DIVISION

OF

ELECTRONICS & INSTRUMENTATION

ENGINEERING

Code No.	Subject Name	Credit
EI201	Sensors and Transducers	3:1:0
EI202	Sensors and Transducers Laboratory	0:0:2
EI203	Control Systems	3:1:0
EI204	Control Systems Laboratory	0:0:2
EI205	Measurement Systems	3:1:0
EI206	Embedded Instrumentation System	3:1:0
EI207	Measurement Laboratory	0:0:2
EI208	Signal Conditioning Circuits	3:1:0
EI209	Signal Conditioning Circuits Laboratory	0:0:2
EI210	Process Dynamics and Control	4:0:0
EI211	Computer Based Process Control Laboratory	0:0:2
EI212	Industrial Instrumentation	4:0:0
EI213	Microprocessor Based Instrumentation System	3:1:0
EI214	Digital Control Systems	3:1:0
EI215	Logic and Distributed Control Systems	3:1:0
EI216	Biomedical Instrumentation	4:0:0
EI217	Instrumentation and Control Laboratory	0:0:1
EI218	Instrumentation and Control Laboratory	0:0:2
EI219	Measurements and Instrumentation	4:0:0
EI220	Measurements and Instrumentation Laboratory	0:0:2
EI221	Embedded System Laboratory	0:0:2
EI222	Instrumentation and Control Systems	3:0:0
EI 301	Industrial Instrumentation	4:0:0
EI 302	Process Control	3:1:0
EI 303	Advanced Digital Signal Processing	3:1:0
EI 304	Fiber Optics and Laser Instrumentation	3:0:0
EI 305	Biomedical Instrumentation and Image Processing	4:0:0
EI 306	Industrial Instrumentation and Process Control Laboratory	0:0:2
EI 307	Advanced Control System	3:1:0
EI 308	Computer Control of Process	3:1:0
EI 309	Distributed Control System, Networks and Protocols	4:0:0
EI 310	Automotive Instrumentation	3:0:0
EI 311	Virtual Instrumentation	3:0:1
EI 312	Real Time and Embedded Systems	4:0:0
EI 313	Embedded System Laboratory	0:0:2

EI 201 SENSORS AND TRANSDUCERS

Credit: 3: 1: 0
Marks: 40 + 60

Unit I : Science of Measurement

Measurement systems – Significance of Measurements, Methods of Measurements – Direct and Indirect Methods, Classification of Instruments –Deflection and Null Type, Generalised Measurement System, Characteristics of Instruments – Static and Dynamic, Types of errors, Error analysis, Units and Standards.

Unit II : Classification and Characteristics of Transducer

Transducer – Definition, Classification of Transducer – analog and digital transducer- primary and secondary transducer- active and passive transducer-Inverse transducer, Characteristics and choice of transducer, Factors influencing choice of transducer.

Unit III : Resistance and Inductance Transducer

Resistance Transducer-Basic principle, Potentiometer – Loading effects, Resolution, Linearity, Non-linear Potentiometer, Noise in potentiometer, Resistance strain gauge – Types, Resistance thermometer, Thermistors – characteristics, Thermocouple – Compensation circuits – junction and lead compensation, merits and demerits. Inductance Transducer:- Basic principle, Linear variable differential transformer, RVDT, Synchro, Induction potentiometer, variable reluctance accelerometer, microsyn.

Unit IV : Capacitance and Piezoelectric Transducer

Capacitance Transducer – Basic principle, tranducers using change in - area of plates- distance between plates- variation of dielectric constants, frequency response, Merits, demerits and uses. Piezoelectric transducer- Basic principle, Mode of operation, properties of piezoelectric crystals, loading effects, frequency response and impulse response uses.

Unit V : Pressure, Digital and other Miscellaneous sensors

Pressure sensors – bourdon tube, bellows, diaphragm. Digital Transducer – shaft encoder, optical encoder,digital speed transducer. Hall effect transducer, sound sensors, vibration sensors – seismic tranducer, chemical sensor – PH sensor, velocity transducer, Introduction to smart sensors.

Text Books

1. A.K. Sawhney "A Course in Electrical and Electronics Measurements and Instrumentation" – Dhanpat Rai & Co., (Pvt) Ltd., 2000.
2. S.Renganathan "Transducer Engineering" – Allied publishers Limited, 1999.

Reference Books

1. Ernest O. Doeblin "Measurement Systems – Application & Design" McGraw – Hill Publishing company, 1990.
2. Woolvert, G.A., "Transducer in Digital Systems" Peter Peregrinus Ltd., England, 1998.

3. D. Patranabis "Principles of Industrial Instrumentation" Tata McGraw – Hill Publishing Company Limited, New Delhi, 1996.

EI202 SENSORS AND TRANSDUCERS LABORATORY

Credit: 0: 0: 2
Marks: 50 + 50

1) Study of characteristics of straingauge
2) Characteristics study of Load cell
3) Characteristics study of LVDT
4) Characteristics study of RTD
5) Characteristics study of Thermocouple
6) Characteristics study of pressure transducer
7) Characteristics study of LDR
8) Measurement of speed using optical sensor
9) Measurement of Torque using Torque transducer
10) Characteristics study of loudspeaker and microphone
11) Characteristics study of resistive potentiometer
12) Characteristics study of optocoupler and photocell

EI203 CONTROL SYSTEMS

Credit: 3: 1:0
Marks: 40 + 60

Unit I : Introduction
Open loop and closed loop systems - transnational and rotational mechanical systems and analogous electrical systems - Basic components of control systems - potentiometer - synchros - tachogenerator - a.c and d.c servo motor. Mathematical representation, block diagram, signal flow graph and transfer function of electrical systems.

Unit II : Time Response
Time response - step response of first order and second order systems - time domain specifications - type and order of a system - steady state error - static error and generalized error coefficients - frequency response - frequency domain specifications - estimation of the specifications for a second order system.

Unit III : Stability Analysis
Stability - characteristic equation - location of roots in s plane for stability - Routh Hurwitz criterion -Root Locus Techniques

Unit IV : Frequency Response
Bode plot - Nichol's chart - Nyquist stability criterion - applications of Bode plots and Nyquist stability criterion, polar plot.

Unit V : PID Controllers
P, PI, PD and PID controllers Design and application - Fuzzy controller - Introduction and application – Fuzzy controllers to reduce settling time, overshoot and oscillations – Temperature controller – Pressure controller – flow and level controller using fuzzy neural network controllers computer based control of processes.

Text Books

1. Ogata, K., "Modern Control Systems Engineering", PHI,1997.
2. Nagrath and Gopal.,:"Control System Engineering", II Edition, Wiley & Sons.1982.

Reference Books

1. Gopal, M., : "Control System - Principles & Design", TMH, 1997.
2. Benjamin C. Kuo., :"Automatic Control Systems", III Edition PHI 1987.

EI204 CONTROL SYSTEMS LABORATORY

Credit: 0: 0: 2
Marks: 50 + 50

1. Study of Temperature On-OFF controller
2. Speed-Torque characteristics of AC servometer
3. Study of open and closed loop DC motor speed control system
4. Study of controllers
5. Transfer function of separately excited DC generator
6. Transfer function of field controlled DC motor
7. Transfer function of Armature controlled DC motor
8. Characteristics of Synchros and Resistive potentiometers
9. Magnetic Amplifier characteristics
10. Study of position control system
11. Stepper motor control
12. Response of RC and RL network

EI205 MEASUREMENT SYSTEMS

Credit: 3: 1: 0
Marks: 40 + 60

Unit I : Measurement Of Voltage Current, Power and Energy
Principles of operation of permanent magnet moving coil, moving iron, dynamometer – calibration of voltmeters and ammeters – Power measurement by three ammeter and three voltmeter method – induction type wattmeter – energy meter – calibration of energy meter & wattmeter.

Unit II : Measurement of RLC

Whetstone, Kelvin, Wien, Hay, Maxell, Anderson and Schering bridges – Q meter – Potential transformer & current transformers – KVA meters – Power factor meter – Megger.

Unit III : Electronic Analog Meter

DC and AC voltmeters - differential voltmeters - AC current measurements – multimeters – vector impedance meter - power meter - Review of signal sources - signal generator – wave analyzer – harmonic distortion analyzer - spectrum analyzer correlator.

Unit IV : Digital Measurement

Digital displacement transducers, increment and absolute – Digital method of measuring displacement & velocity – Digital alpha numeric display – digital methods of measurement of frequency – phase difference.

Unit V : CRO & Recorders

General purpose oscilloscope – CRT screen characteristics – vertical & horizontal amplifiers –delay line – time base and sweep trigger circuits synchronization – sampling oscilloscope – digital storage oscilloscope – typical measurements using CRO – moving coil recorders – XY plotters – UV recorders – digital recording.

Text Book:

1. Golding, E.W. and Widdis, F.C.: "Electrical Measurements and Measuring Instruments", Pitman, 1963.
2. Swahney, K.A., "Course in Electrical & Electronics Measurement & Instrumentation", Dhanpat Rai & Sons, 1982.
3. Kalsi, G.C., "Electronic Instrumentation" TMH, 1998.

Reference Books

1. Cooper, W.D., and Helfrick, A.D., "Electronic Instrumentation and Measurement Techniques", Third Edition, Prentice Hall of India, 1991
2. Cidwell, W., " Electrical Instruments and Measurements", TMH, 1969.
4. Woolvert, G.A., "Transducers in Digital Systems", Peter peregrinvs Ltd., England, 1988.
5. Bouwens, A.J., "Digital Instrumentation", McGraw Hill, 1986.

EI206 EMBEDDED INSTRUMENTATION SYSTEM

Credit: 3: 1: 0
Marks: 40 + 60

Unit I : Introduction

Embedded system evolution trends – basic real time concepts – real time design issues – 68HCII Microcontrollers – architecture – instruction set – interrupt handling – integrating interrupts in a system – examples – the shared data problem – software architecture.

Unit II : Real Time Operating Systems (RTOS)
Real time specifications – real time kernels – inter-task communications and synchronizations – real time memory management.

Unit III : System Performance, Analysis and Optimization
Response – time calculation – interrupt latency – time loading and its measurement – scheduling – reducing response times and time loading – analysis of memory requirements – reducing memory loading – input – output performance.

Unit IV : Debugging Techniques and Development Tools
Faults, failures, bugs and effects – reliability – testing – fault tolerance – host and target machines – linker / locators for embedded software – getting embedded software into target system.

Unit V : Real Time Applications
Real time system as complex systems – real time databases – real time image processing – real time Unix – building real time applications with real time programming languages.

An example : The tank monitoring system

Text Books

1. Philip A. Laplante, "Real Time Systems Design and Analysis: An Engineer's Handbook", edition, Prentice Hall of India, New Delhi, 2000
2. David E. Simon, "An Embedded Software Primer", Addision Wesley, New Delhi, 2000

Reference Books

1. Raymond J.A. Bhur and Donald L. Bialey, "An Introduction to Real Time Systems: From Design to Networking with C/C++", Prentice Hall of Inc., New Jersey, 1999
2. John B.Peatman, "Design with Microcontrollers", McGraw Hill Book Co., New york, 1988
3. Jonathan W. Valvano, "Embedded Micro Computer System: Real Time Interfacing", Brooks/Cole, USA, 2000
4. C.M. Krishnan and Kang G. Shin, "Real Time Systems", McGraw Hill, New Delhi, 1997

EI207 MEASUREMENT LABORATORY

Credit: 0: 0: 2
Marks: 50 + 50

1. Measurement of voltage, frequency & using CRO
2. Measurement of phase difference by CRO using Lissajous figures
3. Measurement of resistance using Kelvin double bridge and Wheatstone bridge
4. Measurement of inductance using Hay's and Owen's bridge
5. Measurement of Inductance using Anderson and Maxwell bridge
6. Measurement of Capacitance using Schering's bridge

7. Measurement of angular displacement using potentiometer
8. Calibration of Voltmeter
9. Calibration of Energy meter
10. Calibration of Wattmeter
11. Calibration of Ammeter
12. Measurement of Capacitance using Desauty's bridge.

EI208 SIGNAL CONDITIONING CIRCUITS

Credit: 3: 1: 0
Marks: 40 + 60

Unit I : Operational Amplifier
Ideal OP AMP, Non- inverting mode, inverting mode, non ideal OP -AMP, OP - AMP characteristics DC : Bias, offsets and drift, AC: BW, slew rate, Noise and frequency compensation - OP - AMP circuits used in instrumentation - Scale changer, inverter and non - inverter, Adder, Subtractor, multiplier and divider, integrator, differentiator, comparators, logarithmic converter, I to V converter , V to I converter - precision rectifiers- clipper and clamper - sample and hold circuit.

Unit II : Signal Sources and Oscillators
Signal Sources - Oscillators: Classification of feedback oscillator - RC oscillator - Wien bridge - phase shift oscillators - LC oscillators- Hartley - Colpits - crystal oscillators square wave and pulse generator circuits - schimitt trigger, astable multivibrator, monostable multivibrator - triangular wave generator -saw tooth wave generator.

Unit III : Amplifiers and Filters
Buffer Amplifier, Differential Amplifier - use of operational amplifier with capacitive displacement transducers- charge amplifiers - Instrumentation amplifiers - Three amplifiers configuration - Isolation amplifiers - Filters - Passive and Active filters - Low pass, High pass, Band pass and Band reject filter - First order second order transformations - state variable filter - switched capacitor filters.

Unit IV : Voltage Regulators and Multipliers
Series OP- AMP regulator - IC voltage regulators - 723 general-purpose regulator - Multiplying DC voltage - frequency doubling - phase angle detection - AM modulation/demodulation SSB modulation/demodulation - frequency shifting.

Unit V : PLL Circuits
PLL, ADC and DAC: Basic principles -phase detector and comparator: analog and digital - voltage controlled oscillator - Low pass filter - monolithic PLL - applications of PLL: frequency multiplication -division - frequency translation - AM detection - FM detection - FSK demodulation. ADC and DAC: techniques - their characteristics.

Text Books
1. Roy Choudhury and Shail Jain., " Linear Integrated Circuits", Wiley Eastern Ltd., 1991.

2. K. Sawhney.,: "A Course in Electrical and Electronics Measurement and Instrumentation"., Dhanpat Rai and Company (Pvt.,) Ltd., 1997.

Reference Books

1. Denton J. Dailey., " Operational Amplifiers and Linear Integrated Circuit", McGraw Hill, 1989.
2. Coughlin and Discol., " Operational Amplifiers and Linear Integrated Circuit", Prentice Hall of India Pvt., Ltd., 1992.
3. William David Cooper and Albert D. Helfrick.,: " Electronics Instrumentation and Measurement Techniques", Prentice Hall of India Pvt., Ltd., 1986.

EI209 SIGNAL CONDITIONING CIRCUITS LABORATORY

Credit: 0: 0: 2
Marks: 50 + 50

1. Measurement of OP-AMP parameters (Gain, Input offset voltage, Input Offset current, Bias current, CMRR, output voltage, slew rate).
2. Characteristics of OP-AMPs and applications: Summer, Integrator, Differentiator.
3. Design and testing of waveform generators using OP-AMPs: Square, Triangular.
4. Design and testing of precision rectifier, V to I and I to V convertors.
5. Design and testing of an Instrumentation amplifier.
6. Design and testing of active filters.(I & II order).
7. Design and testing of a frequency multiplier using PLL.
8. Sinusoidal oscillators using RC phase shift and Wien Bridge.
9. Simplification of a logic function and its realization using (i) AND, OR, NOT gates and (ii) Universal gate.
10. Verification of truth table of JK, RS, D and T flip-flops.

11. Design and testing of a crystal oscillator using logic gates and counters.
12. Testing of Half-adder, Full-adder and ALU modules.
13. Testing of parallel-to-serial and serial-to-parallel shift register.
14. Decoders, encoders and Interfacing TTL and CMOS gates.
15. Testing of A/D and D/A converters.

EI 210 PROCESS DYNAMICS AND CONTROL

Credit: 4: 0: 0
Marks: 40 + 60

Unit I : Process Dynamics

Elements of process control - process variables - degrees of freedom - Characteristics of liquid system, gas system, thermal system - Mathematical model of liquid process, gas process, flow process, thermal process, mixing process - Batch process and continuous process - Self regulation.

Unit II : Basic Control Actions

Characteristics of on-off, proportional, single -speed floating control, integral and derivative modes - composite control modes - PI, PD and PID control modes - Response of controllers for different types of test inputs - Integral wind up - Auto - manual transfer - Selection of control mode for different processes - Typical control schemes for level, flow, pressure and temperature.

Unit III : Optimum Controller Settings

Tuning of controllers by process reaction curve method - continuous cycling method, damped oscillation method - Ziegler - Nichol's tuning - 1/4 decay ratio - Feed Forward control - Ratio control - cascade control - averaging control - multivariable control.

Unit IV : I/P and P/I Converters

Pneumatic and electric actuators - valve positioner - control valve - Characteristics of control valve - valve body - globe, butterfly, diaphragm ball valves - control valve sizing - Cavitation, flashing in control valves - Response of pneumatic transmission lines and valves.

Unit V : Applications

Distillation column - control of top and bottom product compositions - reflux ratio - control of chemical reactor - control of heat exchangers - steam boiler - drum level control and combustion.

Text Books

1. Curtis Johnson, D., " Process Control Instrumentation Technology" , Prentice Hall Of India,1996.
2. Eckman, D.P., " Automatic Process Control" , Wiley Eastern,1985.

Reference Books:

1. Peter Harriot.,: "Process Control" , TMH
2. Patranabis, D.,: " Principles of Process Control", TMH 1981.
3. Coughanoner, and Koppel., : " Process Systems Analysis and Control" , TMH 1991.

EI211 COMPUTER BASED PROCESS CONTROL LABORATORY

Credit: 0: 0: 2
Marks: 50 + 50

1. ON-OFF Controllers
2. P + I + D Controller
3. Temperature Control Loop
4. Pressure Control Loop
5. Flow Control Loop
6. Level Control Loop

7. Viscometer and pH meter
8. D/P Transmitter
9. Calibration of pressure gauge using Dead weight Tester
10. Control valves with and without positioner
11. P/I converter and I/P converter
12. Process control simulator
13. PLC
14. Linearisation of thermocouple and RTD – based temperature transmitter

EI212 INDUSTRIAL INSTRUMENTATION

Credit: 4: 0: 0
Marks: 40 + 60

Unit I : Flow Measurements
Introduction - definitions and units- classification of flowmeters - pitot tubes, orifice meters, venturi tubes, flow tubes, flow nozzles, positive displacement flowmeters, variable area flowmeters.

Unit II : Anemometers And Flow Meters
Mechanical anemometers, hot wire / hot film anemometer, Laser Doppler anemometer (LDA), electromagnetic flowmeters, turbine and other rotary element flowmeters, ultrasonic flowmeters, Doppler, cross correlation flowmeters, Vortex flowmeters. Measurement of mass flow rate: Radiation, angular momentum, impeller turbine, constant torque hysteresis clutch, twin turbine, coriolis, gyroscopic and heat transfer type mass flow meters.

