

UNIT II: INTRODUCTION TO LABVIEW AND LOOPS

Introduction- Advantages of LabVIEW- Software Environment – Front Panel Control and Indicators- Block diagram- Data Types- Data Flow Program- LOOPS: For Loop- While Loop- Structure Tunnels- Shift registers- Feedback Nodes- Control Timing- Communication among multiple loops- Local variables- Global variables.

UNIT III: ARRAYS AND CLUSTERS

Introduction- Arrays in LabVIEW- One Dimensional array- Two Dimensional array- Multi dimensional array- Initializing arrays- Deletion, Inserting and Replacing – Array functions- Matrix operations with array. Clusters: Introduction- creating controls, Indicators and constant,- Cluster operations- Assembling and Disassembling clusters- conversion between arrays and clusters. Waveforms - waveform chart- XY graphics.

UNIT IV: DATA ACQUISITION

Introduction- signals- signal conditioning- DAQ hardware configuration- DAQ hardware-

Analog Inputs- Analog outputs- Counters- DAQ software architecture- DAQ assistant- Selecting and configuring a data acquisition device- Components of computer based measurements system.

UNIT V: ANALYSIS TOOLS AND APPLICATIONS IN VIRTUAL INSTRUMENTATION

Fourier transform-Power spectrum-Correlation-Windowing and filtering tools Simple temperature indicator-ON/OFF controller-P-I-D controller – Oscilloscope emulation Simulation of a simple second order system

TEXT BOOKS:

1. Jovitha Jerome, “Virtual Instrumentation Using LabVIEW”, Eastern Economy Edition, PHI Learning private ltd, 2010.

REFERENCE BOOKS:

1. S.Gupta and J.P.Gupta, “PC Interfacing for Data Acquisition and Process Control” Instrument society of America, 1994.
2. Peter W. Gofton, “Understanding Serial Communications” Sybex International.
3. Robert H.Bishop, “Learning with LabVIEW” Prentice Hall, 2003.

4. BIOMEDICAL INSTRUMENTATION **Semester II**

UNIT-I MEDICAL INATRUMENTATION BASICS

Generalized system constraints - classification of biomedical instruments - bio statistics - generalized static and dynamic characteristics - regulation of medical device.

SENSOR TRANSDUCERS: Resistive - capacitive - inductive piezoelectric - thermocouple thermister - fiber - optic sensor - radiation sensor - smart sensors - electro chemical sensor - electric fibro sensor - blood –glucose sensor.

UNIT-II: BIOELECTRIC SIGNALS AND ELECTRODES

Origin of bioelectrical activity - volume conductor fields ECG ,EEG,EMG, MEG, Electrode –electrolyte interface - polarizable electrode - electrode model - recording electrodes - micro electrode.

UNIT-III: MEASURMENT SYSTEM

Patient monitoring system - measurement of blood pressure - heart rate - pulse rate - temperature - heat sound - blood flow volume - respiratory systems measurement - cardiac output measurement - blood ph po2 measurement- oximeters - audio meters spectrophoto meters.

UNIT-IV: MEDICAL IMAGING SYSTEM

Information content of an image - radiography - computed radio graphy - computed tomography - magnetic resonance imaging - nuclear medicine - single photon emission computed tomography positron emission tomography - ultrasonagraphy.

UNIT-V: THERAPUTIC AND PROSTHETIC DEVICES

Cardiac pacemaker - defibrillators - hemodialysis - lithotripsy - ventilator incubators drug delivery device - artificial heart valve - heart lung machine - application of laser.

TEXT BOOKS

1. John G. Webster , “Medical instrumentation application and design”, 3rd Edition 2001
2. R.S. Khandpur, “Hand book of biomedical instrumentation”, Tata Mc graw Hill New Delhi, 2nd edition, 2003

REFERENCE BOOK

1. Joseph J. Carr and John M.brown, “Introduction to biomedical equipment technology”, Pearson education, 2003
2. Shakli Chatterjee., Aubert Miller., “ Biomedical Instrumentation”, Congage Learning, 2010

EMBEDDED SYSTEMS LABORATORY **Semester II**

(Any 12 Experiments)

PIC 16F87X BASED EMBEDDED SYSTEMS & RTOS

1. Arithmetic and logical operation
2. Single digit timer using seven segment displays.
3. DAC interface.
4. ADC INTERFACE.
5. LCD interface.
6. Stepper motor control.
7. Serial communication using RS232C.
8. PWM

ARM BASED EMBEDDED SYSTEMS

1. 8 Bit Digital output (LED interfacing).
2. 4X4 matrix Keypad interfacing
3. 128X64 pixels Graphics LCD interface
4. CAN interface

PSoC BASED EMBEDDED SYSTEMS

1. LED interfacing and Switch
2. Keypad interfacing
3. LCD interface
4. ADC interface

INTELLIGENT INSTRUMENTATION and MEDICAL ELECTRONICS LABORATORY

Semester II

(Any 12 Experiments)

INTELLIGENT INSTRUMENTATION LAB: (USING Lab VIEW)

1. Converting VI in to Sub VI
2. ADC using DAQ Interface
3. DAC using DAQ Interface
4. Temperature control using WSN
5. Implementation of Digital filters using LabVIEW DSP Module
6. ADC and LCD interface using LabVIEW ARM Module
7. Tank level monitoring system using DAQ Interface
8. Traffic light control using DAQ Interface

MEDICAL ELECTRONICS

9. Hand Grip heart rate monitor.
10. Characteristics of O_2 gas sensor.
11. Measuring blood pressure using Sphygmomanometer and give the tabular column for various stages.
12. Plethysmograph and to measure the heart rate.
13. Spiro meter used to perform an air flow and lung volume.
14. Hand Dynamometer.
15. pH meter
16. Observe the output wave form of heart rate monitoring using pulse oximeter in DSO