Unit III : Flowmeters And Level Measurements
Target flowmeters: V-cone flowmeters, purge flow regulators, flow switches, flowmeter calibration concepts- flowmeter selection and application. Level measurement: Introduction, float level devices, displaced level detectors, rotating paddle switches, diaphragm and differential pressure detectors.: Resistance, capacitance and RF probes: radiation, conductivity, field effect, thermal ,ultrasonic, microwave, radar and vibrating type level sensors - Level sensor selection and application.

Unit IV : Non-Destructive Testing (NDT)
Introduction: Various methods for NDT - advanced NDT techniques - Transmitters: Introduction, terminology, features of smart and intelligent transmitters, Smart and Intelligent temperature, pressure and differential pressure transmitters. Smart and intelligent flowmeters. Other smart and intelligent measurement systems. Integration of intelligent transmitters into knowledge based process management systems.

Unit V : Virtual Instrumentation And EMC
Virtual instrumentation: Definition, parts of the system, windows in data acquisition, personal computers for DAS and instrument control, instrument drivers, EMC: Introduction, interface coupling mechanism, basics of circuit layout and grounding - interface, filtering and shielding. Electrical and intrinsic safety- enclosures. NEMA types: personnel safety, Explosion hazards and intrinsic safety.

Text Books

1. Doebelin, E.O.,: " Measurement Systems Application and Design" , fourth edition McGraw Hill International,1978.
2. Noltingk, B.E.,: "Instrumentation Reference Book", II edition Butterworth Heinemann,1996.

Reference Books

1. Flow measurement, "Practical Guides for Measurement and Control" , ISA publication, 1991.
2. Anderew, W.G., "Applied Instrumentation in Process Industries" - a survey Vol-I Gulf Publishing company.
3. Liptak, B.G.,: "Process Measurement & Analysis", IV Edition, Chilton Book company 1995.
4. Considine, D.M.,: "Process Instruments and Control & Handbook", McGraw Hill 1985.

EI213 MICROPROCESSOR BASED INSTRUMENTATION SYSTEM

Credit: 3: 1: 0
Marks: 40 + 60

Unit I : Organisation of 8085
Organisation and architecture of 8085 microprocessor - Instruction set - Addressing modes - Assembly language programming - Bus cycles, instruction cycle, programming examples

Unit II : Organisation of 8086
Organisation of 8086 microprocessor - memory segmentation - Addressing bytes and words - Address formation - Addressing modes in 8086 - minimum mode and maximum mode - multiprocessing- interfacing memory and I/O devices with 8085and 8086 microprocessor.

Unit III : Interface Chips
Principle, block diagram and control word formats for 8251, 8257, 8259 and 8279 - 8255 and 8253.

Unit IV : Applications
Water level monitoring in mining - Turbine monitor in thermal plant - DC motor control - Temperature control - Position control using stepper motor.

Unit V : Introduction To Multiprogrammer
Introduction to HPIB Multiprogrammer - Multiprogrammer capabilities and applications - Digital input card - Digital output card - process interrupt card.

Text Books

1. Krishna Kant.,: “Microprocessor Based Data Acquisition System Design”, Tata McGraw Hill,1987.
2. John ,D. Lenk.,: “Handbook of Microprocessor Based Instrumentation and Control”, Prentice Hall Inc.,1984.
3. Ramesh Gaonkar, S., "Microprocessor Architecture, Programming & Applications with 8085/8080A" – Penram International - 1997.

Reference Books

1. David, M, Auslander, and Paul Sagues.,: “Microprocessors for Measurement and Control”, Osborne/McGraw Hill,1981.
2. Rodney Zaks., : “An introduction to Microprocessors - From Chips to Systems”, BPB Publications,1985.
3. Kenneth Ayala, J.,"The 8051 Microcontroller Architecture, Programming & Applications" – Penram International publishing-1996.

EI214 DIGITAL CONTROL SYSTEMS

Credit: 3: 1:0
Marks: 40 + 60

Unit I : Sample Theory and Converters

Review of Sample theory - Shannon's sampling theorems - Sampled Data Control system, Digital to Analog conversion – Analog to Digital conversion, Ramp type A/D, Dual slope A/D, Successive approximation A/D. - A/D & D/A converters - Review of Z and Inverse Z transform - Reconstruction - Zero Order Hold.

Unit II : System Response

Response of sampled data systems to step and ramp inputs - Steady state errors - Z domain equivalent - Stability studies - Bilinear transfomation - Jury's stability test.

Unit III : Function Realisation

State sequences for sampled data systems - solutions - Pulse transformation function by direct, cascade and parallel realization - Sampled data model for continuous system - Controllability and observability.

Unit IV : Digital Process Control Design

Digital PID algorithm - Positional and incremental forms - Dead-beat algorithm-Ringing - Dahlin's and Kalman's algorithms - Implementation of control algorithms using microprocessors - General description of microcontrollers - Digital quantization.

Unit V: Applications

System models, control algorithms and their implementation for micro processor based position and temperature control systems - Operational features of stepper motors - Drive circuits - Interfacing of stepper motor to microprocessors.

Text Book

1. Gopal.M: “Digital Control Engineering”,Wiley Eastern Publications, 1988

Reference Books

1. Ahson, S.I., : “ Microprocessors with Applications in Process Control” , TMH, 1984.
2. Nagrath, J.J, and Gopal, M, “ Control System Engineering” , Wiley & Sons., 1985
3. Constantine Houpis, and Garry Lamont., “Discrete Control systems” - Theory, Hardware and Software, McGraw Hill,1985.

EI215 - LOGIC AND DISTRIBUTED CONTROL SYSTEMS

Credit: 3: 1: 0
Marks: 40 + 60

Unit I : Review Of Computers In Process Control

Data loggers: Data acquisition systems (DAS): alarms, computer control hierarchy levels. Direct Digital control (DDC). Supervisory digital control (SCADA). Characteristics of digital data. Controller software. Linearization. Digital Controller modes, error, proportional, derivative and composite controller modes.

Unit II : Programmable Logic Conntroller (PLC) Basics

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

Unit III : PLC Intermediate Functions

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

Unit IV : Interface And Backplane Bus Standards For Instrumentation Systems

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

Unit V : Distributed Control Systems (DCS)

Evolution of DCS - building blocks - detailed descriptions and functions of field control units - operator stations - data highways - redundancy concepts. DCS - supervisory computer tasks and configuration - DCS- system integration with PLC and computers. Communication in DCS. Case studies in DCS.

Text Books

1. John Webb, W, Ronald Reis, A.,: " Programmable Logic Controllers Principles and Applications", 3/e, Prentice hall Inc., New Jersey, 1995.
2. Krishna Kant, " Computer based Industrial Control", Prentice Hall India. 1997.

Reference Books

1. Lukcas , M.P.,: " Distributed Control Systems", Van Nostrand Reinhold Co., New York ,1986.
2. Moore., : " Digital Control Devices" , ISA Press, 1986.
3. Hughes, T.,: " Programmable Logic Controllers", ISA Press 1994.
4. Mckloni, D.T.,: "Real Time Control Networks" , ISA Press 1994.
5. Deshpande, P.B, and Ash ,R.H.,: " Elements of Process Control Applications" , ISA Press 1995.

EI216 BIOMEDICAL INSTRUMENTATION

Credit: 4: 0: 0
Marks: 40 + 60

Unit I : Electrophysiology and Biopotential Recorders

Neuron – Axon – Axon potential – Electrophysicology of Cardiovascular system – ECG – Phonocardiography – Neurophysiology – Central nervous system – EEG – Respiratory system – Muscular system - EMG, - Eye – ERG

Unit II : Measurement and Physiological Parameters

Physiological Transducers - Measurement of Blood pressure – Blood flow - Cardiac output measurement – heart rate – respiration rate – measurement of lung volume – Oximeters – Audiometer.

Unit III : Therapeutic and Surgical Equipments

Electro Surgical unit – short wave & microwave diathermy – Laser surgical unit – Anesthesia machine – Pacemakers – Total artificial heart (TAH) – Dialyser – Heart lung machine – Defibrillators – Ventilators – Nerve stimulators – centralized and Bedside patient monitoring system – Nerve stimulators.

Unit V : Biomedical Equipments and Electrical Safety

Flame photometer – spectrophotometer – chromatography – PH, PCO2, analysis – sterilizers – Electrical safety hazards in hospitals.

Unit V : Imaging Systems and Telemetry

Computerized Tomography (CT) – MRI instrumentation – Ultrasound scanner – X-ray machine – Fluroscopic techniques – angiography – Cardiac catherisation lab – Echo cardiograph – vector cardiograph – Biotelemetry.

Text Books

1. Richard Aston.,: "Principles of Biomedical Instrumentation and Measurement", Merrill publishing company, 1990.

2. Arumugam, M.,: "Biomedical Instrumentation", Anuradha Agencies, Publishers, Kumbakonam, 1992.

Reference Books

1. Geddes, L.A., and Baker, L.E.,: " Principles of Applied Biomedical Instrumentation", John wiley, 1989.
2. Kandpur, R.S., : " Handbook of Biomedical Instrumentation", TMH, 1987.

EI217 INSTRUMENTATION AND CONTROL LABORATORY

Credit: 0: 0: 1
Marks: 25 + 25

1. Study of characteristics of strain gauge
2. Study of characteristics of Load cell
3. Study of characteristics of LVDT
4. Study of characteristics of RTD
5. Study of characteristics of Thermocouple
6. Study of characteristics of Resistive potentiometer
7. Study of characteristics of Loudspeaker
8. Study of characteristics of Microphone
9. Study of characteristics of Pressure transducer
10. Study of Tachogenerator characteristics

EI218 INSTRUMENTATION & CONTROL LABORATORY

Credit 0 : 0 : 2
Marks 50 + 50

1. Study of characteristics of strain gauge .
2. Study of characteristics of Load cell..
3. Study of characteristics of LVDT
4. Study of characteristics of RTD.
5. Study of characteristics of thermocouple
6. Study of characteristics of Resistive potentiometer.
7. Study of characteristics of Loud speaker
8. Study of characteristics of Micropohone
9. Study of Tachogenerator characteristics.
10. Study of controllering.
11. Study of Temperature ON-OFF control.

EI219 MEASUREMENTS AND INSTRUMENTATION

Credit: 4: 0:0
Marks: 40 + 60

Unit I : Introduction

Functional elements of an instrument - static and dynamic characteristics-errors in measurement-statistical evaluation of measurement data -standard and calibration.

Unit II : Transducers

Classification of transducers - selection of transducers resistive, capacitive and inductive transducers- piezo electric transducers - optical and digital transducers - pH electrodes - transducers for measurement of displacement, temperature, level, flows, pressure, velocity and acceleration.

UNIT III : Signal conditioning Circuits

Bridge circuits - differential and instrumentation amplifiers filter circuits - V to I and I to V converters - P/I and I/P converters - S/H circuit, A/D and D/A converters -multiplexing and demultiplexing -data acquisition systems -grounding techniques.

UNIT IV : Storage and Display Devices

Magnetic disc and tape recorders - digital plotters and printers - CRT displays - digital CRO - LED, LCD and Dot matrix displays.

UNIT V : Electrical and Electronics Instruments

Principle - analog and digital ammeters and volt-meters-single and three phase watt meters and energy meter- magnetic measurements - instrument transformers - instruments for measurement of torque, speed, frequency, phase, viscosity and moisture.

Text Book:

1. Doebeling, E.O.,: " Measurement Systems- Application and Design", McGraw Hill Publishing Company, 1990.

Reference Books

1. Stout MoB., " Basic Electrical Measurement", Prentice Hall of India, 1986.
2. Dalley, J.W., Riley, W.F. and Meconnel, K.G., "Instrumentation for Engineering Measurement", John Wiley & Sons, 1999.
2. Moorthy, D.V.S., " Transducers and Instrumentation", prentice Hall of India Pvt., Ltd., 1995.
3. Coombs. C.F., "Electronics Instrument Hand Book", McGraw Hill, 1995.
4. Mooris. A.S., "Principle of Measurement and Instrumentation" Prentice Hall of India, 1999.

EI 220 -MEASUREMENTS AND INSTRUMENTATION LABORATORY

Credit: 0: 0: 2
Marks: 50 + 50

1. Measurement of voltage and frequency using CRO.
2. Measurement of phase difference by CRO using Lissajous figures.
3. Measurement of resistance using Kelvin's double bridge and Whetstone Bridge
4. Measurement of inductance using Hay's and Owen's bridge.
5. Measurement of inductance using Anderson and Maxwell's bridge.
6. Measurement of capacitance using Schering's bridge.
7. Measurement of angular displacement using potentiometer.
8. Measurement of capacitance using Desauty's bridge.
9. Calibration of voltmeter.
10. Calibration of ammeter.
11. Calibration of energy meter.
12. Calibration of wattmeter.
13. Study of temperature measuring transducers (RTD, thermocouples and IC 590).
14. Study of displacement and pressure transducer

EI221 EMBEDDED SYSTEM LABORATORY

Credit: 0: 0: 2
Marks: 50 + 50

8085 Assembly Language Programme

1. Simple programmes for basic arithmetic operations: Addition, Subtraction, Multiplication and division.
2. Code Conversion: BCD to Binary, Binary to BCD, BCD to seven segment code Binary to Hexadecimal.
3. Square root of a number, factorial, sorting

8086 Assembly Language Programme

4. Search and sort
5. Programms involving string instructions

8051 Assembly Language Programme

6. Simple programs involving timers and counters

Interfacing

7. Stepper motor interface using 8085
8. ADC motor interface using 8085
9. DAC motor interface using 8085
10. Study of interrupt structures of 8085, 8086 and 8051
11. Study of programmable I/O ports of 8051 microcontroller

EI 222 INSTRUMENTATION AND CONTROL SYSTEMS

Credit: 3:0:0
Marks: 40+60

UNIT I

General Concepts of Mechanical Instrumentation, generalised measurement system. Classification of instruments as indicators, recorders and integrators – their working principles, Precision and accuracy. Measurement of error and analysis.

UNIT II

Measurement of displacement, time, speed, frequency, acceleration – vibrometer, accelerometer etc. Pressure measurement: Gravitational, bourdon, elastic transducers, strain gauge, pressure cells, measurement of high and low pressure. Temperature measurement: Bi-metallic, resistance thermometer, thermocouples, pyrometer and thermistors, Hot-wire anemometer, magnetic flow meter, ultrasonic flow meter, calibration.

UNIT III

Viscosity: Capillary tube viscometer, efflux viscometer, Humidity: absorption hydrometer, Dew point meter. Strain: Strain gauges, types, wheatstone circuit, temperature compensation, gauge rosettes calibration. Force measurement: Scales and Torque measurement: Mechanical torsion meter, electrical torsion meter.

UNIT IV

Control Systems: Open and closed systems, servomechanisms, transfer functions, signal flow graphs, block diagram algebra, and hydraulic and pneumatic control systems, Two-way control, proportional control, differential and integral control. Simple problems.

UNIT V

Time response of first order and second order systems, concept of stability, necessary condition for stability, Routh stability criterion, Polar and Bode plots, Nyquist stability criterion. Simple problems.

Text Books:

1. Sawheny, A.K., ‘Electrical and Electronics Measurements & Instrumentation’, Dhanpat Rai & Co., 1993.
2. Nagoor Kani. A., ‘Control Systems’, RBA Publications, 1998 (For Units IV & V).

Reference Books:

1. Thomas G Beckwith, Lewis Buck, N.Roy D. Maragoni, ‘Mechanical Measurements’, Narosa Publishing House, New Delhi, 1989.
2. Collet, C.V. and Hope, A.D., ‘Engineering Measurements’, 2nd Ed., ELBS.
3. Nagrath, M. and Gopal, I.J, , ‘Control Systems Engineering’, Wiley Eastern Limited, 1991.

EI 301 INDUSTRIAL INSTRUMENTATION

Credit: 4: 0: 0
Marks: 40 + 60

UNIT: I -*Pressure Measurement*
Pressure standards - Dead weight tester - Different types of manometers - Elastic elements-Electrical methods using strain gauge-High pressure measurement-Vacuum gauges - Mcleod gauge - Thermal conductivity gauges -Ionization gauge- Differential pressure transmitters - Installation and maintenance of pressure gauges

UNIT: II -*Flow Measurement*
Positive displacement flowmeters - Inferential flowmeter-Turbine flowmeter-Variable head flowmeters -Rotameter - Electromagnetic flowmeter - Ultrasonic flowmeter-Coriolis mass flowmeter- Calibration of flowmeters - Installation and maintenance

UNIT: III. -*Temperature Measurement*
Temperature standards - fixed points -filled-system thermometers - Bimetallic thermometer-Thermocouple - Laws of thermocouple - Cold junction compensation- Measuring circuits - Speed of response -linearization - Resistance thermometer- 3 lead and 4 lead connections - thermistors - IC temperature sensors - Radiation pyrometer- Optical Pyrometer-Installation, maintenance and calibration of thermometers and thermocouples.

UNIT: IV -*Level Measurement*
Visual techniques - Float operated devices - Displacer devices - Pressure gauge method - Diaphragm box-Air purge system-Differential pressure method – Hydro-step for boiler drum level measurement - Electrical methods - Conductive sensors - capacitive sensors -Ultrasonic method - Point level sensors-Solid level measurement

UNIT: V -*Smart Instrumentation and Reliability Engineering*
Smart intelligent transducer- Comparison with conventional transducers- Self diagnosis and remote calibration features- Smart transmitter with HART communicator- Reliability Engineering- Definition of reliability -Reliability and the failure rate – Relation between reliability and MTBF- MTTR - Maintainability - Availability – Series and parallel systems

Text Books

1. Doeblin E.O, 'Measurement Systems': Application and Design, Fourth Edition, McGraw Hill, Newyork, 1992 ISBN 0-07-100697-4.
2. Renganathan.S, 'Transducer Engineering', Allied publishers, Chennai 1999
3. Eckman, D.P., 'Industrial Instrumentation', Wiley Eastern Ltd., 1990 ISBN 0-85226-206.

Reference Books

1. Liptak B. 'Process Measurement and Analysis', 3rd Edition Chilton book company Radnor, pennsylvania, 1995 ISBN 0-7506-2255.
2. Patranabis, D., 'Principles of Industrial Instrumentation', Second Edition Tata McGraw Hill Publishing Co. Ltd.. New Delhi. 1997, ISBN 0074623346
3. Barney G.C.V., 'Intelligent Instrumentation', Prentice Hall of India Pvt. Ltd., New Delhi,

1985, ISBN 0134689437
4. Tatamangalam R., ‘Industrial Instrumentation Principles and Design’, Springer Verlog, 2000 ISBN 1852332085

EI 302 PROCESS CONTROL

Credit: 3:1:0
Marks: 40+60

UNIT: I. -*Introduction to Process Control*
Process dynamics- Elements of process control- Process variables- Degrees of freedom- Characteristics of liquid system, gas system, thermal system-Mathematical model of liquid process, gas process, flow process, thermal process, mixing process- Chemical reaction- Modeling- Objective of modeling- Batch process and continuous process- Self regulation

UNIT: II. -*Control Action and Controller Tuning*
Basic control action- Characteristic of ON-OFF, proportional floating control, integral and derivative models- Response of Controllers for different types of test inputs-selection of control mode for different process with control scheme-Optimum controller settings- Tuning of controllers by process reaction curve method- Continuous cycling method, damped oscillation method- Ziegler Nichol’s tuning-Cohen Coon method -Pole placement method

UNIT: III -*Design of Controllers for Stable Unstable and Multivariable System*
Design of PI, PID controller for integrator, dead time, time delay systems- Design of non-linear controller with input multiplicities –Introduction to multivariable system-evolution of loop interaction –evolution of relative gains- single loop and overall stability- model equations for a binary distillation column- Transfer function matrix-Method of inequalities-Decoupling control- Centralized controller- Case study on design of decentralized controllers-Pairing criteria for unstable system

UNIT: IV -*Complex Control Techniques and Final Control Elements*
Feed forward control- Ratio control- Cascade control- Split range control- Averaging control-Multivariable control- Inferential control-Model predictive control- Adaptive control- Internal model control- Dynamic matrix control-model -Generalized predictive control- Activators-Positioner- Control valve- Types of valves- Design and characteristics of Control valve-Control Valve selection and sizing- Cavitation and flashing-I/P & P/I converters

UNIT: V -*Industrial Application*
Control of distillation column-control of top and bottom product compositions- Control of chemical reactor- Control of heat exchanger- Control of steam boiler drum level control and combustion- P&I diagrams- Intelligent contro1

Text Books

1. Harriot P.. ‘Process Control’, Tata McGraw Hill Publishing Co., New Delhi, 1995 ISBN 8170237963
2. M.Chidambaram, ‘Applied Process Control’, Allied Published, 1998, ISBN 0070404917

3. Stepanopoulos, 'Chemical Process Control: An Introduction Theory and Practice', Prentice Hall, New Delhi 1999, ISBN 8120306651

Reference Books

1. Norman A Anderson, 'Instrumentation for Process Measurement and Control', CRC Press LLC, Florida, 1998, ISBN 0849398711.
2. Marlin. T.E., 'Process Control', Second Edition McGraw Hill NewYork, 2000, ISBN 0070404917
3. Liptak B.G 'Process Control', Third Edition, Chilton Book company, Pennsylvania, 1995 ISBN0750622547
4. D.P. Eckman, 'Automatic Process Control', Wisle Eastern limited, New Delhi ISBN 0-852262051
5. Sinskey, 'Process Control System', Forth Edition, MC Graw Hill, Singapore, 1996, ISBN 0876645295
6. Curtis D. Johnson, 'Process Control Instrumentation Technology', Seventh Edition, Prentice Hall New Delhi 2000 ISBN 8120309871

EI 303 ADVANCED DIGITAL SIGNAL PROCESSING

Credit: 3:1:0
Marks: 40+60

UNIT: I.-*Introduction to DSP*:
Signals and their orgin, Noise-Classification of continuous time signals and Discrete time signals classification and properties of systems. Sampling Theoram-sampling-digitizing-aliasing-anti-alias filter. Convolution theorem-linear convolution and circular convolution - Applications of filters and - Digital signal processing (DSP) advantages of DSP

UNIT: II. *-Transforms:*
Z-Transform and its properties –Inverse Z-transform –Discrete Fourier Transforms (DFT) and its properties-Radix 2FFT, Computational advantages of FFT over DFT-Decimation in time FFT algorithm-Decimation-in Frequency FFT algorithm –MATLAB exercises.

UNIT: III. *-IIR Digital Filter Design using MAT LAB*
Block diagram Representation of digital filter-Basic IIR digital filter structures- Structure Realization Using MATLAB-Preliminary consideration in digital filter design – Bilinear Transformation.

UNIT: IV. *-FIR Digital Filter Design Using MATLAB*
Basic FIR Filter Structure, Structure realization using MATLAB, FIR Filter design based on windowed Fourier series, Frequency sampling method, equiripple linear, phase FIR filter design using MATLAB, window based FIR filter design using MATLAB, Least square error FIR filter design using MATLAB

UNIT: V. -***DSP Processor- TMS320C5X***

Introduction to programmable DSPS, Architecture of TMS 320 C5X, TMS 320C5X Assembly language Instructions, Instruction Pipelining in C5X,

Programming using DSP Processor:

Convolution using MAC and MACD Instructions, Square wave generation, Ramp signal generation, Triangular wave generation.

<u>Text Books</u>

1. Sanjit .K. Mitra "Digital Signal Processing A Computer based approach 'Tata McGraw Hill Edition ,2001,ISBN 0-07-044705-5
2. B.Venkataramani, M Bhasker, Digital Signal Processors, Tata Mc Graw-Hill Publishing company limited ,2002,ISBN 0-07-047334-X

<u>References</u>

1. John .G.Proakis ,Digital Signal Processing Principles,Algorithms and Applications , Addision – Wesley 2002,ISBN-81-203-1129-9.
2. Emmanuel C.Ifeachor Digital Signal Processing A Practical Approach ,Pearson Education Asia,2002,ISBN 81-7808-609-3.
3. TMS 3205X User's Manual, Texas Instruments, 1993.

EI 304 FIBER OPTICS AND LASER INSTRUMENTATION

Credit: 3:0:0
Marks: 40+60

UNIT: I -***Optical Fibers and their Properties***

Principles of light propagation through a fiber-Different types of fibers and their properties - Transmission characteristics of optical fiber-absorption losses-Scattering losses-Dispersion - Optical fiber measurement - Optical sources - Optical detectors - LED -LD - PIN and APD

UNIT: II -***Industrial Application of Optical Fibers***

Fiber optic sensors - Fiber optic Instrumentation system - Different types of modulators-Detectors-Application in Instrumentation - Interferometric method of measurement of length-Moire fringes - measurement of pressure, temperature, current, voltage, liquid level and strain - fiber optic gyroscope - Polarization maintaining fibers

UNIT: III -***Laser Fundamentals***

Fundamental characteristics of Lasers - three level and four level lasers - properties of laser-laser modes - resonator configuration - Q- switching and mode locking - cavity dumping - Types of lasers Gas lasers, solid lasers, liquid lasers - semi conductor lasers

UNIT: IV -***Industrial Application of Lasers***

Laser for measurement of distance, length, velocity, acceleration, current, voltage and atmospheric effect - material processing - laser heating, welding, melting and trimming of materials - removal and vaporization

UNIT: V -***Hologram and Medical Application***

Holography - Basic principle; methods; Holographic Interferometry and applications, Holography for non-destructive testing -Holographic components - Medical applications of lasers; laser and tissue interaction - Laser instruments for surgery, removal of tumors of vocal cords, brain surgery, plastic surgery, gynecology and oncology.

Text Books

1. Jasprit Singh, Semi Conductor Optoelectronics, McGraw Hill,1995 ISBN 0070576378
2. Ghatak A.K. and Thiagarajar K, Optical Electronics Foundation book , TMH, Cambridge University Press, 1989 ISBN 052134089

Reference Books

1. John and Harry, Industrial Lasers and their Applications, McGraw Hill 1974 ISBN 0070844437
2. John F Ready,. Industrial Applications of Lasers, Academic Press, 1997 ISBN 0125839618
3. Monte Ross, Laser Applications, McGraw Hill, 1968 ISBN 0124319025

EI 305 BIOMEDICAL INSTRUMENTATION AND IMAGE PROCESSING

Credit: 4:0:0
Marks: 40+60

UNIT: I -***Introduction to Physiological System***

Bio-potential - Resting and action potential. Electrodes - different types of electrodes - Equivalent circuits for electrodes - Sensors used in Medical Diagnosis - Selection Criteria for Transducers and Electrodes - Design of low noise preamplifiers - Differentia! Amplifiers - Chopper amplifiers - Electrical safety - Grounding and isolation

UNIT: II -***Bio-medical monitoring Systems***

Blood pressure measurement - Measurement of heart rate - heart sound - measurement of blood flow - Cardiac output - Measurement of respiration - Partial pressure measurements - Recent instrument for blood cell count - GSR measurement

UNIT: III. -***Electro-physiological Measurements***

Electro Cardiograph (ECG) - Electro Encephalograph (EEG) -. Electromyograph (EMG) - Phonocardiograph (PCG), Electroretinogram(ERG) - Electrocculograph (EOG)- X ray machine - Computer Tomography (CT)- Magnetic Resonance Imaging (MRI) system -- Ultrasonic imaging system - laser in biomedical

UNIT: IV -***Digital Image Fundamentals***

Elements of a digital image processing system structure of the human eye- Image formation-sampling and quantization, some basic relationships between pixels- Image processing Applications - Image Transforms- Fourier transform, DFT- Properties of two dimensional FFT- Separability, translation-periodicity, rotation, average value- FFT algorithm-Walsh transform-Hademard transform-discrete cosine transform

UNIT: V -*Image Enhancement*

Spatial Domain, methods-Some simple Gray level Transformations, Histogram processing Enhancement using Arithmetic / Logic operations- Basics of spatial filtering, smoothing spatial filters, sharpening spatial filters- Combining spatial Enhancement Methods- Frequency Domain Methods- Smoothing frequency-domain filter- Sharpening frequency domain filters- Homomorphic filtering- Image Processing tool box in Matlab- Implementation of simple Image processing application using Matlab

<u>Text Books</u>:

1. Khandpur R.S., 'Hand book of biomedical instrumentation', Tata McGraw Hill, 1996, ISBN 007451725.
2. Arumuam M., 'Biomedical Instrumentation', Anuradha Agencies, 2001, ISBN 818772112-x
3. Rafeal C. Gonzalez, Richard E. Woods, 'Digital Image Processing', Pearson Education, Asia, 2002, ISBN 8178086298

Reference Books

1. Cromwell L., 'Biomedical Instrumentation and Measurements', Prentice Hall of India, 2000, ISBN 8120306538.
2. John G. Webstar, 'Medical Instrumentation Application and Design', John Wiley & Sons, Inc. 1999, ISBN 997151270 – x

EI 306 INDUSTRIAL INSTRUMENTATION AND PROCESS CONTROL LABORATORY

Credit: 0:0:2
Marks: 50+50

1. Determination of viscosity using Redwood viscometer
2. Current to pressure converter
3. Pressure to current converter
4. Response of system to various inputs
5. Software simulation of PLC Ladder diagram
6. Pressure Gauge calibration using Dead Weight Tester
7. Study of the characteristic of pneumatic control valve
8. Calibration of thermocouple and RTD
9. Study of PID flow control system
10. Study of PID level control system
11. Study of PH meter
12. Simulation of first order and second order system with and without dead time
13. Design of digital control algorithms for first order system.
14. Experiments using MATLAB SIMULINK package
15. Design of data acquisition system using PCI /NI card
16. Identification and control of air temperature control system
17. On line control of PC based liquid level system
18. Experiments in flow process control training plant

19. Virtual Instrumentation package - Study
20. Design of fuzzy logic controller using fuzzy logic toolbox

EI 307 ADVANCED CONTROL SYSTEM

Credit: 3:1:0
Marks 40+60

UNIT: I -*Modeling of Dynamic Systems*
Centrifugal Governor – Ground vehicle- Permanent Magnet stepper motor- Inverted Pendulum – Numerical methods – Liberalization of Differential Equation –Describing function method.

UNIT: II -*Linear System Analysis*
Reachability and controllability – Observability and constructability –Companion forms – Controller / Observer form – State feed-back control – State estimator – Full order and reduced order Estimator

UNIT: III -*Stability*
Definition of stability – Stability of linear system – Hurwitz and Routh stability criteria – Stability of Nonlinear system – Lyapunov's Indirect method

UNIT: IV -*Optimal Control*
Performance Indices – Calculus of variation – Linear Quadratic Regulator – Dynamic programming –Pontrgagin's minimum principle

UNIT: V -*Heuristic and Evolutionary Control Systems*
Fuzzy systems – ANN – Genetic Algorithms – Based Controllers

Text Books:
1. Stanislaw Zak, 'Systems and Control', Oxford University Press, 2003, ISBN 0195150112
2. Norman S.Nice, 'Control Systems Engineering', John Wiley and Sons, 2000m ISBN 0471366013
3. Ogata.K, 'Modern Control Engineering', Prentice-Hall Publication, 1996, ISBN 0130609072

Refence Books:
1. Godwin. C, Graebe.F, and Salgado., 'Control System Design', Prentice Hall, New Jersey, 2001, ISBN 0139586539.
2. William S. Levine, 'The Control Hand Book', IEEE and CRC Press, USA, 2000, ISBN 0849385709
3. Friedland, B, 'Control System Design', McGraw Hill, 1987, ISBN 0070224412
4. Atherton D.P.,'Stability of Nonlinear Systems',Prentice Hall,1980, ISBN 0442304862
5. Peter Cook.A, 'Nonlinear Dynamic Systems', Prentice Hall, 1991

EI 308 COMPUTER CONTROL OF PROCESS

Credit: 3:1:0
Marks: 40+60

UNIT: I -*Introduction to Computer Process Control*

Review of sample theory-Response of sample data system to step and ramp input- steady state error-Z domain equipment- Linear transformation- Pulse transfer function-Modified Z-transform- Sample data model for continuous system bilinear transformation- Jury's Stability test

UNIT: II -*Design of Digital Controller*

Digital PID –Deadbeat- Dahlin's algorithms-Pole placement controller-Kalman's algorithms-Design for load changes- Design of feed forward controller- Predictive controller-Implementation of control algorithm using microprocessor- Position and Velocity forms-Dead time compensation and smith predictor algorithm

UNIT: III -*Programmable Logic Controller*

Introduction- Overview of PLC systems- I/O Modules- Power supplies General PLC programming procedures-Programming ON-OFF outputs- Auxiliary commands and functions- Creating ladder diagrams from process control descriptions- PLC basic functions-Register basics-Timer and counter functions

UNIT: IV -*PLC Intermediate Functions*

Arithmetic functions- Comparison function-SKIP and MCR function-Data move system-PLC advanced intermediate function- Utilizing digital bits- Sequencer functions- Matrix functions-PLC advanced function- Alternate programming language- Analog PLC operation-Networking of PLC- PLC installation- Design of interlocks and alarms using PLC- Three way traffic light problem- Annunciator problem-Trouble shooting and maintenance

UNIT: V -*Applications*

Implementation of microprocessor based position and temperature control systems-Operational features of stepper motor- Drive circuits- Interfacing of stepper motor to computer- Interfacing of computer with temperature flow, level process

Text Books

1. Despande, P.B. and Ash R.H., 'Computer Process Control', ISA Publication, 1995.
2. Houpis C.M., Lamount, G.B., 'Digital Control Systems' - Theory, Hardware and Software, Mc-Graw Hill Book Co., 1985.
3. Kuo.B, 'Digital Control System', Mc-Graw Hill Book Co., 1996.

<u>Reference Books</u>

1. Petrezeulla, 'Programmable Controllers', McGraw Hill, 1989
2. HughesT, 'Programmable Logic Controllers', ISA Press, 1989
3. Steponopoulous.G, 'Chemical Process Control', Tata Mc Graw Hill, 1986

EI 309 DISTRIBUTED CONTROL SYSTEM, NETWORKS AND PROTOCOLS

Credit: 4:0:0
Marks: 40+60

UNIT: I -*Computer Networks*
Common bus topology- Star topology- Ring topology- Fully connected topology- Combined topologies- Protocols and protocol architecture- Asynchronous and Synchronous Communication USART, UART- Serial data transmission standard – RS232, RS422, RS485 – Multi-drop Communication- Data coding methods- ASCII, EBCDOC, Baudot, Morse and BCD Codes-Digital encoding schemes.

UNIT: II -*Data Compression, Security and Integrity*
Data Compression – Huffman code- Runlength encoding-relative encoding-Lempel- Image compression- JPEG, MPEG- Data Integrating –Error parity checking analysis- Deribie bit error detection- Burst error detection- Cyclic redundancy checks- Polynomial division- Analysis of CRC- CRC implementation - Error correction- Hamming codes- Single error correction- Multi-bit error correction- Comparison of error detection and correction- Data Security- Encryption and decryption- Caesar Cipher Bit level ciphering- Data encryption protection- Public key encryption- RSA algorithms and digital signatures- Authentication using Hash-Based schemes

UNIT: III -*Data Network Fundamentals*
Network hierarchy and switching - Open system interconnection model of OSI - Data link control protocol - BISYNC - SDLC - HDLC - Media Access protocol - Command/response - Token passing - CSMA/ CDMA, TCP/IP- Internetworking- Bridges - Routers - Gateways - Open system with bridge configuration - Open system with gateway configuration - Standard ETHERNET and ARCNET configuration – Special requirement for networks used for control.

UNIT: IV -*Distributed Control Systems*
Evolution - Different architectures - Local control unit - Operator interface - Displays- Engineering interface-alarms and alarm management-DCS Case study- Study of anyone popular DCS available in market - Factors to be considered in selecting DCS - Case studies in DCS.

UNIT: V -*HART and Field Bus*
Introduction - Evolution of signal standard - HART Communication protocol – Communication modes - HART networks -Control system interface - HART commands – HART field controller implementation - HART and the OSI model – Field bus - Introduction - General field bus architecture - Basic requirements of field bus standard - Field bus topology - Interoperability - Interchangeability.

<u>Text Books</u>

1. A.S. Tanenbaum, ‘Computer Networks’, Third Edition, Prentice-Hall of India, 1996, ISBN 8130311655.
2. Michal P. Lucas, ‘Distributed Control Systems’, Van Nostrand Reinhold Co., 1986

3. Behrooz A.F., 'Data Communication and Networking', 2nd Edition, TMH 2000, ISBN 0070435034

Reference Books

1. Romilly Bowden, 'HART application Guide', HART Communication Foundation, 1999.
2. William A Shay, 'Understanding Data Communications and Networks', Cole Publishing Company, A division of Thomson Learning, 2001, ISBN 053495954 - Y

EI 310 AUTOMOTIVE INSTRUMENTATION

Credit: 3:0:0
Marks: 40+60

Unit: I -*Automobile Panel Meters And Sensor Design*

Ergonomics- Panel Meters- Controllers- Sensor for Fuel Level in Tank, Engine Cooling Water Temperature Sensors Design, Engine Oil Pressure Sensor Design, Speed Sensor, Vehicle Speed Sensor Design, Air Pressure Sensors, Engine Oil Temperature Sensor.