1. PROCESS CONTROL **Semester III**

UNIT I: FINAL CONTROL ELEMENTS

Final control operation: Signal conversion, actuators, control element- signal conversions: analog electrical signals, digital electrical signals, neumatic signals- power electronics, switching devices, controlling devices – actuators: electrical actuators, pneumatic actuators – control elements: mechanical, electrical, fluid walls

UNIT II: DISCRETE STATE PROCESS CONTROL

Definition of Discrete state process control – characteristics of the system: Discrete state variables, process specification, event sequence description – Process characteristics: Process equation, Process load, Process Lag, Self –regulation – Control system parameters: Error, variable range, Control parameter range, Control Lag, Dead time, Cycling, Controller modes- Discontinuous Controller Modes: Two-position Mode, Multiposition Mode, Floating control Mode – Continuous control Modes: Proportional control Mode, Integral control Mode, Derivative –control Mode- Composite Control Mode: Proportional –Integral Control, Proportional –Derivative Control Mode, Three Mode controller (PID)

UNIT III: ANALOG AND LOGIC CONTROLLERS

General features of analog controllers: Physical layout, front panel, side panel – Electronic controllers: Error detector, Single mode, composite controller mode – Pneumatic Controllers: General features, Mode Implementation – Relay controllers: Background, Ladder diagrams- Programme Logic Controllers: Relay sequences, Programmable Logic Controller Design, PLC operation, Programming, Functions of PLC software

UNIT IV: COMPUTER BASED CONTROL

Digital applications: Single and multivariable alarms, Two position control – Computer based controllers: Hardware configuration, Smart sensors, multiloop controllers- Software requirements- algorithms to implement the control equations: errors, proportional mode, integral mode, derivative mode,PID Control mode – Data Loggers – Supervisory control – Process control system networks, field bus operations, General characteristics of buses

UNIT V: CONTROL LOOP CHARACTERISTICS

Control System configurations: Single variable, Cascade Control – Multivariable control system: analog control, supervisory and direct digital control – Control system quality: definition of quality, measure of quality – Stability: Transfer function frequency dependence, stability criteria- Process Loop Tuning: Open Loop Transient Response Method, Ziegler-Nichols Method, Frequency Response Method

TEXT BOOK

1. Curtis D. Johnson, “Process control instrumentation Technology”, Eight editions, Prentice Hall of India, 2006

REFERENCE BOOK

1. Bela G. Liptak “Process Control”, butterworth – Heinemann
2. Frank D. Petruzella, “Programmable Logic Controllers”, Third Edition, Tata McGraw Hill Education Private Limited, 2010.
3. Michael P.Lukas, “Distributed Control Systems”, Van Nostrand Reinfold Company,1995

2. DIGITAL SIGNAL PROCESSING **Semester III**

UNIT I: INTRODUCTION

Continuous Time (CT) and Discrete Time (DT) signals – classification of CT and DT signals – Basic CT and DT signals – Signal Operations – Representation of signals by impulses- Linear Time Invariant(LTI) system.

UNIT II: SAMPLING AND TRANSFORMS

Sampling: Introduction – sampling theorem –reconstruction of a signal from its samples using interpolation – Aliasing – DT processing of a CT signal – sampling of DT signals Laplace Transform: Introduction – Laplace transform – region of convergence for LT – Inverse Laplace Transform – properties of Laplace transform.

Z-TRANSFORM: Definition of the z-Transform – z-Transform and ROC - Stability and ROC – Properties of Region of Convergence – Properties of the z-Transform- Relationship between the Fourier Transform and the z-Transform – Relationship between s-plane and z-plane – Inverse zTransform.

UNIT III: DISCRETE FOURIER TRANSFORM & COMPUTATION

The Discrete Fourier Transform –Relation of The DFT to Other Transforms – Properties of the Discrete Fourier transform – Comparison between Circular Convolution and Linear Convolution – Methods to Evaluate Circular Convolution of Two Sequences – Linear Convolution from Circular Convolution. Introduction of DFT – Efficient Computation of DFT – Properties of DFT – FFT algorithms – Radix – FFT algorithm – Decimation in Time – Decimation in Frequency algorithms – Use of FFT- algorithms in Linear Filtering and correlation.

UNIT IV: DESIGN OF DIGITAL FILTERS

Block diagram representation - Equivalent structures - Basic FIR Digital filter structures- Basic IIR digital filter structures- Amplitude and phase response of fir filters – linear phase filters –windowing techniques for design of linear phase FIR filters – rectangular, Hamming – Frequency sampling techniques – IIR Filters – magnitude response – Phase response – group delay – Design of Low Pass Butterworth filters(low pass)- Bilinear transform – Prewarping. Impulse invariant transformation.

UNIT V: DIGITAL SIGNAL PROCESSORS

Introduction to DSP architecture – Von Neumann Architecture – Harvard architecture- Dedicated MAC unit – Multiple ALUS, Advanced addressing modes, pipelining, and Overview of instruction set of TMS320CSX and C54XX

TEXT BOOKS

1. J.G.Proakis and D.G.Manollakis, "Digital Signal Processing Principles Algorithms and Applications" Pearson education, New Delhi 2003/PHI.
2. S.K.Mitra, "Digital Signal Processing – A Computer Based Approach" Tata McGraw Hill, New Delhi, 2001.
3. Alen V Oppenheim Alen S. Wilsky and Hamid Nawab S "Signals and Systems", second Edition, PHI, New Delhi, 1997

REFERENCE BOOKS

1. Alan V.Oppenheim, Ronald W.Schafer and John R.Buck,"Discrete-Time Signal Processing" Pearson Education, New Delhi, 2003.
2. B.Venkataramani, M.Baskar,"Digital Signal Processors, Architecture, Programming and Applications"TataMcGraw Hill, New Delhi, 2003.
3. S.Salivahanan, A.Vallavaraj, C.Gnanapriya, Digital Signal Processing"Tata McGraw Hill, New Delhi, 2003.
4. J.R.Jhonson, Introduction to Digital Signal Processing Prentice Hall of India, 1989.

3. VLSI SYSTEM DESIGN **Semester III**

UNIT – I:VLSI DESIGN METHODOLOGY

VLSI design process – Architectural design – Logical Design – Physical design – Layout Styles – Full custom – Semicustom approaches.

BASIC ELECTRICAL PROPERTIES OF MOS AND CMOS CIRCUITS: MOS transistor - Threshold Voltage – Threshold Voltage equations- MOS device equations – Basic DC equations - Second order effects – MOS Models – Small signal AC characteristics – NMOS inverter – Depletion mode and Enhancement mode pull ups – CMOS inverter – DC Characteristics – inverter delay – Pass Transistor – Transmission gate – power consumption in CMOS gates – Static Dissipation – Dynamic Dissipation.

UNIT – II: VLSI FABRICATION TECHNIQUES

An overview of wafer fabrication – wafer processing – oxidation patterning – diffusion – ion implantation – deposition – silicon gate NMOS process – CMOS process N-Well and P-Well process – Twin tub – Silicon on insulator – CMOS process enhancements – Interconnect – Circuit elements – latch up prevention techniques.

UNIT – III: LAYOUT DESIGN RULES

Need for design rules – Mead Conway design rules for the silicon gate NMOS process – CMOS based design rules –simple layout examples – sheet resistance – area capacitance – wiring capacitance – driving large capacitive loads.

UNIT – IV: LOGIC DESIGN

Switch logic – pass transistor and transmission gate based design – gate logic – inverter – two input NAND gate – NOR gate – Other forms of CMOS logic – Clocked CMOS Logic – recharged Domino CMOS Logic – Structured design – simple combinational logic design examples – Parity generator – Multiplexers – Clocked Sequential circuit – Two phase clocking – Charge Storage – Dynamic Shift register Semi static register – JK flip flop circuit.

UNIT – V: SUBSYSTEM DESIGN PROCESS

General arrangement of a 4 bit arithmetic processor – Design of 4-bit shifter – Design of ALU sub system – implementing ALU function with an adder – Carry look ahead adders – multipliers – serial parallel multipliers – pipelined- multiplier array – Modified Booth‟s algorithm – increment / decrement – Two Phase non-overlapping clock generator.

TEXT BOOKS

1. Kamran Eshraghian, Douglas A Puknel and Sholeh Eshraghian, “Essentials of VLSI Circuits and Systems,” prentice Hall of India, New Delhi, 2005.
2. Neil H.E West and Kamran Eshranghian, “Principles of CMOS VLSI Design: A system perspective “, Addison-Wesley, 2nd Edition, 2004.

REFERENCE BOOKS

1. Sung-Mo Kang and Yusuf Leblebici, “CMOS Digital integrated circuits”, Tata McGraw Hill 3rd Edition, New Delhi, 2008.
2. Jan M Rabaey, Chandrasekaran A and Nikolic B, “Digital Integrated Circuits”, Pearson Education, 3rd edition, 2004.
3. Amar Mukharjee, “Introduction to NMOS and CMOS VLSI System”, Prentice Hall, USA, 1986.
4. Wayne wolf, “Modern VLSI Design: System on chip design”, Pearson Education Inc., 3rd Edition, Indian Reprint, 2007.

DIGITAL SIGNAL PROCESSING LABORATORY **Semester III**

(Any 12 Experiments)

USING TMS320C5X/TMS320C54XX/TMS320C67XX (Any 6 Experiments)

1. Arithmetic operations.
2. Waveform generation.
3. Study of Sampling and effect of under sampling
4. DFT computations.
5. FFT Computations.
6. Convolution of two discrete signals.
7. FIR Filter design
8. IIR filter design

SIMULATION USING MATLAB (Any 6 Experiments)

1. Generation of signals andImpulse, Step, Exponential & Ramp functions.
2. DFT computations.
3. FFT Computations.
4. Design of FIR filter.
5. Design of IIR filter.
6. Image Segmentation.
7. Study of various noises and filtering
8. Convolution of two Sequences.

VLSI LABORATORY **Semester III**

(Any 12 Experiments)

Design and simulation of Combinational Logic Circuit using VHDL/Verilog

1. Test benches in VHDL/Verilog
2. Adder
3. Logic gates verification
4. Multiplexer and Demultiplexer
5. Encoder and Decoder
6. Multiplier

Design and simulation of Sequential Logic Circuit using VHDL/Verilog

1. Flip Flops
2. Counter
3. Shift registers
4. Frequency Divider
5. Modeling of sequential digital system

FPGA Implementation

1. Implementation of ALU
2. 4- bit Adder
3. 8- bit ALU
4. Real Time Clock
5. Implementation of MAC unit
6. Multiplexer and Demultiplexer
7. Encoder and Decoder
8. Multiplier
9. Flip Flops.

1. PROGRAMMABLE LOGIC CONTROLLERS AND ITS APPLICATIONS Semester-IV

UNIT-I: BASIC PLC PROGRAMMING

General PLC programming procedures - Programming on/off inputs and outputs: Relation of digital gate logic to contact/ coil logic - Creating ladder diagrams from process control descriptions.

UNIT-II: BASIC PLC FUNCITON AND INTERMEDIATE FUNCTION

PLC Register Basics - Timer Functions - Counter Functions - Arithmetic Functions - Number comparison functions - Numbering systems and PLC number conversion functions.