Unit: II -*Indicating Instrumentation Design*

Moving Coil Instrument Design, Moving Iron Instruments, Balancing Coil Indicator Design, Ammeter and voltmeter- Odometer and Taximeter Design. Design of Alphanumeric Display for Board Instruments

UNIT: III -*Warning And Alarm Instruments*

Brake Actuation Warning System. Traficators, Flash System, Oil Pressure Warning System, Engine Overheat Warning System, Air Pressure Warning System, Speed Warning System. Door Lock Indicators, Gear Neutral Indicator, Horn Design, Permanent Magnet Horn, Air Horn, Music Horns

UNIT: IV -*Dash Board Amenities*

Car Radio Stereo, Courtesy Lamp, Timepiece, Cigar Lamp, Car Fan, Windshield Wiper, Window Washer, Instrument Wiring System and Electromagnetic Interference Suppression, Wiring Circuits for Instruments, Electronic Instruments. Dash Board Illumination

UNIT: V -*Switches And Controls*

Horn Switches, Dipper Switches, Pull and Push Switches, Flush Switches, Toggle Switches, Limit Switches, Ignition Key, Ignition Lock, Relay and Solenoid. Non-contact Switches

Text Books

1. Walter E, Billiet and Leslie .F, Goings, 'Automotive Electric Systems', American Technical Society, Chicago, 1971.
2. Judge.A.W, 'Modern Electric Equipments for Automobiles', Chapman and Hall, London, 1975.

Reference Books

1. Sonde.B.S., ‘Transducers and Display System’, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1977.
2. W.F. Walter, ‘Electronic Measurements’, Macmillan Press Ltd., London.
3. E.Dushin, ‘Basic Metrology and Electrical Measurements’, MIR Publishers, Moscow, 1989

EI 311 VIRTUAL INSTRUMENTATION

Credit: 3:0:1
Marks: 40+60

UNIT: I -*Introduction*

Programming paradigms- Virtual Instrumentation- Definition to Virtual Instrumentation (VI)– LabVIEW software- *LabVIEW* basics- LabVIEW environment- Simple problems

UNIT: II -*VI using LabVIEW*

Creating, Editing and debugging a VI in LabVIEW- Creating a sub VI- Loops and charts- Case and sequence structures- File I/O- VI customization- Simple problems

UNIT: III -*Data acquisition and control in VI*

Plug-in DAQ boards- Organization of the DAQ VI System- Performing analog input and analog output- Scanning multiple analog channels- Driving the digital I/Os- Buffered data acquisition-Simple problems

UNIT: IV -*LabVIEW for Advanced Systems*

Bio-bench control and simulation using LabVIEW- Integrated design Environment for dynamic systems- LabVIEW based fuzzy logic and genetic algorithms

UNIT: V -*LabVIEW and Automation Technology*

Mathematics and simulation in LabVIEW- Commercial communication applications- Fourier transform analysis- Time frequency analysis of signals- Designing digital filters- Quality, Reliability and maintenance of LabVIEW programs

Text Books

1. Rahman, and Herbert Pichlik,, ‘LabVIEW – Applications and Solutions’, National Instruments Release, ISBN 0130964239
2. National Instruments LabVIEW Manual

Reference Books

1. Lisa K. Wells Jeffrey Travis, ‘LabVIEW for Everyone’, National Instruments Release, ISBN 013065096
2. ‘Sensors and Transducer and LabVIEW’, National Instruments Release, ISBN 0130811556

EI 312 REAL TIME AND EMBEDDED SYSTEMS

Credit: 4:0:0
Marks: 40+60

UNIT: I -*System Design*
Definitions, Classifications and brief overview of micro-controllers microprocessors and DSPs. Embedded processor architectural definitions. Typical application scenario of embedded systems

UNIT: II -*Interface Issues Related to Embedded Systems*
A/D, D/A converters, timers, actuators, FPGA, ASIC, diagnostic port

UNIT: III -*Techniques for embedded Systems*
State Machine and state Tables in embedded design, Simulation and Emulation of embedded systems. High level language descriptions of S/W for embedded system, Java based embedded system design.

UNIT: IV -*Real time Models, Language and Operating Systems*
Event based, process based and graph based models, Petrinet models - Real time languages - Real time kernel, OS tasks, task states, task scheduling, interrupt processing, clocking communication and synchronization, control blocks, memory requirements and control, kernel services.

UNIT: V -*Case Studies*
Discussion of specific examples of complete embedded systems using MC 68 HC11, Intel 8051, ADSP2181, PIC series of micro controller- Programming using Macro assemblers

<u>Text Books</u>

1. Herma K., 'Real Time systems - Design for Distributed Embedded Applications', Kluwer Academic, 1997, ISBN 0792398947
2. Ganssle J., 'Art of Programming Embedded Systems', Academic Press, 1992, ISBN 0122748808
3. Ball S.R., 'Embedded Microprocessor Systems'- Real World Design, Prentice Hall, 1996, ISBN 0750675349.

<u>Reference Books</u>

1. Gajski, D.D. Vahid, F, Narayan S., 'Specification and Design of Embedded Systems', PTR Prentice Hall, 1994, ISBN 0131507311.
2. Intel Manual on 16-bit Embedded Controllers, Santa Clara, 1991.
3. Slater, M., 'Microprocessor based Design, A Comprehensive guide to effective Hardware Design', Prentice Hall, New Jersey, 1989, ISBN 0135822483.
4. Peatman.J.B., 'Design with PIC Micro Controllers', Pearson Education, Asia, 2001, ISBN 00704923
5. C.M.Krishna, Kang G. Shin, 'Real Time Systems', McGrawHilF, 1997, ISBN 007057043.
6. Raymond J.A.Buhr, Donald L. Bailey, 'An Introduction to Real Time Systems', Prentice Hall International, 1999, ISBN 0136060706.

EI 313 EMBEDDED SYSTEM LABORATORY

Credit: 0:0:2
Marks: 50+50

Atmal 8051 Programming using Keil C

1. Simple programmes for basic arithmetic operations: Addition, subtraction, Multiplication and division.
2. Code Conversion: BCD to Binary, Binary to BCD, BCD to seven segment code, Binary to Hexadecimal
3. Square root of a number, Factorial, Sorting

Motorola Micro Controller Programming

1. Simple programs involving timers and counters
2. DAC interface using 8085
3. ADC interface using 8051

Interfacing

1. Stepper motor interface using 8051
2. Study of interrupt structures of Atmel 8051 and Motorola MC 68 HC 11
3. Traffic light Interface using 8051.
4. Speed control of DC motor using microcontrollers.

Digital Signal Processing

1. Design of Digital filter using DSP tool box
2. Signal generation using TMS320
3. Convolution Algorithm Implementation in TMS Processor
4. FFT Implementation in TMS Processor

ADDITIONAL SUBJECTS

Code No	Subject Name	Credit
EI223	Virtual Instrumentation	3:0:1
EI224	Neural Networks And Fuzzy Logic Control	4:0:0
EI225	Instrumentation And Control In Petrochemical Industries	4:0:0
EI226	Instrumentation And Control In Paper Industries	4:0:0
EI227	Instrumentation In Iron And Steel Industries	4:0:0
EI228	Instrumentation For Pollution Control	4:0:0
EI229	Ultrasonic Instrumentation	4:0:0
EI230	Telemetry And Telecontrol	4:0:0
EI231	Aircraft Instrumentation	4:0:0
EI232	Robotics and Automation	4:0:0
EI233	Digital Control Lab	0:0:2
EI314	Process Control	3:1:0
EI315	Biomedical Instrumentation	4:0:0
EI316	Advanced Control System	3:1:0
EI317	Distributed Control System, Networks and Protocols	4:0:0
EI318	System Identification And Adaptive Control	4:0:0
EI319	Optimal Control Systems	4:0:0
EI320	Robotics And Automation	4:0:0
EI321	Digital Image Processing Techniques	4:0:0
EI322	Virtual Instrumentation Laboratory	0:0:2

EI223 VIRTUAL INSTRUMENTATION

Credit : 3:0:1 **Marks: 40+60**

UNIT –I

Review of virtual Instrumentation: Historical perspective, advantages, block diagram and architecture of a virtual instrument, data-flow techniques, graphical programming in data flow, comparison with Conventional programming.

UNIT – II

VI programming techniques: VIS and sub-VIS, loops and charts, arrays, clusters and graphs, case and sequence structures, formula nodes, local and global variables, string and file I/O

UNIT –III

Data acquisition basics: ADC, DAC, DIO, counters & timers, PC Hardware structure, timing, interrupts, DMA, software and hardware installation.

UNIT –IV

Common instrument interfaces: Current loop, RS 232C/ RS485, GPIB, System buses, interface buses: USB, PCMCIA, VXI,SCXI, PXI, etc., networking basics for office & Industrial applications, VISA and IVI, image acquisition and processing. Motion control.

UNIT – V

Use of analysis tools: Fourier transforms, power spectrum, correlation methods, windowing & filtering. VI applications in various fields.

Textbooks

1. Gary Johnson, Labview Graphical Programming , Second edition, McGraw Hill, Newyork, 1997.
2. Lisa K. wells & Jeffrey Travis, Labview for everyone, Prentice Hall, New Jersey, 1997.

References

1. Sokoloff, Basic concepts of Labview 4, Prentice Hall, New Jersey, 1998.

EI224 NEURAL NETWORKS AND FUZZY LOGIC CONTROL

Credit : 4:0:0 **Marks: 40+60**

UNIT – I

Introduction to neural networks, different architectures of neural networks, Rosenblott's perceptrons, multi layer perceptrons, back propagation algorithm, Hopfield's networks, Kohnen's self organizing maps, adaptive resonance theory.

UNIT – II

Neural networks for control systems: Schemes of neuro-control, identification and control of dynamical systems , case studies(Inverted Pendulum, Articulation Control)

UNIT – III

Introduction to fuzzy logic: Fuzzy sets, fuzzy relations, fuzzy conditional statements, fuzzy rules, fuzzy learning algorithms.

UNIT – IV

Fuzzy logic for control systems : Fuzzy logic controllers, fuzzification interface, knowledge/rule base, decision making logic, defuzzification interface, design of fuzzy logic controllers, case studies(Inverted Pendulum, Articulation Control)

UNIT – V

Neuro-fuzzy and fuzzy-neural control systems: Adaptive fuzzy systems , optimizing the membership functions and the rule base of fuzzy logic controllers using neural networks, fuzzy transfer functions in neural networks.

Text Books

1. Kosko, B, Neural Networks and Fuzzy Systems : A Dynamical Approach to Machine Intelligence, Prentice Hall, New Delhi , 1991.
2. Wasserman P.D, Neural Computing Theory & Practice ,Van Nortland Reinhold,1997.
3. J.Ross,Fuzzy Logic with Engineering Applications, 1997 – ISBN-0-07-144711-X

References`

1. Jacek M. Zurada, 'Introduction to Artificial Neural Systems', Jaico Publication House,1995.

EI225 INSTRUMENTATION AND CONTROL IN PETROCHEMICAL INDUSTRIES

Credit : 4:0:0 **Marks: 40+60**

UNIT – I

Instrumentation and control in distillation columns: Distillation equipment, variables and degrees of freedom, measurement and control of column pressure, liquid distillate, vapour distillate and inserts, control of feed in reboiler and reflux, cascade and feed forward controls.

UNIT – II

Instrumentation and control in chemical reactors: Temperature and pressure control in batch reactors.

Instrumentation and control in dryers: Batch dryers and continuous dryers..

UNIT – III

Instrumentation and control in heat exchangers: Variables and degrees of freedom , liquid to liquid heat exchangers, steam heaters, condensers, reboilers and vaporisers, use of cascade and feed forward control

UNIT – IV

Instrumentation and control in evaporators: Types of evaporators, measurement and control of absolute pressure, density,conductivity, differential pressure and flow.

UNIT – V

Instrumentation and control in effluent and water treatment: Chemical oxidation, chemical reduction, neutralization, precipitation and biological control.

Text Books

1. Liptak B. G, Process Control , Third edition , Chilton Book Company, Pennsylvania, 1995. ISBN–0–7506–2254-7
2. Liptak B. G, Process Measurement and Analysis, Third edition , Chilton Book Company, Pennsylvania, 1995. ISBN-07506-2255-5

Reference

1. Considine D.M., 'Process / Industrial Instruments and Control Handbook', Fourth edition, McGraw Hill, Singapore, 1993. ISBN-0-07-012445-0

EI226 INSTRUMENTATION AND CONTROL IN PAPER INDUSTRIES

Credit : 4:0:0 **Marks: 40+60**

Unit I
Raw materials-pulping process – chemical recovery process – paper making process – converting.

Unit II
Measurements of basic weight – density – specific gravity – flow – level of liquids and solids – pressure – temperature – consistency – moisture – pH – oxidation – reduction potential – graphic displays and alarms

Unit III
Blow tank controls – digester liquor feedpump controls – brown stock wacher level control – stock chest level control – basic weight control – dry temperature control

Unit IV
Dissolving tank density control – white liquor classifier density control – white liquor flow control – condensate conductivity control

Unit V
Computer applications in pulping process control, liquid level control and input stock control

Text Book

1. Karunya Notes

EI227 INSTRUMENTATION IN IRON AND STEEL INDUSTRIES

Credit : 4:0:0 **Marks: 40+60**

UNIT – I
Flow diagram and description of the processes: Raw materials preparation, iron making, blast furnaces , stoves, raw steel making , basic oxygen furnace, electric furnace.

UNIT – II
Casting of steel: Primary rolling , cold rolling and finishing.

UNIT – III
Instrumentation: Measurement of level, pressure, density, temperature, flow weight, thickness and shape, graphic displays and alarms.

UNIT – IV
Control and systems: Blast furnace stove combustion control system, gas and water controls in BOF furnace . Sand casting old control.

UNIT – V

Computer applications: Model calculation and logging, rolling mill control, annealing process control

Computer (center utilities dispatch computer).

Text Books

1. Tupkary R.H, Introduction to Modern Iron Making , Khanna Publishers, New Delhi, 1986 - II Edition
2. Tupkary R.H., Introduction to Modern Steel Making, Khanna Publishers, New Delhi, 1989 – IV Edition.

Reference Books

1. Liptak B. G, Instrument Engineers Handbook, volume 2, Process Control, Third edition, CRC press, London, 1995
2. Considine D.M, Process / Industrial Instruments and Control Handbook, Fourth edition, McGraw Hill, Singapore, 1993 – ISBN-0-07-012445-0

EI228 INSTRUMENTATION FOR POLLUTION CONTROL

Credit : 4:0:0 **Marks: 40+60**

UNIT – I : Environmental Monitoring

Classification, ambient environmental monitoring –source monitoring –implant environment monitoring-personal monitoring.

UNIT – II : Air Pollution Monitoring

Air Pollutants- basics of monitoring technologies like conductimetry,coulemetry – pizeo eletric oscillations methods-paper tape method- optical method-air pollution monitoring instruments.

UNIT – III : Water Pollution Monitoring

Water pollutants –basic techniques –spectrometric methods- emission spectrograph- atomic absorption spectra photometry- water pollution monitoring instruments.

UNIT – IV : Noise pollution monitoring

Noise pollution and its measurement

UNIT – V : Industrial pollutants and its monitoring

Monitoring Instruments of industrial pollution.

Text Books

1. Soli J. Arceilala, "Waste Water Treatment for Pollution Control", Tata McGraw Hill, 1998, ISBN-0-07-463002-4
2. M.N.Rao, HVN Rao, "Air Pollution", Tata McGraw Hill, 2000,ISBN-0-07-457871-2

3. B.C. Punmia, Ashok Jain, “Waste Water Engineering”, Laxmi Publication, 1998, ISBN – 81-7008-091-6
4. V.P. Kuderia, “Noise Pollution & Its Control”, Pragari Prakasan, 2000, ISBN-81-7556-186-6.

Reference Book

1. Faith W.L., and Atkinson A.A., : “Air pollution”, 2nd edition Wiley Interscience Inc., New York, 1972.

EI229 ULTRASONIC INSTRUMENTATION

Credit : 4:0:0 **Marks: 40+60**

UNIT – I

Ultrasonic waves: Principles and propagation of various waves, characterization of ultrasonic transmission, reflection and transmission coefficients, intensity and attenuation of sound beam. Power level, medium parameters.

UNIT – II

Generation of ultrasonic waves: Magnetostrictive and piezoelectric effects, search unit types, construction and characteristics.

UNIT – III

Ultrasonic test methods: Pulse echo, transit time, resonance, direct contact and immersion type and ultrasonic methods of flaw detection.

UNIT – IV

Ultrasonic measurement: Ultrasonic method of measuring thickness, depth and flow, variables affecting ultrasonic testing in various applications.

UNIT – V

Ultrasonic applications: Ultrasonic applications in medical diagnosis and therapy, acoustical holography.

Text Book

1. Karunya Notes

EI230 TELEMETRY AND TELECONTROL

Credit : 4:0:0 **Marks: 40+60**

UNIT I : Telemetry Fundamentals Classification:

Fundamental concepts: significance, principle, functional blocks of telemetry and tele control system methods of telemetry- electrical, pneumatic; hydraulic and optical telemetry-state of the art-telemetry standards.

UNIT II : Landline Telemetry
Electrical telemetry'- current systems-voltage systems synchro systems-frequency systems-position and pulse systems-example of a landline telemetry system.

UNIT III : Radio Telemetry
Block diagram of a radio telemetry system transmitting and receiving techniques-AM,FM,PM multiplexing -transmitting and receiving techniques- digital coding methods advantages of PCM,PWM,PPM,FSK-Delta modulation coding and decoding equipment -example of a radio telemetry system.

UNIT IV : Optical Telemetry
Optical fibres for signal transmission -sources for fiber optic transmission - optical detectors-trends in fibre optic device development-example of an optical telemetry system.

UNIT V : Telecontrol Methods
Analog and digital techniques in tele control, tele control apparatus-remote adjustment. Guidance and regulation Tele control using information theory- example of a tele control system.

Text Book

1. Karunya Notes

EI231 AIRCRAFT INSTRUMENTATION

Credit : 4:0:0 **Marks: 40+60**

UNIT I: Introduction
Classification of aircraft ~instrumentation -instrument displays, panels, cock- pit layout.

UNIT-ll: Flight Instrumentation
Static & pitot pressure source -altimeter -airspeed indicator -machmeter -maximum safe speed indicator- accelerometer.

UNIT-III: Gyroscopic Instruments
Gyroscopic theory -directional gyro indicator artificial horizon -turn and slip indicator.

UNIT-IV: Aircraft Computer Systems
Terrestrial magnetism, aircraft magnetism, Direct reading magnetic components- Compass errors gyro magnetic compass.

UNIT- V : Power Plant Instruments
Fuel flow -Fuel quantity measurement, exhaust gas temperature measurement and pressure measurement.

Text Books

1. Pallett, E.B.J ., : " Aircraft Instruments -Principles and applications", Pitman and sons, 1981.

EI232 ROBOTICS AND AUTOMATION

Credit : 4:0:0 **Marks: 40+60**

UNIT-I

Robots introduction -Basic components.-Classification—Characteristics-Drives & Control systems –Actuators-Control loop

UNIT-II

Transducers & Sensors-Tactile sensors-Proximity & Range sensors-Image Processing & Analysis-Image Data reduction-Feature extraction-Object Recognition

UNIT-III

End effects – Types-Mechanical Grippers-Vacuum Cups-Magnetic Grippers-Robot/End effector Interface-Software for industrial robots positive stop PGM, PTP, CP

UNIT-IV

Robot motion analysis–Kinematics-Homogenous Transformations-Robot Dynamics Configuration of Robot controller

UNIT-V

Industrial Robots –welding painting-Assembly-Remote Controlled Robots for Nuclear, Thermal, Chemical plants-Industrial Automation-Typical EGS of automated industries.

Text Books

1. Oran Koren, "Robotics for Engineers", McGraw Hill, 1980. ISBN-0-07-100534-X
2. Mikell P. Groover etal, "Industrial Robots – Technology Programming & Applications" McGraw Hill Ltd., 1986. ISBN-0-07-100442-4

EI233 DIGITAL CONTROL LABORATORY

Credit : 0:0:2 **Marks: 50+50**

12 experiments will be notified by the HOD from time to time

EI314 PROCESS CONTROL

Credit : 3:1:0 **Marks: 40+60**

UNIT: I *-Introduction to Process Control*

Process dynamics- Elements of process control- Process variables- Degrees of freedom-Modeling of liquid process, gas process, flow process, thermal process, mixing process-Chemical reaction-Modeling

UNIT: II. -*Control Action and Controller Tuning*

Basic control action- Characteristic of ON-OFF, proportional floating control, integral and derivative models- Response of Controllers for different types of test inputs-selection of control mode for different process with control scheme-Optimum controller settings- Tuning of controllers by process reaction curve method- Continuous cycling method, damped oscillation method- Ziegler Nichol's tuning-Cohen Coon method -Pole placement method

UNIT: III -*Design of Controllers for Nonlinear Systems*

Design of PI, PID controller for integrator, dead time, time delay systems- Design of non-linear controller with input multiplicities

UNIT: IV -*Design of Controllers for Multivariable Systems*

Introduction to multivariable system-evolution of loop interaction –evolution of relative gains- single loop and overall stability- model equations for a binary distillation column- Transfer function matrix-Method of inequalities- Decoupling control- Centralized controller

UNIT: V -*Complex control techniques*

Feed forward control- Ratio control- Cascade control- Split range control- Averaging control- Inferential control-Model predictive control- Adaptive control- Internal model control- Dynamic matrix control-model -Generalized predictive control

Text Books

1. Harriot P, 'Process control', Tata McGraw Hill Publishing Co., New Delhi, 1995 ISBN 8170237963
2. M.Chidambaram, 'Applied Process Control', Allied Publishers, 1998 ISBN 8170237963

Reference Books

1. Norman A Anderson, Instrumentation for process measurement and control, CRC Press LLC, Florida, 1998 ISBN 0849398711
2. Marlin. T.E., Process Control, Second Edition McGraw Hill NewYork, 2000 ISBN 0070404917
3. D.P. Eckman, Automatic Process Control, Wiley Eastern Limited, New Delhi ISBN 0852262051
4. Sinskey, Process Control System, Forth Edition, McGraw Hill, Singapore, 1996 ISBN 0876645295
5. Curtis D. Johnson, Process Control Instrumentation Technology, Seventh Edition, Prentice Hall, New Delhi, 2000 ISBN 8120309871
6. Stepanopoulos, 'Chemical Process Control: An Introduction Theory and Practice', Prentice Hall, New Delhi 1999 ISBN 8120306651

EI315 BIOMEDICAL INSTRUMENTATION

Credit : 4:0:0 **Marks: 40+60**

UNIT: I -*Introduction to Physiological System*
Cell and its structure- Resting and Action Potential- Electrode theory- Equivalent circuits for electrodes – Types of electrodes- Biochemical electrodes- Design of low noise preamplifiers – Isolation Amplifier- Chopper Amplifiers - Electrical hazards and safety in hospital

UNIT: II - *Electro-physiological Measurements*
Physiology of heart- Electro Cardiograph (ECG) - Heart sound- Phonocardiograph (PCG)- Physiology of brain- Electro Encephalography (EEG)- Physiology of eye– Electro-Retinogram(ERG)- Electromyography (EMG)

UNIT: III. – *Heart- Lung monitoring Systems*
Measurement of Blood flow- Cardiac output- Measurement of Respiration- Lung volume- Measurement of Heart rate- Oxygen saturation of blood- Blood cell counters

UNIT: IV –*Bio Imaging*
X ray machine - Computer Tomography (CT)- Magnetic Resonance Imaging (MRI) system - - Ultrasonic imaging system – Computer in medicine

UNIT: V –*Therapeutic Instruments*
Defibrillator Principle- Defibrillator circuit- Demand pacemaker- Microprocessor based ventilator - Applications of laser medicine - Kidney machine - Centralized patent monitoring system

Text Books

1 Khandpur R.S., Hand book of Biomedical Instrumentation, Tata McGraw Hill, 2000 ISBN 0074517252
2 M. Arumugam, Biomedical Instrumentation, Anuradha Agencies, 2001 ISBN 818772112-X

Reference Books

1. Leslie Cromwell L, Biomedical Instrumentation and Measurements, Prentice Hall of India, 2000 ISBN 8120306538
2. John G. Webstar, Medical Instrumentation Application and Design, John Wiley & Sons, Inc. 1999, ISBN 997151270-X.
3 Joseph Carr, Introduction to Biomedical equipment Technology, Pearson Education Inc., 2001, IV edition ISBN-81-7808-327-2.

EI316 ADVANCED CONTROL SYSTEM

Credit : 3:1:0 **Marks: 40+60**

UNIT: I -*Modeling of Dynamic Systems*
Definition of System- Mathematical modeling- State space representation of system- Centrifugal Governor – Ground vehicle- Permanent Magnet stepper motor- Inverted Pendulum

UNIT: II –*Analysis of Mathematical models*
State space method- Phase plane- Isoclines- Numerical methods- Taylor Series- Euler's method- Predictor Corrector method- Runge Kutta method- Principle of Linearization of Differential Equation –Describing function method for nonlinear system

UNIT: III -*Linear System Analysis*
Reachability and controllability – Observability and constructability –Companion forms– Controller / Observer form – State feed-back control – State estimator – Full order and reduced order Estimator- Combined controller estimator compensator

UNIT: IV –*Stability of Linear System*
Definition of stability – Stability of linear system – Asymptotically Stable System- Lyapunov function- Hurwitz and Routh stability criteria

UNIT: V –*Stability of Nonlinear System*
Stability of Nonlinear system – Lyapunov stability theorems- Lyapunov function for nonlinear system- Stability analysis by describing function method

Text Books

1. Stanislaw Zak, Systems and Control, Oxford University Press, 2003 ISBN 0195150112
2. Gopal M., 'Digital Control and State Variable Methods', Tata McGraw Hill Pub., 2003. ISBN 0070483027

Reference Books

1. Godwin. C, Graebe.F, and Salgado., Control system design, Prentice Hall, New Jersey, 2001 ISBN 0139586539
2. William S. Levine, The Control hand book, IEEE and CRC Press, USA, 1996 ISBN 0849385709
3. Norman S. Nice, Control Systems Engineering, John Wiley and Sons, 2000 ISBN 0471366013
4. Ogata.K, Modern Control Engineering , Prentice-Hall Publication, 2001 ISBN 0130609072

EI317 DISTRIBUTED CONTROL SYSTEM, NETWORKS AND PROTOCOLS

Credit : 4:0:0 **Marks: 40+60**

UNIT: I -*Computer Networks*
Common bus topology- Star topology- Ring topology- Fully connected topology- Combined topologies-

UNIT: II –*Protocol and Architecture*
Serial data transmission standard – RS232, RS422, RS485 – CAN- HART- Field Bus

UNIT: III -*HART and Field Bus*
Introduction - Evolution of signal standard - HART Communication protocol – Communication modes - HART networks -Control system interface - HART commands – HART field controller implementation - HART and the OSI model – Field bus - Introduction - General field bus architecture - Basic requirements of field bus standard - Field bus topology - Interoperability - Interchangeability.

UNIT: IV -*Data Network Fundamentals*
Network hierarchy and switching - Open system interconnection model of OSI - Data link control protocol - BISYNC - SDLC - HDLC - Media Access protocol - Command/response - Token passing - CSMA/ CDMA, TCP/IP - Internetworking - Bridges - Routers - Gateways - Open system with bridge configuration - Open system with gateway configuration - Standard ETHERNET and ARCNET configuration – Special requirement for networks used for control.

UNIT: V -*Distributed Control Systems*
Evolution - Different architectures - Local control unit - Operator interface - Displays- Engineering interface-alarms and alarm management-DCS Case study- Study of anyone popular DCS available in market - Factors to be considered in selecting DCS - Case studies in DCS.

Text Books

1. A.S. Tanenbaum, Computer Networks, Third Edition, Prentice-Hall of India, 2001 ISBN 8130311655
2. Behrooz A F, Data Communication and Networking, 2nd Edition, Tata McGraw Hill, 2000 ISNB 0070435034

Reference Books

1. William A Shay, Understanding Data Communications and networks, Cole Publishing Company, A division of Thomson Learning, 2001 ISBN 053495054-X

EI318 SYSTEM IDENTIFICATION AND ADAPTIVE CONTROL

Credit : 4:0:0 **Marks: 40+60**

Unit: I -Modeling and Simulation of Processes
Impulse response - Frequency response - Step response methods - Signal modeling - Discretisation techniques- Runge-Kutta method -Z-transform method - Use of Simulation packages - Simulation of 1st order, 2nd order systems with and without dead time.

Unit: II -MIMO System Identification Techniques
Off line - On line methods - Recursive least squares - Modified recursive least squares techniques - Fixed memory - RLS algorithm - Maximum likelihood - Instrumental variable Stochastic approximation techniques.

Unit: II -Classification of Adaptive control
Introduction - Uses - Definitions - Auto tuning - Types of adaptive control.

Unit: IV -MRAS and STC
Approaches - The Gradient approach - Liapunov functions - Passivity theory - Control policies - pole placement control - Minimum variance control - Predictive control.

Unit: V -Issues in Adaptive control and Applications
Stability-Convergence-Robustness-Application of adaptive control.

Reference Books

1. Isermann R., Digital Control Systems, Vol. I and II, Narosa Publishing House, Reprint 1993.
2. Wellstead P.E. andZarrop M.B., Self tuning systems, John Wiley and Sons, 1991.

EI319 OPTIMAL CONTROL SYSTEMS

Credit : 4:0:0 **Marks: 40+60**

Unit: I –*Calculus of Variation*
Functions and Functional- Maxima and minima of function- Variation of functional- Extremal of functional- Euler Lagrange equation

Unit: II –*Optimal Control Introduction*
Statement of optimal control problem -performance indices- Linear Quadratic Regulator (LQR)- State Regulator- output regulator- Control configuration

Unit: III –*LQR Design*
Algebraic Riccati Equation (ARE)- Solving ARE using the Eigen vector method- Discrete Algebraic Riccati Equation- Pontryagin‘s minimum principle

Unit: IV -*Dynamic Programming Numerical techniques for optimal control*
Principle of optimality - computational procedure for solving optimal control problem - Dynamic programming application to discrete and continuous system- Numerical techniques for optimal control- Simplex method - Hill climbing - gradient - penalty function methods

Unit: V –Matlab Examples for optimal control problems
Infinite time Linear Optimal Regulator design- Optimum control of tracking system- Output weighed linear control- Terminal time weighing problem

Reference Books

1. Stanislaw Zak, Systems and Control, Oxford University Press, 2003 ISBN 0195150112
2. Rao, S.S. Optimization theory and applications, Wiley Eastern, New Delhi, 1992.
3. Gopal, M. Modern control System Theory, Wiley Eastern Limited, New Delhi, 1992. ISBN-81-224-0503-7
4. Ogata, K. Modern Control Engineering, Prentice Hall of India, New Delhi, 1992. ISBN-0-87692-147

EI320 ROBOTICS AND AUTOMATION

Credit : 4:0:0 **Marks: 40+60**

Unit: I -Basic concepts
Definition and origin of robotics -Different types of robots - Various generations of robots - Degrees of freedom

Unit: II -Power sources and sensors
Hydraulic, pneumatic and electric drives - Determination of HP of motor and gearing ratio - Variable speed arrangement - Path determination - machine vision - Ranging, laser, acoustic, magnetic, fibre-optic and tactile sensors.

Unit: III -Manipulators, actuators and grippers
Construction of manipulators -Manipulator dynamics, force control and stability - Electronic and pneumatic manipulator control circuits - End effectors - Various type of grippers -Design considerations.

Unit: IV -Kinematics, AI & Expert systems
Homogeneous Coordinator - Solution of inverse kinematics problem – Multiple solutions, Jacobian's work envelope - Hill climbing techniques - Scope of AI, knowledge representation - robot programming languages.

Unit: V -Case Studies
Robots in Automotive industries and manufacturing industries.

Reference Books

1. Groover M.P., Weiss M, Nagel R.N, Odrey N.G, 'Industrial Robotics - Technology, Programming and Applications’, McGraw Hill, 1986. ISBN-0-07-100442-4

2. John J. Craig, 'Introduction to Robotics, Mechanics and Control', Addison-Wesley Publishing Co, 1999, I edition ISBN-020-152539-9.
3. McDonald A.C, 'Robot Technology -Theory, Design and Applications', Prentice Hall, New Jersey, 1986.
4. Asada H. & Slotine JJ.E., 'Robot analysis & control', John Wiley & Sons, New York, 1986.
5. Fairhust M.C., 'Computer Vision for Robotic systems - An introduction', Prentice Hall, London, 1988.
6. Koren Y., 'Robotics for Engineers', McGraw Hill Book Co., USA, 1985. ISBN-0-07-100534-X
7. Klafter, 'Robotics Engineering', Prentice Hall, 1994.
8. Nikku, 'Introduction to Robotics', TBH Publishers, 2000, ISBN – 81203 23793
9. Mithal, 'Robotics and Control', TBH Publishers, 2003, ISBN – 0070482934

EI321 DIGITAL IMAGE PROCESSING TECHNIQUES

Credit : 4:0:0 **Marks: 40+60**

UNIT: I –Digital Image Fundamentals
Fundamental steps in Digital Image processing-Components of an Image Processing Systems-Light and the Electromagnetic Spectrum-Examples of fields that use Digital Image Processing- Visual Perception-Image sensing and Acquisition-Image sampling and Quantization-Imaging Geometry- Basic relationships between pixels.

UNIT: II – Image Enhancement in Spatial and Frequency Domain
Basic Gray Level Transformations-Histogram Processing-Arithmetic and Logic Operations-Smoothing Spatial filters- Sharpening Spatial filters-Introduction to Frequency and the Frequency Domain-Smoothing Frequency Domain Filters-Sharpening Frequency filters

UNIT: III –Image Morphology and Segmentation
Dilation and Erosion-Opening and Closing-Hit-or-Miss Transformation-Basic Morphological Algorithms-Detection of Discontinuities-Edge linking and Boundary detection-Thresholding-Region based Segmentation-Use of Motion in Segmentation.

UNIT: IV –Image Representation and Description
Representation Approaches-Boundary Descriptors: Shape Numbers, Fourier Descriptors, Statistical Moments-Regional Descriptors: Topological Descriptors-Texture: Statistical, Structural and Spectral Approaches-Relational Descriptors

UNIT: V –Object Recognition
Patterns and Pattern Classes-Matching-Recognition based on Decision-Theoretic Methods: Optimum Statistical Classifiers-Structural Methods: Matching Shape Numbers, String Matching, Syntactic Recognition of Strings, Syntactic Recognition of Trees.

Reference Books

1. Rafael C. Gonzalez, Richard E.Woods "Digital Image Processing" Second Edition, Pearson Education Asia 2002. ISBN-81-7808-087-7
2. Pratt, W.K "Digital Image Processing, 3rd ed., John Wiley & Sons, New York, 2002. ISBN-9-814-12620-9

EI322 VIRTUAL INSTRUMENTATION LABORATORY

Credit : 0:0:2 **Marks: 50+50**

12 experiments will be notified by HOD from time to time

ADDITIONAL SUBJECTS

Code No.	Subject Name	Credit
EI234	Measurement Systems	3:1:0
EI235	Signal Conditioning Circuits	3:1:0
EI236	Logic & Distributed control systems	40:0
EI237	Microprocessors and Microcontrollers	4:0:0
EI238	Electronic Circuits	3:1:0
EI239	Analytical Instrumentation	4:0:0
EI240	Networks & Protocols for Instrumentation & Control	4:0:0
EI241	Data structures & Algorithms	4:0:0
EI242	Optical Instrumentation	4:0:0
EI243	Signals & Systems laboratory	0:0:2
EI323	Distributed Control System and Networks	4:0:0
EI324	Advanced Digital Process Control	3:1:0
EI325	Transducer Engineering	4:0:0
EI326	Artificial Intelligence and AI Programming	3:1:0

EI234 MEASUREMENT SYSTEMS

Credit: 3: 1: 0 **Marks: 40 + 60**

Unit- I : Measurement of Voltage, Current, Power and Energy
Principles of operation of permanent magnet moving coil, moving iron, dynamometer - calibration of voltmeters and ammeters - Power measurement by three ammeter and three voltmeter method - induction type wattmeter - energy meter - calibration of energy meter & wattmeter.

Unit-II : Measurement of RLC
Whetstone, Kelvin, Wien, Hay, Maxwell, Anderson and Schering bridges - Q meter - Potential transformer & current transformers - KVA meters - Power factor meter - Megger.

Unit-III : Electronic Analog Meter
DC and AC voltmeters - differential voltmeters - AC current measurements - multimeters - vector impedance meter - powermeter - Review of signal sources -signal generator - wave analyzer - harmonic distortion analyzer - spectrum analyzer correlator.

Unit -IV : Digital Measurement
Digital displacement transducers, increment & absolute - Digital method of measuring displacement & velocity - Digital alpha numeric display - digital methods of measurement of frequency - phase difference.

Unit-V : CRO & Recorders

General purpose oscilloscope - CRT screen characteristics - vertical & horizontal amplifiers - delay line - time based and sweep trigger circuits synchronisation - sampling oscilloscope - digital storage oscilloscope - typical measurements using CRO - moving coil recorders - X-Y plotters - U-V recorders - digital recording.

Text Book

1. Sawhney, K.A., "Course in Electrical & Electronics Measurement & Instrumentation", Dhanpat Rai & Sons, 1982.
2. Kalsi, G.C., "Electronic Instrumentation " TMH, 1998.
3. Bouwens., A.J., " Digital Instrumentation", McGraw Hill, 1986.
4. Ernest O. Doeblin "Measurement Systems – Application & Design" McGraw – Hill Publishing company, 1990.