UNIT-III: DATA HANDLING FUNCITONS AND PLC FUNCTIONS WORKING WITH BITS

The PLC SKIP and MASTER CONTROL RELAY functions - JUMP Functions - Data Move Systems - Other PLC Data Handling Functions - Digital Bit Functions and Applications - Sequencer functions - Controlling Robot with a PLC - Matrix functions.

UNIT-IV: INTRODUCTION TO SCADA

SCADA definitions, SCADA Functional requirements and components, SCADA Hierarchical concept, SCADA architecture, General features, SCADA Applications, Benefits. Remote Terminal Unit (RTU), Interface units, Human- Machine Interface Units (HMI), Display Monitors/Data Logger Systems, Intelligent Electronic Devices (IED). Introduction - Communication Network, SCADA Server, SCADA Control systems and Control panels.

UNIT-V: SUPERVISIORY CONTROL AND DATA ACQUISITION

SCADA –Developer and runtime packages – architecture – Tools – Tag Internal and External Graphics, Alarm Logging – Tag Logging – Structured tags – Trends – History – Report Generation - Proprietary and open protocols – OLE/OPC – DDE ;- Client /server configuration- – Interfacing of SCADA with PLC, drive and other field devices- Case studies of process plants using SCADA.

TEXT BOOKS

1. John W. Webb &Ronald A., Reis, "Programmable Logic Controllers Principles and Applications", Fifth Edition, Prentice Hall Publication, New Delhi, 2002.
2. Gary Dunning, "Introduction To Programmable Logic Controllers", Third Edition.
3. Stuart A. Boyer: "SCADA-Supervisory Control and Data Acquisition", Instrument Society of America Publications,USA,2004.
4. David Bailey, Edwin Wright, Practical SCADA for industry, Newnes, 2003

REFERENCE BOOKS

1. W.Bolton, "Programmable Logic Controllers", Fifth Edition, Elsevier Publication.
2. John R. Hackworth, Frederick D. Hackworth, "Programmable Logic Controllers Programming Methods and Applications", Pearson Publication.
3. Frank D. Petruzella, "Programmable Logic Controllers", Third Edition, Tata McGraw Hill Education Private Limited, 2010.
4. Michael P.Lukas, "Distributed Control Systems", Van Nostrand Reinfold Company,1995
5. Gordon Clarke, Deon Reynders: "Practical Modern SCADA Protocols: DNP3, 60870.5 and Related Systems", Newnes Publications, Oxford, UK,2004

PLC, SCADA & INSTRUMENTATION LABORATORY **Semester IV**

(Any 12 Experiments)

1. Study of Displacement measurement using LVDT
2. Study of Instrumentation amplifier
3. Study of P.I.D Controller.
4. Study of Flow measurement
5. Study of Thermocouple characteristics
6. Study of Strain measurement using strain gauge
7. Develop the Ladder diagram for the Arithmetic and Logic Gates.
8. Develop and test the control circuit for dynamic braking of DC motor using ladder programming (Timer and UP/Down Counter).
9. Develop and test the control circuit for Conveyor using ladder programming.
10. Develop the control circuit for automatic tank filling using ladder programming with SCADA.
11. Develop the control circuit for automatic Traffic Light using ladder programming with SCADA.
12. Monitoring of industrial drive through SCADA system.
13. Interfacing of PLC with SCADA system.
14. Develop the control circuit for automatic Vehicle parking using ladder programming with SCADA.
15. Develop the control circuit for automatic tank filling using SCADA.
16. Develop the control circuit for automatic Traffic Light using SCADA.

1. ELECTRONIC TEST INSTRUMENTS **Elective (Semester I)**

UNIT I: ANALOG METERS

D.C,A.C voltmeters, ammeters, multimeter, power meter, Q-meter, true RMS meter, vector impedance meter, vector voltmeter, component measuring instrument.

UNIT II: SIGNAL SOURCES

Sine wave generator-Frequency synthesized sine wave generator-Sweep frequency generator, pulse and square wave generator-Function generator-Wave analyzer-ApplicationsHarmonic distortion analyzer-Spectrum analyzer-Applications-Audio Frequency generatorNoise generator.

UNIT III: OSCILLOSCOPES

General purpose oscilloscope-CRO- Logic analyzer, its architecture & operation and Use of logic analyzer, Spectrum analyzer Network analyzer, Oscilloscope , DSO trigger modes Examples using MSO Use & limitations of different types of analysis.

UNIT IV: DIGITAL INSTRUMENTS

Digital method for measuring frequency, period, phase difference, pulse width, time interval, total count-Digital voltmeter-Types-Automatic polarity indication, automatic ranging, and auto zeroing-DMM-Microprocessor based DMM-DPM-swept – spectrum analyzer-network analyzer-discharge analyzer- logic probes-logic analyzer.

UNIT V: DISPLAY AND RECORDING DEVICES

Bar graph display-Segmental and dot matrix display-X-Y recorders, magnetic tape recorders-Digital recording-Data loggers-Interference and screening-Electrostatic and electromagnetic interference & earth loops.

TEXT BOOKS

1. Albert D. Herlfrick& William D. Cooper, "Modern electronic Instrumentation & Measurement Techniques", Prentice Hall of India,2002 .
2. A.J.Bouwens,"Digital Instrumentation", Tata McGrawHill, 1997.
3. Robert A.Witte, "Electronic Test Instruments, Theory and applications" Prentice Hall, 1993.

REFERENCE BOOKS

1. B.M.Oliver and J.M.Cage, "Electronic Measurements & Instrumentation" McGraw Hill International Edition, 1975.
2. Joseph, J.Carr, "Elements of Electronic Instrumentation & Measurements" III edition, Pearson Education,2003.