Reference Books

1. Golding, E.W., and Widdis, F.C.,: " Electrical Measurements and Measuring Instruments", Pitman, 1963.
2. Cidwell, W., : " Electrical Instruments and Measurements", TMH, 1969.
3. Woolvert, G.A., " Transducers is digital systems", Peter peregrinvs Ltd., England, 1988.

EI235 SIGNAL CONDITIONING CIRCUITS

Credit: 3: 1: 0 **Marks: 40 + 60**

Unit-I : Operational Amplifier:
Introduction Ideal OP AMP, op-amp internal circuit,IC741 opamp,DC characteristics,AC characteristics.

Unit- II : Operational amplifier applications
Scale changer, inverter and non -inverter, Instrumentation Amplifier, Adder, Subtractor, multiplier and divider, integrator, differentiator, comparators-applications, logarithmic converter, I to V converter , V to I converter - precision rectifiers- clipper and clamper - sample and hold circuit,555 Timers- Monostable & Astable operation.

UNIT - IIIAmplifiers and Filters:
Buffer Amplifier, Differential Amplifier - use of operational amplifier with capacitive displacement transducers- charge amplifiers - Instrumentation amplifiers - Three amplifiers configuration - Isolation amplifiers - Filters - Passive and Active filters - Low pass, High pass, Band pass and Band reject filter - First order second order transformations - state variable filter - switched capacitor filters.

UNIT – IV Voltage Regulators and Multipliers:
Series OP- AMP regulator - IC voltage regulators - 723 general-purpose regulator - Multiplying DC voltage - frequency doubling - phase angle detection - AM modulation/demodulation SSB modulation/demodulation - frequency shifting.

UNIT –V :PLL:e

Basic principles -phase detector and comparator: analog and digital - voltage controlled oscillator - Low pass filter - monolithic PLL - applications of PLL: frequency multiplication - division - frequency translation - AM detection - FM detection -FSK demodulation.

Text Books:

1. Op amps & Linear Integrated Circuits- Ramkant Gaykwad,PHI III Edition,ISBN-81-203-0807-7.
2. Roy Choudhury and Shail Jain., " Linear Integrated Circuits", Wiley Eastern Ltd., 1991

Reference Books:

1. Denton J. Dailey., " Operational Amplifiers and Linear Integrated Circuit", McGraw Hill, 1989.
2. Coughlin and Driscol., " Operational Amplifiers and Linear Integrated Circuit", Prentice Hall of India Pvt., Ltd., 1992.
3. William David Cooper and Albert D. Helfrick.,: " Electronics Instrumentation and Measurement Techniques", Prentice Hall of India Pvt., Ltd., 1986.

EI236 LOGIC AND DISTRIBUTED CONTROL SYSTEMS

Credit: 3: 1: 0 **Marks: 40 + 60**

Unit-I : Review of Computers in Process Control
Data loggers: Data acquisition systems (DAS): alarms, computer control hierarchy levels. Direct Digital control (DDC). Supervisory digital control (SCADA). Characteristics of digital data. Controller software. Linearization. Digital Controller modes, error, proportional, derivative and composite controller modes.

Unit-II : Programmable Logic Controller(PLC) Basics
Definition- overview of PLC systems - Input/ Output modules - Power supplies –ISO slots. General PLC programming procedures - programming on-off outputs. Auxiliary commands and functions - creating ladder diagrams from process control descriptions. PLC basic functions - register basics - timer functions - counter functions.

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

Unit-IV : Introduction to (DCS)
Evolution of DCS - building blocks - detailed descriptions and functions of field control units - operator stations - data highways - redundancy concepts.

Unit-V: Implementation of DCS
DCS - supervisory computer tasks and configuration - DCS- system integration with PLC and computers. Communication in DCS. Case studies in DCS.

Text Books:

1. John Webb, W, Ronald Reis, A.,: " Programmable logic controllers principles and applications", 3/e, Prentice hall Inc., New Jersey, 1995.
2. Krishna Kant.,: " Computer based industrial control", Prentice Hall India. 1997.

Reference Books:

1. 1. Lukcas , M.P.,: " Distributed control systems", Van Nostrand Reinhold Co., New York ,1986.
2. Moore., : " Digital control devices" , ISA Press, 1986.
3. Hughes, T, " Programmable logic controllers", ISA Press 1994.
4. Mckloni, D.T.,: "Real time control networks" , ISA Press 1994.
5. Deshpande, P.B, and Ash ,R.H.,: " Elements of process control applications" , ISA Press 1995.

EI237 MICROPROCESSORS AND MICRO CONTROLLERS

Credit: 4: 0: 0 **Marks: 40 + 60**

Unit – I
Architecture of 8085 Microprocessor : Functional Block Diagram – Registers,ALU,Bus systems – Timing and control signals Machine cycles and timing diagrams.

Unit – II
PROGRAMMING OF 8085: Instruction formats – Addressing modes – Instruction set – Need for assembly language programmes.

Unit – III
I/O INTERFACING: Memory mapped I/O scheme – I/O mapped I/O scheme – Input and Output cycles _ Simple I/O ports – Programmable peripheral interface(8255). Data transfer schemes – Interfacing simple keyboards and LED displays.

Unit – IV
INTERRUPTS AND DMA: Interrupt feature – Need for Interrupts – Characteristics of Interrupts – Interrupt structure – Methods of servicing Interrupts – Development of Interrupt service subroutines – Multiple Interrupt requests and their handling – Need for direct memory access – Devices for Handling DMA – Typical DMA Controller features.
APPLICATIONS: Multiplexed seven segment LED display systems – Waveform generators – Stepper motor control – Measurement of frequency, phase angle and power factor – Interfacing ADC0801 A/D Converter –DAC 0800 D/As Converters.

Unit – V

INTEL 8051 MICROCONTROLLER: Architecture of 8051 – Memory Organization – Addressing modes – Instruction set – Boolean processing – Simple programmes.

8051 PERIPHERAL FUNCTIONS : 8051 interrupt structures – Timer and serial functions – Parallel port features : Modes of operations – Power control, features – Interfacing of 8051 – Typical applications – MCS 51 family features 8031/8051/8751

Text Books

1. Ramesh S.Goankar, "Microprocessor Architecture : programming and Applications with the 8085 ",fourth edition,Penram International,2000.
2. Singh,I.P.,"Microcontrollers and Their Applications ", IMPACT Learning Material Series ,IIT,New Delhi,1997.
3. The 8051 Microcontroller Architecture, Programming & Applications II Edition Kenneth J Ayala PRI ISBN 81-900828-4-1

References:

1. Douglas, V.Hall., "Microprocessors and Interfacing Programming and Hardware",2nd Edition,McGraw Hill Inc., 1992.
2. Microcontroller Hand Book,INTEL,1984.

EI238 ELECTRONIC CIRCUITS

Credit: 3: 1: 0 **Marks: 40 + 60**

Unit – I : Power Supplies

Rectifiers – Half Wave and Full Wave Rectifiers - Average and RMS Value – Ripple Factor – Regulation –Rectification efficiency – Transformer Utility Factor – Filters _ Inductor,Capacitor, L Type,PI Type,Ripple factor and regulation- Need for voltage regulator – Series and Shunt regulators – Comparison – Current limiting and protection circuits - Switched mode power supplies.

Unit – II : Wave Shaping

Response of High Pass and Low Pass RC circuit for sinusoidal,step,pulse,square,ramp and exponential inputs – Linear Wave Shaping – Integrator,Differntiator,Applications – Non-linear wave Shaping – Clipping and clamping circuits,calmping circuit theories, Applications, Attenuator – Introduction to pulse transformers

Unit – III : Amplifier

BJT and FET amplifiers – Cascaded BJT amplifiers – RC coupled amplifier- Analysis at low, medium and high frequencies – BIFET amplifiers – DC amplifiers – Problems in DC amplifiers - Differential and Common mode gain – CMRR – Cascade and Darlington Amplifiers –Chopper Amplifiers.

Unit – IV : Power Amplifiers and Feed Back Amplifiers

Power Amplifiers – Classification – Class A/B/C – Single ended and Push ended – Configuration – Power Dissipation and output power- Conversion efficiencies-

Complementary symmetry power amplifiers- Class AB operation –Power FET(NMOS)- Basic concepts of feedback amplifiers – Effect of negative feedback on input, output resistances, gain, stability, distortion and bandwidth – Voltage and current feedback circuits

Unit – V : Oscillators
Barkhausen criteria – RC and LC oscillators – Frequency stability of oscillators – Crystal oscillators – Non-sinusoidal oscillators – Review of switching Characteristics of Transistor – Multivibrators- Bistable, Monoslable, Astable and Schmitt trigger.

Text Books:

1. .Jacob Millman and Arvind Grabel, 'Microelectronics', 2nd edition, Mc Graw hill international edition , 1997.
2. Jacob Millman and Halkias C.,'Integrated Electronics', Mc Graw hill, 5th reprint, 1993.

References:

1. David A Bell, 'Electronic Devices and Circuits', Prentice hall of India, New Delhi, 1998
2. Thomas Floyd, "Electronic Devices", Prentice Hall of India, 2003
3. Boylestad L. Robert and Nashelsky Louis, 'Electronic Devices and Circuits', Prentice hall of India, New Delhi, 1997

EI239 ANALYTICAL INSTRUMENTATION

Credit: 4: 0: 0 **Marks: 40 + 60**

Unit I
Basic principles of spectroscopy – emission and absorption of radiation – Introduction – UV – Visible Spectrometry – radiation sources – wave length selection – detectors.

Unit II
Molecular Spectra – electronic, Vibrational, rotational energies IR-absorption. Spectroscopy – single, double beam spectrophotometers – sample handling techniques.

Unit – III
Microwave spectroscopy – NMR,ESR spectroscopy basic principles – Instrumentation Techniques and applications.

Unit – IV
Principles of X – ray fluorescence Spectrometry detection of X-rays and nuclear radiation ionization chamber – GM counter, scintillation Counter. Scanning electron microscope – Instrumentation.

Unit – V
Electrochemical methods: Electrical conductivity of liquids – determination of pH – Principles of gas and liquid chromatography – Instrumentation and analysis.

Text Books

1. Willard M. Instrumental method of Analysis.
2. Skoog. and. west., “Principles of Instruments analysis.”
3. Arumugam M., “Biomedical Instrumentation”, Anuradha Agencies, 2003
4. Cromwell L., “Biomedical Instrumentation and Measurements”, Prentice Hall of India, 2000

EI240 NETWORKS & PROTOCOLS FOR INSTRUMENTATION & CONTROL

Credit: 4: 0: 0 **Marks: 40 + 60**

Unit – I: Introduction and Basic principles
Protocols, physical standards,modern instrumentation,Bits,Bytes and characters, Communication principles, Communication modes. Synchronous and Asynchronous systems, Transmission Characteristics Data Coding, UART.

Unit – II: Serial Communication Standards :
Standards organizations , Serial data communications interface standards, Balanced and unbalanced transmission lines, RS232,422,,423,449,485 interface standard ,Troubleshooting, The 20mA current loop, Serial interface converters ,Interface to printers,IEEE 488,USB.

Unit – III: Introduction to Protocols
Flow control Protocols ,BSC Protocols,HDLC,SDLC,Data communication for Instrumentation and Control, Individual OSI layers,OSI Analogy-example

Unit – IV: Industrial Protocols
Introduction, ASCII based protocols,Modbus Protocols,Allen Bradley Protocol,HART,field bus.

Unit – V: Local Area Networks:
Circuit and packet switching, Network Topologies,LAN Standards,Ethernet,MAC,Token bus,Internet work connections,NOS,Network Architecture and Protocols.

Text Book.

1. Practical Data Communications for Instrumentation and Control by John Park,Steve Mackay,Edwin Wright. Elseiver Publications. I Edition ISBN 0750657979

Reference Books:

1. Stallings W. “High speed Networks TCP/IP and ATM Design Principles “ PHI , 1998.
2. Behrouz A. Forouzan “ Data Communication and Networking” II Edition TMH, 2000.

EI241 DATA STRUCTURES AND ALGORITHMS

Credit: 4: 0: 0 **Marks: 40 + 60**

Unit I: Introduction

Simple data structures – Data structure operations – Algorithms - Complexity of algorithms

Unit II: Linear Data Structures

Stacks – Array implementation of stacks – Conversion of infix expressions to polish notation – Parenthesis checking – Queues – Array implementation – Dequeues – Priority Queues – Linked list – Operation on linear list - Link list implementation of stacks and queues – Circular list – Doubly linked list – List with header node – Applications – Dynamic Memory Management – Garbage collection – String Manipulation.

Unit – III

Trees – Definition – Binary Trees – Operations on Binary trees – Storage representations – Application of trees – Manipulation of Arithmetic expressions – Huffman's Algorithm.
SORTING : Bubble sort,Quick sort – Binary tree sorts,Heap sort,Insertion sort and Radix sort.

Unit – IV : Searching

Linear search – Binary search – Search Trees – B-Trees – Tries structure – Hash table methods – Collison resolution techniques.

Unit – V : File Structures

Definitions and Concepts – File Orgaization – Sequential,Random,linked organization – Inverted files – Virtual memory – VSAN files –Multi Key Access – Multi list organization.

Text Books

1. Yedidyah Langsam, Mohse J.Augustin And Aaron M.Tenanbaum,"Data structures using C and C++", Prentice hall ,1997.
2. Timothy A Bud, " Classic Data structures in C++" Addition Wesley , 1998.

Reference

1. Tremply and Sorenson . , " Introduction to Data Structures with Applications " Mc RaHil 1988
2. Mark Allen weiss , " Data Structures and problem solving using JAVA ' Addition Wesley 1988.

EI242 OPTICAL INSTRUMENTATION

Credit: 4: 0: 0 **Marks: 40 + 60**

Unit I Introduction to Fiber optics

Total internal reflection – refractive index- Numerical Aperture Acceptance angle. – Fiber – Different types of Fiber – Propagation of light through different fibers –Types of losses – absorption losses – Scattering losses – dispersion

Unit II Fiber optics Instrumentation and application

Fiber optics Instrumentation system – optical sources – LED , LD – Optical detector – PIN, APD, photo diode , photo transistor - Fiber optics sensors – Measurement of pressure , Temperature , Current , Voltage , Liquid Level , Strain

Unit III Laser Fundamentals:

Basic properties of Lasers- Threshold condition – Laser rate equation –three level systems – types of Lasers – Gas Lasers- Solid Laser – Semiconductor Lasers – Liquid Laser

Unit IV Industrial Apllication of Lasers:

Laser for measurement of distance, Length , Velocity, acceleration, current and voltage – material processing – Laser Heating , welding , Melting and trimming of materials

Unit V Holography and Medical Applications

Holography – Basic principles – Methods – Recording and reconstruction – Applications – Non Destructive testing _ Medical Application of Laser – Laser instrumentation For Surgery

Text Books :

1. John & Harry ,” Industrial lasers and their applications “, McGraw Hill , 1974
2. Senior J M , “ Optical Fiber Communication principles and practice “, Prentice Hall 1985

Reference Books:

1. John F Read , “ Industrial applications of Lasers, Academic press, 1978
2. Monte Ross, Laser applications, McGraw Hill, 1968
3. Keiser G, Optical Fiber Communication, McGraw Hill, 1991
4. Jasprit Singh , Semiconductor opto electronics , McGraw Hill, 1995
5. Ghatak A.K and Thiagarajar K, Optical electronics foundation book ,TMH, New Delhi,1991

EI243 SIGNALS & SYSTEMS LABORATORY

Credit: 0: 0:2 **Marks: 50 + 50**

12 experiments will be notified by the HOD from time to time

EI323 DISTRIBUTED CONTROL SYSTEM AND NETWORKS

Credit: 4:0:0 **Marks: 40+60**

UNIT: I –*Introduction to Computer Networks*

Uses of Computer networks – Network hardware – Network software – Example networks – Guided transmission media – Public switched telephone network.

UNIT: II – *The Data Link Layer*

Data link layer design issues – Error detection and Correction – Elementary data link protocols- Open system interconnection model of OSI -Sliding window protocols- Example data link protocols

UNIT: I11 -*Data Network Fundamentals*
Network hierarchy and switching - - Data link control protocol - BISYNC - SDLC - HDLC - Media Access protocol - Command/response - Token passing - CSMA/ CDMA, TCP/IP-Internetworking- Bridges - Routers - Gateways - Open system with bridge configuration - Open system with gateway configuration - Standard ETHERNET and ARCNET configuration – Special requirement for networks used for control.

UNIT: IV – *Hart and Field Bus*
Introduction to HART and smart instrumentation-HART – Physical layer- data link layer-application layer- Typical specification for a rosemount transmitter- Open industrial Field bus and DeviceNet Systems

UNIT: V -*Distributed Control Systems*
Evolution - Different architectures - Local control unit - Operator interface - Displays-Engineering interface-alarms and alarm management-DCS Case study- Study of anyone popular DCS available in market - Factors to be considered in selecting DCS - Case studies in DCS.

Reference Books

1. A.S. Tanenbaum, Computer Networks, Third Edition, Prentice-Hall of India, 2001 ISBN 8130311655
2. Binder Z and Perret R, Components and Instruments for Distributed Control System, Franklin Book Co., 1983 ISBN 0080299911
3. John Park, Practical Data Communications for Instrumentation Ana Control, Elsevier Publications. 2003.
4. William A Shay, Understanding Data Communications and networks, Cole Publishing Company, A division of Thomson Learning, 2001 ISBN 053495054-X

EI324 ADVANCED DIGITAL PROCESS CONTROL

Credit: 3:1:0 **Marks: 40+60**

Unit: I -Introduction to Computer Process Control

Review of sample theory-Response of sample data system to step and ramp input- steady state error-Z domain equipment- Linear transformation- Pulse transfer function-Modified Z-transform- Sample data model for continuous system bilinear transformation- Jury's Stability test

Unit: II -Design of Digital Controller

Digital PID –Deadbeat- Dahlin's algorithms-Kalman's algorithms-Implementation of control algorithm using microprocessor- Position and Velocity forms-Dead time compensation and smith predictor algorithm

Unit: III -Programmable Logic Controller

Introduction- Overview of PLC systems- I/O Modules- Power supplies General PLC programming procedures-Programming ON-OFF outputs- Auxiliary commands and functions- Creating ladder diagrams from process control descriptions- PLC basic functions-Register basics-Timer and counter functions

Unit: IV -PLC Intermediate Functions

Arithmetic functions- Comparison function-SKIP and MCR function-Data move system-PLC advanced intermediate function- Utilizing digital bits- Sequencer functions- Matrix functions- PLC advanced function- Alternate programming language- Analog PLC operation- Networking of PLC- PLC installation- Design of interlocks and alarms using PLC- Three way traffic light problem- Annunciator problem-Trouble shooting and maintenance

Unit: V -Applications

Implementation of microprocessor based position and temperature control systems-Operational features of stepping motor- Drive circuits- Interfacing of stepper motor to computer- Interfacing of computer with temperature flow, level process

Reference Books

1 Despande P.B. and Ash R.H., Computer Process Control, ISA Publication, USA, 1988 ISBN 155617005X
2 Houpis C.H, Lamont G.B., Digital Control Systems - Theory, Hardware, Software, McGraw Hill Book Co., 1991, ISBN 0070305005
3. Kuo.B, Digital Control Systems, Oxford University Press, 1991 ISBN 0030128846
4. HughesT.A., Programmable Logic Controllers, ISA Press, 2000 ISBN 1556177291

EI325 TRANSDUCER ENGINEERING

Credit : 4:0:0 **Marks:40+60**

Unit I : Generalized Characteristics Of Transducers

Introduction-static characteristics-dynamic characteristics-frequency response of first order transducer- frequency response of second order transducer-higher order transducer-procedure to determine the constants and transfer function of a system

Unit II : Resistance and Inductance Transducer

Basic principle-potentiometer-resistance strain gauge-measurement of torque-stress measurement on rotating members-semi conductor strain gauges-contact pressure-humidity measurement-light.