2. MEASUREMENT TECHNIQUES AND ITS APPLICATIONS Elective (Semester I)

UNIT I: REVIEW OF MEASUREMENT SYSTEM

Functional elements of a measuring system –significance of measurement- methods of measurements-mechanical, electrical and electronic instruments- classification of instruments- deflection and null type instruments-analog digital modes of operation.

UNIT II: MEASUREMENT OF VIBRATION

Nature of vibration - Quantities involved in vibration measurements - Seismic transducer - Types of accelerometers – potentiometric type accelero-meter, LVDT accelerometer, Piezo electric accelerometer.

UNIT III: HIGH FREQUENCY MEASUREMENT

Resonance methods - Measurement of inductance and capacitance - Measurement of effective resistance by resistance variation method and reactance variation method – T networks – parallel T networks and bridge T networks - Radio frequency measurement – sensitivity and selectivity measurement of radio receiver.

UNIT IV: OPTO ELECTRONIC MEASUREMENT

Photo sensitive devices – light emitting diodes, photo diodes, photo conductors - Photo voltaic cell, photo thyristors, photo transistors - Light modulating techniques – light suppression, light attenuation, photometric and radiometric fittings.

UNIT V: ULTRASONIC MEASUREMENT

Ultrasonic method of flow measurement, and measurement of thickness, measurement of displacement - Ultrasonic digitizer.

TEXT BOOK

1. E.O Doeblin, “Measurement systems, Application and Design”, McGraw Hill International Edition

REFERENCE BOOK

1. A K Sawhney “A Course in Electrical and electronics Measurement and Instrumentation”, Dhanpat Rai and Co Pvt. Ltd., New Delhi

3. ANALYTICAL INSTRUMENTATION **Elective (Semester I)**

UNIT I: COLORIMETRY AND SPECTROPHOTOMETRY

Special methods of analysis- Beer-Lambert law-colorimeters-UV-ViS spectrophotometers-Single and double beam instruments-Sources and detectors-IR Spectrophotometers-Types-Attenuated total reflectance flame photometers- Atomic absorption spectrophotometers-sources and detectors-FTIR spectrophotometers-Flame emission photometers.

UNIT II: CHROMOTOGRAPHY

Different techniques - Gas chromatography – Detectors - Liquid chromatographs – Applications - High pressure liquid chromatographs - Applications.

UNIT III: INDUSTRIAL GAS ANALYZERS AND POLLUTION MONITORING INSTRUMENTS

Types of gas analyzers-Oxygen, NO2 and H2S types, IR analyzers, thermal conductivity analyzers, analysis based on ionization of gases. Air pollution due to carbon monoxide, hydrocarbons, nitrogen oxides, sulphur dioxide estimation-dust and smoke measurements.

UNIT IV: pH METERS AND DISSOLVE COMPONENT ANALYZERS

Principle of pH measurement, glass electrodes, hydrogen electrodes, reference electrodes, selective ion electrodes, ammonia electrodes, biosensors, dissolved oxygen analyzer-sodium analyzer-silicon analyzer.

UNIT V: RADIO CHEMICAL AND MAGNETIC RESONANCE TECHNIQUES

Nuclear radiationsDetectors-GM Counter-Proportional counter-Solid state detector-Gamma cameras-X-ray spectroscopy-Detectors-Diffract meters-Absorption meters-Detectors NMR-Basic principles-NMR spectrometer-Applications. Mass spectrometers-Different types-Applications.

TEXT BOOKS

1. R.S. Khandpur, “Handbook of Analytical Instruments” Tata Mc Graw Hill publishing Co.Ltd.2003.
2. H.H.Willard, L.L.Merrit, J.A.Dean, F.A.Settle, “Instrumental methods of analysis” CBS publishing & distribution, 1995.

REFERENCE BOOKS

1. Robert D.Braun, “Introduction to Instrumental Analysis” Mc Graw Hill, Singapore, 1987.
2. G.W. Ewing, “Instrumental Methods of Analysis” Mc Graw Hill 1992.
3. DA Skoog and D.M.West, “Principles of Instrumental Analysis” Harper and Row publishers, 1974.

1. DATA COMMUNICATION AND NETWORKS **Elective (Semester II)**

UNIT-I INTRODUCTION

Modern Instrumentation and Control Systems – Introduction to Networks –232-overview - EIA-485-overview – current loop & EIA converters GPIB, interface buses:USB, PCMCIA, VXI, SCXI and PXI: Networking Basics for industrial automation instrumentation Bus – MOD BUS, HART, RS 422, IEC/ISA Field Bus.

UNIT-II : TRANSMISSION

D/D conversion: Line coding, A/D conversion, PCM, Delta modulation, Parallel and serial transmission. D/A conversion: ASK, FSK, PSK, DPSK and QPSK. MODEM.

UNIT-III: MULTIPLEXING

FDM, WDM and TDM. Multiple accesses: CSMA/CD, Polling and token passing. Channelization: FDMA, TDMA and CDMA. LAN, WAN and MAN

UNIT-IV: INTERNET AND WIRELESS DATA NETWORK

TCP/IP standards, IPv4, IPv6, Worldwide web. Wireless LAN, IEEE standards: 802.11a/b/g/n, ZigBee and Bluetooth.

UNIT-V: DEVICENET

Overview – layers. Profibus -overview-protocol stack. HART protocol – overview-layers. Foundation field bus- layers – Error Detection and Diagnostics. Local interconnect networks, Redundancy Overview – Actuator- sensor Interface- CAN bus – overview-layers. Device Net and SDS (Smart Distributed Systems)-Physical Layer and Wiring Rules- The Data link Layer- The Application Layer.

TEXT BOOKS

1. Behrouz A. Forouzan, “Data Communications and Networking”, 4th Edition, Tata McGraw-Hill, Delhi, 2006
2. John Park, Steve Mackey and Edwin Wright, “Data Communications for Instrumentation and Control”, Elsevier, 2003
3. Steve Mackay, Edwin Wright and Deon Reynders, “Practical Industrial data networks: Design, Installation and troubleshooting”, Elsevier international projects ltd., 2004

REFERENCE BOOKS

1. William Buchanan, “Computer Buses-Design and Application”, CRC Press, 2000
2. Theodore S Rappaport, “Wireless Communications: Prentice and Practice”, Prentice Hall PTR, second edition, 2002.
3. Perry Marshall and John Rinaldi, ”Industrial Ethernet”, The Instrumentation, Systems and Automation Society, 2005
4. Richard Zurawski ,”Industrial Communications Technology Handbook”, CRC Press, 2005

2. COMPUTER AIDED INSTRUMENTATION **Elective (Semester II)**

UNIT – I: DATA ACQUISITION SYSTEMS AND DIGITAL SIGNAL TRANSMISSION

General Configuration – single and multichannel DAS – A/D and D/A converters – Digital data Acquisition Systems – Sample and Hold Circuit – Anti-aliasing filter –Introduction to noise and ground/ shielding – Introduction to protocols and standards - Data Transmission systems – Pulse code formats – Analog and Digital modulation Techniques

UNIT – II: TELEMETRY AND INDUSTRIAL ETHERNET

Telemetry systems – RF network analyzer – Higher frequency signal sources – Introduction to wireless communication - Introduction-IEEE standards – Ethernet MAC layer – IEEE 802.2 and Ethernet SNAP – OSI and IEEE 802.3 standard. Ethernet transceivers, Ethernet types, switches & switching hubs, 10 Mbps Ethernet, 100 Mbps Ethernet, Gigabit Ethernet. TCP/IP overview-Internet layer protocols – Host-to-Host layer.

UNIT – III: COMMON INSTRUMENT INTERFACES

Current loop, RS 232c/RS485, GPIB, interface buses: USB, PCMCIA, VXI, SCXI and PXI: Networking Basics for industrial automation instrumentation Bus – HART, RS 422, IEC/ISA Field Bus, ZigBee and Bluetooth - Open System interconnection (OSI) model – MOD BUS

UNIT – IV: DEVICENET

Overview – layers. Profibus-overview-protocol stack. HART protocol – overviewlayers. Foundation field bus-layers – Error Detection and Diagnostics. Local interconnect networks, Redundancy Overview – Actuator- sensor Interface- CAN bus – overview-layers. Device Net and SDS(Smart Distributed Systems)-Physical Layer and Wiring Rules- The Data link Layer-The Application Layer.

UNIT – V: PC IN REAL TIME ENVIRONMENT AND PROGRAMMING

Introduction-PC system and facilities – PC BUS and signals – Interrupts – Interfacing PC to outside world – PC in real time environment - Real-Time applications of PC – PC based distributed control systems – Real time programming: Introduction – Multi-Tasking – Task Management – Inter-Task communication – RealTime operating systems versus Real-time programming languages.

TEXT BOOKS

1. John Park, Steve Mackey and Edwin Wright, "Data Communications for Instrumentation and Control", Elsevier, 2003
2. Steve Mackay, Edwin Wright and Deon Reynders, "Practical Industrial data networks: Design, Installation and troubleshooting", Elsevier international projects ltd., 2004
3. Krishna Kant, "Computer Based Industrial Control", Prentice Hall India Ltd., 2004.

REFERENCE BOOKS

1. Bouwens, A.J., "Digital instrumentation", McGraw Hill, Reprint 2007.
2. S. Gupta and J.P Gupta, "PC Interfacing for Data Acquisition and Process Control", 2nd Edition 2002.
3. Doeblin, "Measurement and system, Application and Design", McGraw-Hill, 5th Edition 2003.
4. John lenk, D., "Handbook of **M**icro computer based Instrumentation and control", Prentice Hall, 1984.
5. M.M.S.,Anand, Electronic Instruments and Instrumentation Technology, Prentice Hall, 2004.

3. MICROWAVE THEORY AND TECHNIQUES **Elective (Semester II)**

UNIT I: INTRODUCTION TO MICROWAVES

History of Microwaves, Frequency spectrum, Microwave frequency bands, Applications of microwaves in different fields , Plane waves and free space propagation, TE and TM waves, TEM (Transverse electromagnetic) waves, group and phase velocities

UNIT II: MICROWAVE TRANSMISSION LINES AND ANALYSIS

Review of transmission lines, characteristic impedance-open circuit, closed circuit, quarter wavelength and half wavelength lines, Standing wave ratio, VSWR, Reflection coefficient, Impedance matching, coaxial, strip and microstrip transmission lines (introduction).

UNIT III: WAVEGUIDES AND DEVICES

Introduction to waveguides, Propagation through wave guides, Guided waves slow waves and fast waves, rectangular and circular wave guides, cut off frequency, group velocity, Waveguide Tees, Magic Tees, Rat Race, Directional couplers, Isolators, attenuators, resonator and circulators.

UNIT IV: MICROWAVE LINEAR BEAM TUBES AND CROSS FIELD DEVICES

Introduction, Microwave tubes, limitations of conventional tubes, Transit time effects, Multi cavity Klystron, re-entrant cavities, Velocity modulation and beam bunching, bunching diagrams, reflex klystron, magnetron, working of magnetron, travelling wave tubes-slow wave structures-amplification mechanism.

UNIT V: TRANSFERRED ELECTRON DEVICES AND TRANSIT TIME DEVICES

Gunn Effect and Gunn diode-modes of operation, Microwave Semiconductor devices, Tunnel diodes- negative resistance-band theory for forward and reverse biasing, Schottky diodes, Point contact diodes, Varactor diodes, IMPATTT diode-structure-negative resistance-efficiency and output power, TRAPATT diode-principle of operation and performance.