Basic principle-linear variable differential transformer-LVDT equations-RVDT-application of LVDT-LVDT pressure transducer-synchros- synchros as position transducer-induction potentiometer-variable reluctance accelerometer- microsyn

Unit III : Capacitance and Piezoelectric Transducers

Basic principle-capacitance displacement transducer- equibar- differential pressure transducer-feedback type capacitance proximity pickup-condenser microphone-pulse width modulating circuit.

Introduction-material for piezoelectric transducer-equivalent circuit of a piezoelectric crystal-piezoelectric coefficients- modes of deformation-general form of piezoelectric transducers-general form of piezoelectric transducers-environmental effects

Unit IV : Magnetic sensors

Introduction- sensors and the principles-magneto resistive sensors-hall effect and sensor-inductance and eddy current sensors-angular movement transducer-electromagnetic flow meter-switching magnetic sensor-SQUID sensor.

Unit V : Smart sensor and recent trends in sensor technologies

Introduction- primary sensor- excitation- amplification- filters- converters-compensation-data communication- standards for smart sensor interface- film sensors-thick film and thin film sensors- MEMS-micro machining- nano- sensors

Reference Books

1. Doebelin, E.O., 'Measurement system', McGraw Hill, fourth edition,Singapore,1990
2. Dr.S.Renganathan, 'Transducer Engineering', Allied publishers limited,1999
3. Partranabis.D.,'Sensors and Transducers',PHI, 2003 ,ISBN-81-203-2198-7

EI326 ARTIFICIAL INTELLIGENCE AND AI PROGRAMMING

Credit : 3:1:0 **Marks:40+60**

Unit I

Fundamentals of AI techniques in a practical context. General introduction to artificial intelligence, the roots, goals and main sub-fields of AI, its techniques. Overview of key underlying ideas, knowledge representation, rule based systems, search, and learning.

Unit II

Demonstration of the need for different approaches for different problems. Study of further specific areas of artificial intelligence. Application of simple search algorithms (depth/breadth-first, heuristic functions, hillclimbing, etc.), processes involved in rule-based Expert Systems and in building such systems.

Unit III

Importance of learning in intelligent systems, and its implementation. Study of different types of AI systems, their differences, common techniques, and limitations. Biological Intelligence and Neural Networks, Building Intelligent Agents, Interacting Agent Based Systems

Unit IV

Introduction to general procedural and functional programming techniques as well as basic AI programming styles (Poplog, XVed, Pop-11 Data types, comments, variables, printing, assignments, arithmetic operators Stack and stack errors, procedures, built-in procedures List manipulation, pattern matching Conditionals, iteration Advanced list manipulation and pattern matching techniques, Recursion

Unit V

More advanced programming techniques involving . Knowledge Representation, databases and the implementation of search strategies, Networks and Frames, Natural Language Processing, grammar and parsing. Planning Expert Systems, planning and rule-based reasoning, Uncertainty, Machine Learning

Reference Books

1. S Russell & P Norvig, "Artificial Intelligence: A Modern Approach" (2nd edn), Prentice Hall, 2003
2. E Rich & K Knight, "Artificial Intelligence", (2nd edn), McGraw Hill, 1991
3. N J Nilsson, "Artificial Intelligence: A New Synthesis", Morgan Kaufmann, 1998
4. Online tutorial material, supporting program libraries
5. Dan W. Patterson, "AI & Expert Systems", Eastern, Economy Edition, 2000

ADDITIONAL SUBJECTS

Subject Code	Subject Name	Credit
EI244	Industrial Instrumentation	4:0:0
EI245	Instrumentation and Control Systems	3:0:0
EI246	Process Dynamics and Control	4:0:0
EI247	Sensors and Transducers	3:1:0
EI248	Communication Engineering	4:0:0
EI249	Instrumentation and Process Control	4:0:0
EI327	Transducer Engineering	4:0:0
EI328	Robotics and Automation	4:0:0
EI329	Advanced Micro Controllers	4:0:0
EI330	Advanced Digital Signal Processor	3:1:0
EI331	Modeling of Physiological Systems	4:0:0
EI332	Medical diagnostic and Therapeutic Laboratory	0:0:2
EI333	Communication Theory and Telemetry	4:0:0
EI334	Digital Design Lab	0:0:2
EI335	Bio-Materials	4:0:0
EI336	Computer aided Instrumentation	4:0:0
EI337	Medical Instrumentation	4:0:0
EI338	Anatomy and Physiology	4:0:0
EI339	Data Communication, Networks and Protocols	4:0:0

EI244 INDUSTRIAL INSTRUMENTATION

Credit: 4: 0: 0

Marks: 40 + 60

Unit I : Flow Measurements

Introduction - definitions and units- classification of flowmeters - pitot tubes, orifice meters, venturi tubes, flow tubes, flow nozzles, positive displacement flowmeters, variable area flowmeters.

Unit II : Anemometers And Flow Meters

Mechanical anemometers, hot wire / hot film anemometer, Laser Doppler anemometer (LDA), electromagnetic flowmeters, turbine and other rotary element flowmeters, ultrasonic flowmeters, Doppler, cross correlation flowmeters, Vortex flowmeters. Measurement of mass flow rate: Radiation, angular momentum, impeller turbine, constant torque hysteresis clutch, twin turbine, coriolis, gyroscopic and heat transfer type mass flow meters.

Unit III : Flowmeters And Level Measurements

Target flowmeters: V-cone flowmeters, purge flow regulators, flow switches, flowmeter calibration concepts- flowmeter selection and application. Level measurement: Introduction, float level devices, displaced level detectors, rotating paddle switches, diaphragm and differential pressure detectors.: Resistance, capacitance and RF probes: radiation, conductivity, field effect, thermal ,ultrasonic, microwave, radar and vibrating type level sensors - Level sensor selection and application.

Unit IV : Non-Destructive Testing (NDT)

Introduction: Various methods for NDT - advanced NDT techniques - Transmitters: Introduction, terminology, features of smart and intelligent transmitters, Smart and Intelligent temperature, pressure and differential pressure transmitters. Smart and intelligent flowmeters. Other smart and intelligent measurement systems. Integration of intelligent transmitters into knowledge based process management systems.

Unit V : Virtual Instrumentation And EMC

Virtual instrumentation: Definition, parts of the system, windows in data acquisition, personal computers for DAS and instrument control, instrument drivers, EMC: Introduction, interface coupling mechanism, basics of circuit layout and grounding - interface, filtering and shielding. Electrical and intrinsic safety- enclosures. NEMA types: personnel safety, Explosion hazards and intrinsic safety.

Text Books

1. Doebelin, E.O.,: " Measurement Systems Application and Design" , fourth edition McGraw Hill International,1978.
2. Noltingk, B.E.,: "Instrumentation reference book", II edition Butterworth Heinemann,1996.
3. Patranabis, D., Principles of Industrial Instrumentation, Second Edition Tata McGraw Hill Publishing Co. Ltd.. New Delhi. 1997 ISBN 0074623346.
4. National Instruments LabView Manual.

Reference Books

1. Flow measurement, "Practical guides for measurement and control" , ISA publication, 1991.
2. Anderew, W.G., : "Applied instrumentation In process industries" - a survey Vol-I Gulf Publishing company.
3. Liptak, B.G.,: "Process measurement & analysis" , IV edition Chilton Book company 1995.
4. Considine, D.M.,: "Process instruments and control & handbook", McGraw Hill 1985.

EI245 INSTRUMENTATION AND CONTROL SYSTEM

Credit: 3:0:0 **Marks: 40+60**

UNIT I

General Concepts of Mechanical Instrumentation, generalized measurement system. Classification of instruments as indicators, recorders and integrators – their working principles, Precision and accuracy. Measurement of error and analysis.

UNIT II

Measurement of displacement, speed, frequency, acceleration – vibrometer, accelerometer etc. Pressure measurement: bourdon, elastic transducers, strain gauge, pressure cells, measurement of high and low pressure. Temperature measurement: Bi-metallic, resistance thermometer, thermocouples, pyrometer and thermistors, Hot-wire anemometer, magnetic flow meter, ultrasonic flow meter, calibration.

UNIT III
Viscosity: capillary tube viscometer, efflux viscometer, humidity: absorption hydrometer, dew point meter. Strain: strain gauges, types, wheat stone bridge circuit, temperature compensation, gauge rosettes calibration. Force measurement: scales and torque measurement: mechanical torsion meter, electrical torsion meter.

UNIT IV
Control Systems: Open and closed systems, servomechanisms, transfer functions, signal flow graphs, block diagram algebra, and hydraulic and pneumatic control systems, Two-way control, proportional control, differential and integral control. Simple problems.

UNIT V
Time response of first order and second order systems, concept of stability, necessary condition for stability, routh stability criterion, simple problems.

Text Books:

1. Sawhney, A.K., 'Electrical and Electronics Measurements & Instrumentation', Dhanpat Rai & Co., 1993.
2. Nagrath, M. and Gopal, I.J, 'Control Systems Engineering', Wiley Eastern Limited, 1991.

Reference Books:

1. Thomas G Beckwith, Lewis Buck, N.Roy D. Maragoni, 'Mechanical Measurements', Narosa Publishing House, New Delhi, 1989.
2. Collet, C.V. and Hope, A.D., 'Engineering Measurements', 2nd Ed., ELBS.
3. Nagoor Kani. A., 'Control Systems', RBA Publications, 1998 (For Units IV & V).

EI246 PROCESS DYNAMICS AND CONTROL

Credit: 4: 0: 0 **Marks: 40+60**

UNIT I : Process dynamics
Elements of process control - process variables - degrees of freedom - Characteristics of liquid system, gas system, thermal system - Mathematical model of liquid process, gas process, flow process, thermal process, mixing process - Batch process and continuous process - Self regulation.

UNIT II : Basic control actions
Characteristics of on-off, single -speed floating control, proportional, integral and derivative modes - composite control modes - PI, PD and PID control modes - Integral windup - Auto - manual transfer - Selection of control mode for different processes - Typical control schemes for level, flow, pressure and temperature.

UNIT III : Optimum controller settings
Tuning of controllers by process reaction curve method - continuous cycling method, damped oscillation method - Ziegler - Nichol's tuning - 1/4 decay ratio - feed Forward control - Ratio control - cascade control - averaging control - multivariable control.

UNIT IV : I/P and P/I converters

Pneumatic and electric actuators - valve positioner - control valve - Characteristics of control valve - valve body - globe, butterfly, diaphragm ball valves - control valve sizing - Cavitation, flashing in control valves

UNIT V : Applications

Distillation column - control of top and bottom product compositions - reflux ratio - control of chemical reactor - control of heat exchangers - steam boiler - drum level control and combustion.

Text Books:

1. Curtis Johnson, D., : " Process control instrumentation technology" , Prentice Hall Of India,1996.
2. Eckman, D.P., " Automatic process control" , Wiley Eastern,1985.
3. George Stephanopoulos, Chemical Process Control: An Introduction Theory and practice, Prentice Hall, New Delhi 1999 ISBN 8120306651

Reference Books:

1. Peter Harriot.,: "Process control" , TMH.
2. Patranabis, D.,: " Principles of process control", TMH 1981.
3. Coughanoner, and Koppel., : " Process systems analysis and control" , TMH 1991.

EI247 SENSORS AND TRANSDUCERS

Credit: 3: 1: 0

Marks: 40+60

UNIT - I: Science of Measurement

Measurement systems – Significance of Measurements, Methods of Measurements – Direct and Indirect Methods, Classification of Instruments –Deflection and Null Type, Generalized Measurement System, Characteristics of Instruments – Static and Dynamic, Types of errors, Error analysis, Units and Standards.

UNIT - II: Classification and Characteristics of Transducer

Transducer – Definition, Classification of Transducer – analog and digital transducer-primary and secondary transducer- active and passive transducer-Inverse transducer, Characteristics and choice of transducer, Factors influencing choice of transducer.

UNIT - III : Resistance and Inductance Transducer

Resistance Transducer-Basic principle, Potentiometer – Loading effects, Resolution, Linearity, Non-linear Potentiometer, Noise in potentiometer, Resistance strain gauge – Types, Resistance thermometer, Thermistors – characteristics, Thermocouple – Compensation circuits – junction and lead compensation, merits and demerits.

Inductance Transducer:- Basic principle, Linear variable differential transformer, RVDT, Synchro, Induction potentiometer, variable reluctance accelerometer, microsyn.

UNIT - IV : Capacitance and Piezoelectric Transducer

Capacitance Transducer – Basic principle, transducers using change in - area of plates-distance between plates- variation of dielectric constants, frequency response, Merits, demerits and uses. Piezoelectric transducer- Basic principle, Mode of operation, properties of piezoelectric crystals, loading effects, frequency response and impulse response uses.

UNIT - V : Digital and other Miscellaneous sensors
Digital Transducer – shaft encoder, optical encoder, digital speed transducer. Hall effect transducer, sound sensors, vibration sensors – seismic transducer, chemical sensor – PH sensor, velocity transducer, Introduction to smart sensors.

Text Books:

1. A.K. Sawhney "A course in Electrical and Electronics Measurements and Instrumentation" – Dhanpat Rai & Co., (Pvt) Ltd., 2000.
2. S. Renganathan "Transducer Engineering" – Allied publishers Limited, 1999.
3. Doebelin. E.O., "Measurement Systems Application and Design", fourth edition, McGraw Hill International, 1978.

EI248 COMMUNICATION ENGINEERING

Credit: 4: 0: 0 **Marks: 40+60**

Unit I: Radio Communication Systems
Need for Modulation - Principle of AM, FM and PM – basics of AM - modulation index – signal power –DSBSC-SSBSC

Unit II: Transmitters and Receivers
AM and FM transmitters and receivers – Am and FM demodulation – Comparison of AM, FM and PM – Noise – Effects of noise- Sources and Types of noise -

Unit III: Digital Communication Systems
PAM, PPM, PDM, PCM – delta modulation – differential PCM – merits and demerits – comparison of pulse modulation schemes, FSK – ASK - PSK

Unit IV: Data Transmission
Twisted pair and coaxial cables – Fiber optics – Sources and detectors – Fiber optic Complete system - Analog to digital converters (Successive approximation type, R- 2R type)- Error detection and correction – Multiplexing introduction – TDM & FDM

Unit V: Facsimile & Television
Facsimile- Modem functions – RS232 operation - TV signals – TV receivers – Color TV -Introduction to Satellite communication (Basic block diagram) – Introduction to cellular communication (Basic Concept)

Text Books

1. Roody and Coolen , "Electronic Communication", Prentice Hall of India LTD., 4th Edition, 1999.
2. William Scheweber, "Electronic Communication Systems", Prentice Hall of India LTD., 4th Edition, 2004

Reference Books

1. Kennedy G, "Electronic Communication Systems", McGraw-Hill, 4th Edition,1987.
2. Simon Haykins, "Communication Systems", 3rd Edition, John Wiley,Inc., 1995.
3. Bruce Carlson. A "Communication Systems", 3rd Edition, Tata McGraw – Hill 1986.
4. Taub and Schilling "Principles of Communication Systems", Second Edition, McGraw-Hill , 1987.
5. Anoksingh, "Principles of Communication Engineering", S.Chand and Company Ltd., First edition, 2001.

EI249 INSTRUMENTATION AND PROCESS CONTROL

Credit : 4:0:0 **Marks (40+60)**

Unit I: Introduction to Process control

System – steady state design – process control – process control block diagram – definition of a process, measurement, controller, and control element, loop – damped and cyclic response- feedback control – transient responses – laplace transform – transforms of simple functions – step function, exponential function, ramp function and sine function.

Unit II: Control systems

Open and closed loop systems, servo- mechanisms, hydraulic and pneumatic control systems, two-way control, proportional control, differential control and intergral control.

Control valve – Construction and working of pneumatically operated valve and spring – diaphragm actuator

Unit III

Signal flow graph – Mason's Gain formula, Block diagram algebra.

Stability – concept of stability, definition of stability in a linear system, stability criterion, characteristic equation, Routh test for stability

Unit IV: Pressure and Temperature sensors

Pressure measurement – Construction and working of capacitive pressure sensor, Inductive pressure sensor, strain gauge, pressure sensor, diaphragm, bourdon tube, differential pressure cell

Temperature sensors –Construction and working of RTD, Thermistors, Thermocouples, bimetallic strips

Unit V:

Level sensor – Simple float systems, capacitive sensing element, radioactive methods (nucleonic level sensing) – ultrasonic level sensor**.**

Measurement of density – U-type densitometer, Buoyancy meter

Measurement of composition – Electrical conductivity cell, non-dispersive photometers, pH meter, Zirconia oxygen analyser, dumbbell O2 analyser, Gas chromatograph, Mass spectrometer

Text Books:

1. J.F Richardson A D.G.Peacock, Coulson & Richardson's " Chemical Engineering", Volume 3,(Chemical and Biochemical reactors and process control) Butherworth – Heinemann, an imprint of Elsevier ,2006.
2. Nagrath, M and Gopal, I.J, "Control Systems Engineering", Wiley Eastern Limited, 1991.

References:

1. Donald R. Coughanowr., "Process System analysis and control" Mc- Graw Hill International Edition , Second Edition, 1991.
2. Nagoor kani.A "Control Systems", RBA publications, 1998.

EI327 TRANSDUCER ENGINEERING

Credit:4:0:0 **Marks: 40+60**

Unit I : Generalized Characteristics of Transducers

Introduction-static characteristics-dynamic characteristics-frequency response of first order transducer-higher order transducer –procedure to determine the constants and transfer function of a system.

Unit II :Resistance and Inductance Transducer

Basic principle-potentiometer –resistance strain gauge –measurement of torque –stress measurement on rotating members – semi conductor strain gauges-contact pressure-humidity measurement-light.

Basic principles –linear variable differential transformer- LVDT equations-RVDT-application of LVDT- LVDT pressure transducer – synchros as position transducer – induction potentiometer – variable reluctance accelerometer –microsyn.