TEXT BOOKS:

1. D. M. Pozar, "Microwave Engineering" 3rd Edition, John Wiley & Sons Inc, 2004.
2. R. E. Collin, "Foundations for Microwave Engineering" 2nd Edition, Wiley-IEEE Press, 2000.
3. A. Das and S. K. Das, "Microwave Engineering", 1st Edition, Tata McGraw-Hill, 2005

REFERENCE BOOKS:

1. Samuel Y. Lio, "Microwave devices and circuits", (Prentice Hall)
2. Kennedy and Davis, "Electronic communication systems", – (Tata Mc Graw Hill)
3. P. A. Rizzi, "Microwave Engineering Passive Circuits", 1st Edition, Pearson, 1998.

1. OCEAN ELECTRONICS AND MARINE INSTRUMENTATION

Elective (Semester III)

UNIT I: OCEANOGRAPHIC INSTRUMENTS

Classification of oceanographic instruments – buoys – Temperature Measurements – Salinity, Temperature and Depth Measurements – flow measurements – Wave and Tide Parameter Measurement – Sound Velocity

UNIT II: UNDER WATER ACOUSTICS

Introduction and Fundamentals – Exploring technologies –SONAR Equations – Masking by noise and reverberation – Passive and Active SONAR – Passive detection hydrophones - Side Scanning SONAR – Multibeam SONAR – Doppler SONAR – Integrated Data Acquisition System – Integrated Underwater Survey System - Applications

UNIT III: UNDERWATER COMMUNICATION

Introduction: Perfectly secure communication – Underwater communication channel – VLF, ELF - Underwater Optical Communication Technology.

UNIT IV: OCEAN REMOTE SENSING

Sensors for observing the ocean– Ocean properties measurable from satellite - Ocean colour remote sensing: Recovering useful information from ocean colour – Satellite sensors for ocean colour measurement.

UNIT V: OCEAN RENEWABLE ENERGY

Introduction – Wave and Tidal Current Energy –Tidal Turbine – Concept of Salinity gradient power generation and Ocean Thermal Energy Conversion.

TEXT BOOKS:

1. Baldev Raj, "Science and Technology of Ultrasonic," Narosa Publication House Ian.
2. S. Robinson, "Measuring the Oceans from Space: The principles and methods of satellite oceanography", Springer 2004 edition.
3. Marco Lanzagorta, "Underwater Communications", (Synthesis Lectures on Communications) Morgan & Claypool Publishers.
4. AlirezaKhaligh, "Energy Harvesting: Solar, Wind, and Ocean Energy Conversion Systems", (Energy, Power Electronics, and Machines), CRC Press.

REFERENCE BOOKS:

1. Robert J Urick, "Principle of underwater sound".
2. A.D. Waite, "SONNAR for practicing engineers" 3rd Edition.

2.COMMUNICATION SYSTEM AND FIBER OPTICS Elective (Semester III)

UNIT I: LINEAR MODULATION

Basic Elements of Communication system – Need for Modulation – Linear and angle Modulation Techniques – AM – frequency spectrum – Representation of AM - Power relation – Generation of AM –DSB SC - SSB – Suppression of unwanted sideband – VSB.

UNIT II: ANGLE AND PULSE MODULATION

FM – Frequency spectrum – Pre-emphasis and De-emphasis – FM Methods: Direct method, AFC & Indirect Method – Pulse Modulation: PAM, PWM, PPM, PCM.

UNIT III:RADIO RECEIVERS AND TRANSMITTERS

AM Transmitters – classification – low level and high level –FM transmitter – Radio Receiver –TRF receiver – super heterodyne receiver –AM Receiver – envelop detector– Automatic Gain control – FM receiver – FM demodulators.

UNIT IV: OPTICAL FIBER

Structure of Fibres– Refractive index – Snell‟s Law – Total internal reflection – step Index fiber structure and types– Ray optics representation –Numerical Aperture – wave equation for step index fiber –graded index fiber structure – Fibre materials and properties. Signal degradation in optical fibers: Overview of attenuation - Attenuation units - scattering and absorption losses - core & cladding losses - Bending losses.

UNIT V: OPTICAL SOURCES

LED: LED structures, Light source materials, Quantum efficiency, Modulation Capability, Transient response, Power-Bandwidth Product.LASER Diodes: Modes and threshold conditions, resonant frequencies, structure and radiation pattern, Single mode laser, modulation of Laser Diodes, Temperature Effects.

TEXT BOOKS:

1. George Kennedy & Bernard Davis, “Electronic Communication Systems”, Tata McGraw Hill – Forth Edition.
2. Gerd Keiser, “Optical Fiber Communications”, McGraw Hill.

REFERENCE Books:

1. Simon S. Haykin, “Communication systems”, Wiley Publication.
2. J M Senior, “Optical Fibre Communication”, Principles & Practice by–Prentice Hall of India.

3. INTRODUCTION TO POWER PLANT Elective (Semester III)

UNIT I: **FUNDAMENTALS OF POWER PLANT**

Classification of Power Plant- Energy and Power- Power Distribution in India- Power generation- Power corporations- Classifications of Power Plant Cycle- Fuels and Combustion- Steam Generator- Steam Condenser- Turbines.

UNIT II: STEAM POWER PLANT

Essentials of Steam Power Plant Equipment- Coal handling- Fuel Burning Furnaces- Method of Fuel Firing- Automatic Boiler Control- Pulverized Coal- Water Walls- Ash Disposal- Smoke and Dust Removal- Dust Collectors.

UNIT III: STEAM GENERATOR

Introduction- Types of Boilers- Cochran Boiler- Lancashire Boiler- Locomotive Boiler- Industrial Boiler- Requirement of Good Boiler- High Pressure Boiler.

UNIT IV: STEAM TURBINE

Introduction- Principal and operation of steam Turbine- Classification of Steam Turbine- Simple Impulse Turbine- Compound Impulse Turbine- Pressure Compound Impulse Turbine- Impulse Reaction Turbine- Steam Turbine Governing- Steam Turbine Testing- Choice of Steam Turbine- Steam Turbine Generators- Steam Turbine Specifications.

UNIT V: NUCLEAR POWER PLANT AND POLLUTION CONTROL

Atomic Structure- Nuclear Energy Concepts and Terms- Nuclear Fusion and Fission- Nuclear Reactor- Comparison of Nuclear Power Plant and Steam Power Plant.

Pollution Control: Environmental Pollution due to Energy use, Industrial Trail Emission and Road TransportNoise Pollution and Control- Pollution due to Combustion of fuel- Air Pollution and water pollution by thermal power plants- Radiations from Nuclear Power Plant Effluents.

TEXT BOOK

1. A.K. Raja, AmitPrakashSrivastava, Manish Dwivedi ” Power Plant Engineering “ 2008.

REFERENCE BOOKS:

1. A.B.Gill, “Power Plant Performance”, Elsevier India, New Delhi , 2003.
2. S.M.Elonko and A.L.Kohal, “Standard Boiler Operations”, McGraw Hill, New Delhi, 1994
3. Sam G. Duke Low, “The Control of Boiler”, ISA Press, 1991.
4. R.K.Jain, “Mechanical and Industrial Measurements”, Khanna Publishers, New Delhi, 1995

1. DIGITAL ELECTRONICS AND MICROPROCESSOR **Supportive paper - I**

UNIT-I: LOGIC GATES

Different Logic gates such as AND, OR, NOT, NAND, NOR, EXOR, Symbol and Truth Table, De Morgan‟s Theorems: Statement, verification and applications, Half-adder. Full adder, Half Subtractor and full subtractor, Shift register

UNIT-II: NUMBER SYSTEMS

Introduction to Decimal, Binary, Octal, Hexadecimal Number Systems, BCD Codes, Inter conversions of Decimal, Binary, and BCD Numbers, Parity, Excess-3.

UNIT-III: MICROPROCESSOR

Architecture and Programming of 8085 - functional Block diagrams, bus systems, Instruction set and addressing modes- timing diagram and assembly level programme- Interfacing RAM and ROM sections.

TEXT BOOKS

1. Ramesh Gaonkar, “Microprocessor Architecture, Programming and applications”, with the 8085/8080A, 3rd Edition, Penram International Publishing house.
2. Donald P. Leach, Albert Paul Malvino, “Digital Principles and Applications”, 5th edition, TataMcGraw Hill Company

REFERENCE BOOK

1. Salivahanan, “Electronic Devices and Circuits”, 2nd edition, Tata-McGraw Hill Company.

2. BIOMEDICAL INSTRUMENTATION **Supportive Paper - II**

UNIT-I: MEDICAL INSTRUMENTATION BASICS

Cells and their structure – Transport of ions through the cell membrane – Resting and action potentials Characteristics of Resting potential - Bio-electric potentials – Design of Medical Instruments – Components of the Bio-Medical Instrument System.

UNIT-II: BIOPOTENTIAL RECORDERS

Electrocardiography (ECG) - Electroencephalography (EEG)–Electromyography (EMG) - Electroretinography (ERG) – Electrooculography (EOG)

UNIT-III: SPECIALISED MEDICAL EQUIPMENT

Angiography – Endoscopes – Different types of endoscopes - Computer tomography – Application of Computer tomography - Ultrasonic imaging systems – Magnetic resonance imaging

TEXT BOOK

1. Arumugam M., "Bio Medical Instrumentation", Anuradha agencies Publications.

REFERENCE BOOK

1. R.S. Khandpur, "Hand book of Biomedical instrumentation", Tata mc graw hill New Delhi, 2nd edition, 2003

3. ANALYTICAL INSTRUMENTATION **Supportive Paper - III**

UNIT I: COLORIMETRY AND SPECTROPHOTOMETRY

Electromagnetic radiation-Electromagnetic spectrum-Interaction of radiation with matter-BeerLambert law-Absorption instruments-UV-ViS spectrophotometers- Single beam null type (Beckman model), Spectronic 21 Spectrophotometer- IR Spectrophotometers-Block diagram of double beam IR Spectrophotometer- Atomic absorption spectrophotometers-FTIR spectrophotometers-Flame photometers-Principle- Essential Parts- Block Diagram- Emission System.

UNIT II: CHROMOTOGRAPHY

Gas chromatography-Block diagram-Basic parts-Sample injection system chromatography columns-Thermal conductivity detector - Liquid chromatographs-Types of liquid chromatography- High pressure liquid chromatographs

UNIT III pH METERS AND DISSOLVED COMPONENT ANALYZERS

Principle of pH measurement, glass electrodes, hydrogen electrodes, reference electrodes, selective ion electrodes, ammonia electrodes, biosensors, dissolved oxygen analyzer-sodium analyzer-silicon analyzer.

TEXT BOOK

1. R.S. Khandpur, “Handbook of Analytical Instruments”, Tata Mc Graw Hill publishing Co

REFERENCE BOOKS

1. Robert D.Braun, “Introduction to Instrumental Analysis”, Mc Graw Hill, Singapore, 1987.
2. G.W. Ewing, “Instrumental Methods of Analysis”, Mc Graw Hill 1992.
3. D.A Skoog and D.M.West, “Principles of Instrumental Analysis”, Harper and Row publishers, 1974