Unit III: Capacitance and Piezoelectric Transducers

Basic principle – capacitance displacement transducer-equibar –differential pressure transducer – feedback type capacitance proximity pickup-condenser microphone-pulse width modulating circuit.

Introduction –material for piezoelectric transducer-equivalent circuit of a piezoelectric crystal –piezoelectric coefficients – modes of deformation – general form of piezoelectric –transducers –general form of piezoelectric transducers-environmental effects.

Unit IV: Magnetic Sensors

Introduction – sensors and the principles – magneto resistive sensors – hall effect and sensors –inductance and eddy current sensors –angular movement transducer-electromagnetic flow meter – switching magnetic sensors- SQUID sensor.

Unit V: Amplifiers

Design of low noise pre amplifiers- Isolation amplifier- exlaraction of signab – lock in amplifier – boxcar integrators- high gain operational amplifiers-chopper stablised amplifiers – gain control amplifiers – log and antilog amplifiers.

Reference Books:

1. L.A.Geddes & L.F.Baker, “Principles of Applied Biomedical Instrumentation”, John Wiley and sons Inc,1989.
2. Webster, “Medical Instrumentation – Application & Design”, 2 ed, John Wiley and sons Inc, 1999.
3. Doebelin,E.O, “Measurement System”, McGraw Hill, IV ed,Singapore,1990.
4. Dr.S.Ranganathan, “Transducer Engineering”, Allied Publishers Limited, 1999.
5. Partranabis.D., “Sensors and Transducers”, PHI, 2003, ISBN-81-203-2198-7.

EI328 ROBOTICS AND AUTOMATION

Credit:4:0:0 **Marks: 40+60**

Unit I : Review of basic concepts
Definition and origin of robotics-classification of robots-degrees of freedom-basic components of a robot -Sensors: velocity sensors, position sensors, force and tactile sensors, range and proximity sensor, machine vision -Grippers: Types of grippers, gripper mechanisms-hydraulic pneumatic and electric drives.

Unit II: Manipulator Kinematics
Direct Kinematics: Kinematic modeling of a manipulator-Denavit Hartenberg notation – Kinematic relationship between adjacent links- Manipulator transformation matrix-kinematic model of two link planar, cylindrical arm and articulated arm robots
Inverse Kinematics: Manipulator workspace – solvability of inverse kinematic model – Solution Techniques- closed form solution.

Unit III : Manipulator Dynamics
Lagrangian mechanics- Lagrange –Euler formulation, Newton Euler formulation

Unit IV : Robot programming
Non textual programming- textual programming: robot languages, VAL system and language-VAL palletizing program, VAL pick and place program –Requirements of robot programming languages.

Unit V
Robots in manufacturing industries, fuzzy logic for robotics

Reference Books

1. Groover M.P, Weiss M, Nagel R.N, Odrey N.G, ‘Industrial Robotics – Technology, Programming and Applications, McGraw Hill,1986.
2. John J. Craig , ‘Introduction to Robotics, Mechanics and Control’, Addison – Wesley Publishing Co, 1999, I edition.
3. Koren Y., ‘Robotics for Engineers’, McGraw Hill Book Co.,USA,1985
4. Klafter,’ Robotic Engineering’. Prentice Hall,1994
5. Nikku,;Introduction to Robotics ;, TBH Publishers,2000.
6. Mithal,’ Robotics and control’, TBH Publishers, 2003.
7. David Ardayfio, Fundamentals of Robotics “, Marcel Dekker, Inc,1987.

EI329 ADVANCED MICRO CONTROLLERS

Credit: 4:0:0 **Marks: 40+60**

Unit I: Intel 8051
Architecture of 8051 – Memory Organization- Register Banks – Bit addressable area – SFR area – Addressing modes – Instruction set – programming examples.

Unit II:
8051 Interrupt structure – Timer modules – serial port features – port structure- power saving modes – MCS51 Family features: 8031/8051/8751.

Unit III : 8096 Controller
Architecture of 8096 – Modes – Block diagrams of Interrupt structure – Timers – High Speed Input and outputs – PWM output- serial ports.

Unit IV High Performance RISC Architecture: ARM
The ARM architecture – ARM organization and implementation- The ARM instruction set – The thumb instruction set – Basic ARM assembly language program – ARM CPU cores.

Unit V: PIC Micro Controller
CPU Architecture – Instruction set – Interrupts – Timers –Memory- I/O port expansion – I^2C bus for peripheral chip access- A/D converter – UART.

Text Books

1. “8-bit Embedded Controllers”, Intel Corporation, 1990.
2. Steave Furber,” ARM system – on –chip architecture” Addison Wesley, 2000.
3. John.B.Peatman,” Design with PIC Micro Controller “, Pearson Education, 2003.
4. Kenneth- J.Ayala “ The 8051 micro controller architecture, Programming and Applications” Penram International Publishing, 1996.

References

1. Daniel Tabak, “Advanced Microprocessors” McGraw Hill., 1995.
2. James L.Antonakos, “The Pentium Microprocessor” Pearson Education, 1997.
3. James L.Antonakos, “An Introduction to the Intel family of Microprocessor “ Pearson Education, 1999.
4. Barry B.Breg, “The Intel Microprocessors Architecture, Programming and Interfacing” PHI, 2002.
5. “16-bit Embedded Controllers Handbook”, Intel Corporation, 1989.
6. John.B.Peatman,” Design with Micro Controller “,Mc Graw Hill Singapore 1988.

EI330 ADVANCED DIGITAL SIGNAL PROCESSOR

Credit: 3:1:0 **Marks: 40+60**

Unit I :Overview of Digital Signal Processing and Applications

Signals and their Origin- Convolution and Inverse Filtering-Sampling theorem and discrete time system- Linearity, shift invariance, Causality and stability of discrete time systems-Z Transform -Advantages of Digital Signal Processing -DSP in the sample and transform domain-Fast Fourier Transform- Digital Filters- Multirate Signal Processing-Discrete Wavelet transform-Adaptive Filters

Unit II: Introduction to Programmable DSPs

Multiplier and Multiplier Accumulator- Modified Bus structures and Memory Access schemes in P-DSPs- Multiple Access Memory- Multiported Memory- VLIW Architecture –Pipelining –Special Addressing Modes in P-DSPs-On-Chip Peripherals.

Unit III: Architecture of TMS320C5X

Introduction – Bus Structure- Central Arithmetic Logic Unit-Auxiliary Register ALU – Index Register-Auxiliary Register Compare Register-Block Move Address Register-Block Repeat Registers-Parallel Logic Unit -Memory –Mapped Registers-Program controller-Some Flags in the status Registers-On-Chip Memory-On –Chip Peripherals

Unit IV: **TMS320C5X Assembly Language Instructions and Instruction Pipelining in C5X**

Assembly Language Syntax-Addressing Modes- Load / Store Instructions-Addition/ Subtraction Instructions -Move Instructions -Multiplication Instructions- The NORM Instruction-Program Control Instruction -Peripheral Control-Pipeline Structure-Pipeline operation- Normal pipeline operation.

Unit V: Application Programs in C5X

'C50-based DSP starter Kit-Programs for familiarization of the addressing modes-program for familiarization of Arithmetic Instructions -Programs in C5X for Processing Real Time Signals

Text Books:

1. B.Venkataramani & M.Bhaskar, "Digital Signal Processor", TMH 2003.
2. Texas Instruments " User guide TMS 320C50".

Reference Book:

1. Emmanuel C.Ifeachor, Barrie W. Jeruis ," Digital Signal Processing – A paractical approach" Addison Wesley 1993.

EI331- MODELLING OF PHYSIOLOGICAL SYSTEMS

Credits:4:0:0 **Marks: 40+60**

Unit I

Physiological processes and principles of their control, Control – Blood flow, gas exchange, Ultra filtration, biomedical reactions pneumatic transport- digestion energy utilization and waste disposal, Linear and non-linear control systems, principles of open loop and feedback systems, techniques for system response of characterization

Principles of Modelling

Mathematical approach, electrical analogues, introduction to various process controls like cardiac rate, blood pressure, respiratory rate, blood glucose regulation electrical model of neural control mechanism

Unit II: Modelling of Human Thermal Regulatory system

Parameters involved, control system model, Biochemistry of digestion, types of heat loss from body, models of heat transfer between subsystems of human body like skin core, systems within body and body-environment.

Unit III: Respiratory System

Modelling oxygen uptake by RBC and pulmonary capillaries, Mass balancing by lungs, Gas transport mechanisms of lungs, oxygen and carbon dioxide transport in blood and tissues.

Unit IV: Ultra Filtration System

Transport through cells and tubules, diffusion, facilitated - diffusion and active transport, methods of waste removal, counter current model of urine formation in nephron, modelling Henle's loop.

Unit V: Modelling Body Dynamics

Principles of mechanical properties of bones, tissues - modelling bones, stress propagation in bones, Hills model of muscle mechanism.

Current Trends

Pharmacokinetic modelling illustrated with example like drug diffusion, computer aided modelling .

Text Book:

1. David, O .Cooney, " Biomedical Engineering Principles" Marcel Deeker Pub. Co, 1976.

References:

1. Carson, Cobelli, : "Introduction of Modelling in Physiology and Medicine ", Academic Pr, 2002.
2. Vasilis.Z.Mararelis, " Non linear Dynamic Modelling of Physiological System", John Wiley & Sons, 2002.

EI332 MEDICAL DIAGNOSTIC AND THERAPEUTIC LABORATORY

Credit:0:0:2 **Marks: 50+50**

12 experiments will be notified by the HOD from time to time

EI333COMMUNICATION THEORY AND TELEMETRY

Credit: 4:0:0 **Marks: 40+60**

Unit I

Noise and its effects, sources and types of noise, need for modulation, basis of AM, modulation index, and signal power, SSB, the roll of the receiver, receiver techniques and stages, AM demodulation, SSB and CW demodulation, AM features and drawbacks, concept of frequency modulation, FM spectrum and bandwidth, transmitters, receiver functions, FM demodulation, phase modulation, comparison of AM , FM and PM, FM receivers.

Unit II

Introduction to telemetry principles- The basic system – classification – non –electrical and electrical telemetry – local transmitters and converters, signals theorems- exponential Fourier series – amplitude frequency –phase modulations, Bits and symbols- time function pulse – modulation codes –Interference – error rate- probability of error.

Unit III

Frequency division multiplex system: IRIG standards-FM and PM circuits, PLL, Time Division multiplex system: TDM-PAM – PCM system. Digital multiplexer – differential PCM.

Unit IV

Modems- Quadrature amplitude modulators – Modem protocols- Transmitters and receivers –transmission lines – RF line- Microwave line- wave guide components- wireless telemetry

Unit V

Antennas: Dipoles-arrays-current distribution and design considerations-microwave antennas. Wave propagation – filters- polynomial filters active filters- universal filters – switched capacitor filters- digital filters.

Text Book

William Schweber, "Electronic Communication Systems- A complete course", Third Edition Prentice – Hall International,1999

Reference Books

1. Taub and Schilling, " Principles of Communication", Second Edition, Tata McGraw Hill , 1999.
2. Telemetry Principles, D.Patranabis, Tata McGraw Hill, New Delhi, 1999.
3. Measurement Systems-Applications and Design, E.D. Doeblin,McGraw hill,1990.

EI334 DIGITAL DESIGN LAB

Credit : 0:0:2 **Marks: 50+50**

12 experiments will be notified by the HOD from time to time

EI335 BIO MATERIALS

Credits:4:0:0 **Marks: 40+60**

Unit I

Introduction to the study of the structure and properties of the main classes of materials used in medical devices and surgical implants – metals- ceramics – polymer composites and materials of biological origin

Unit II

The histology of normal tissues – the pathology of abnormal tissues and tissues reaction to implanted materials . Interaction of materials with the biological environment.

Unit III

Interplay of physiochemical properties of polymeric materials and the design of biomedical devices. The use of metal and ceramic based biomaterials for the replacement of hard tissue in orthopedic and dental applications.

Unit IV

Biomaterials used in tissues replacement – absorbable and non- absorbable tissues and soft tissues replacement as well as discussion of tissue – body and blood response to implants.

Unit V

Medical and bioengineering aspects of artificial hearts and cardiac assist devices- physiology and pathological aspects of patient with need for such devices- history of artificial heart development.

Reference: books:

1. B.D.Rater, "Biomaterials Sciences – An Introduction to Materials in Medicine", Academic Press , 1996.
2. Julian H. Parry, "Biocompatibility Assessment of Medical Devices and Materials", Wiley series, 1999.
3. Robert P.Lanza, Robert Lange and William L.Chick, "Principle of Tissues Engineering", Academic press, 2000
4. Jonathan Black, "Biological Performance of Materials Fundamentals of Biocompatibility", 1999.

EI336 COMPUTER AIDED INSTRUMENTATION

Credits:4:0:0 **Marks: 40+60**

Unit I

Data Acquisition and conversion – introduction – signal conditioning of the inputs- single & multi channel DAS – data conversion – A/D & D/A converters – multiplexers – sample and hold circuits.

Unit II
Micro Controllers and PC based DAS – Introduction –8051 microcontroller – Programming in 8051 – application of 8051 – PC based instrumentation – I/P & O/P displays – analog displays and recorders- digital I/O displays – display multiplexing and zero suppression.

Unit III
Graph theoretical concepts for computer vision – Introduction – Basic definition – graph representation of two dimensional digital images – matching – graph grammars – control basic – optimizing controls – analog versus digital instrumentation –converters – telemetry systems – transmitters – (electronic and intelligent) – fibre optic transmission – digital recorders – recorders – tape recorders – speech synthesis – voice recognition.

Unit IV
Computerized ECG-EEG-EMG-CAT – processing of ultra sound images in medical diagnosis – introduction – ultra sound imaging systems – processing the B-mode image-examples of image processing B-mode images – perspectives.

Unit V
Three dimensional fast full body scanning – evaluation of hardware & software – mechanical design – measuring process – ranges of applications – data acquisition by confocal microscopy – image restoration – detection –segmentation – graph construction – interpretation – results –magnetic resonance imaging in medicine – basic magnetic resonance physics – images acquisition – Reconstruction – fast imaging methods.

Reference Books:
1. Bernal Jahne, Horst Han Backer peter Geibler, "Handbook of Computer Vision and Application" Academic press san Diego , London, Boston, network, Tokyo, Toronto, 1999.
2. R.B.Khandpur, "Handbook of Biomedical Instrumentation", Prentice Hall of India, 2001.
3. Zang-Hee Cho etall, "Foundations of Medical Imaging", IEEE Press, 2000.

EI337 MEDICAL INSRUMENTATION

Credit : 4:0:0 **Marks: 40+60**

Unit I
Introduction to human physiology- circulatory system – cardio vascular system-central nervous system – respiratory system – muscular skeletal system – digestive system – excretory system – sensory organs – voluntary and involuntary action.

Unit II
Potentials and their measurements: cell and its structure – resting potentials – action potentials – bioelectric potentials – measurement of potentials and their recording – ECG, EEG, EMG – Hotler monitor – Foetal monitor – cardiac arrthymias – plethysmography

Unit III
Electrodes of respiratory and neuro measurement: Electrode theory – bipolar and unipolar electrode-surface electrode – electrode impedance –equivalent circuit for extra cellular electrodes- micro electrodes – artificial respiration- oxymeter – diathermy – nerve stimulator, blood flow measurement, Spiro meter.

Unit IV
Medical Imaging techniques: X-rays – scanning techniques-ultrasound scanner- color Doppler system, CT, MRI scanning techniques – coronary angiogram

Unit V
Cardiac pacemakers-defibrillators – heart lung machines- haemodialysis – anesthesis equipment – electro surgery – clinical laboratory instrumentation – therapeutic and prosthetic devices, centralized patient monitoring.

References Books:

1. L.A.Geddes & L.F.Baker, "Principles of Applied Biomedical Instrumentation", John Willey and sons Inc, 1989.
2. Webster, "Medical Instrumentation – Application & Design", 2ed, John Wiley and sons Inc, 1999.

EI338 ANATOMY AND PHYSIOLOGY

Credit: 4:0:0 **Marks: 40+60**

Unit I: Basics:
Basic Embryology, Ostelogy and Mycology.
Circuitatory and Respiratory Systems: Structure of heart, structure of lungs, Traches and its branchings, General circulation, Capillary circulation, Venous return, Neural control of cardio vascular system, Regulation of breathing, Carrier of oxygen and carbon dioxide, Dyspnoea

Unit II: Nervous And Sensory Systems:
Structure and function of nervous tissues, Reflex action, Afferent nervous systems, Regulation of posture, Physiology of emotion, Regulation of temperature, Cerebro spinal fluid , sensory end organs, Tongue, Mechanism of sight, hearing and smelling.

Unit III: Digestive System:
Structure of alimentary canal, Related digestive glands, Mechanism of alimentary canal, Secretion of digestive fluids, Liver, Function of liver.

Unit IV: Excretory Systems:
Structure of Kidney, Bladder and Colon, Physiology of Perspiration, Physiology of urine formation, Physiology of miaturation, Physiology of defecations.

Unit V: Endocrine System:
Pituitary gland, Thyroid and Parathyroid glands, pancreas, Ovary and Testis.

References:

1. Charles A.Jacob, "Textbook of Anatomy and Physiology in Radiological Technology", The C.V.Mosby Company, Sam Louis, 1968.
2. Warrik C.K, "Anatomy and Physiology for Radiographers", Oxford University press, Henglong, 1977.
3. Syril A Kalee and Eric Neil, Samsons Wright, "Applied Physiology", Oxford University Press, Hongkong, 1979.

EI339 DATA COMMUNICATION, NETWORKS AND PROTOCOLS

Credit: 4:0:0 **Marks: 40+60**

Unit I – Overview & Basic principles

Open systems interconnection (OSI) model - Protocols - Physical standard - Smart Instrumentation systems- Bits, bytes and characters- Communication principles-Communication modes- Asynchronous systems- Synchronous systems- Error detection-Transmission characteristics- Data coding- The universal asynchronous receiver/transmitter (UART)- The high speed UART (16550)

Unit II- Data communication standards

Standards organizations- Serial data communications interface standards- Balanced and unbalanced transmission lines- EIA-232 interface standard (CCITT V.24 interface standard)- Troubleshooting serial data communication circuits- Test equipment- RS-449 interface standard (November 1977)- RS-423 interface standard-

The RS-485 interface standard- Troubleshooting and testing with RS-485- RS/TIA-530A interface standard (May 1992)- RS/TIA-562 interface standard (June 1992)- Comparison of the EIA interface standards- The 20 mA current loop- Serial interface converters-Interface to serial printers- Parallel data communications interface standards- General purpose interface bus (GPIB) or IEEE-488 or I EC-625- The Centronics interface standard- The universal serial bus (USB**)**

Unit III- Cabling, Electrical Noise and Error Detection

Origin of errors- Factors affecting signal propagation- Types of error detection, control and correction- Copper-based cables -Twisted pair cables- Coaxial cables- Fiber-optic cables- Definition of noise- Frequency analysis of noise- Sources of electrical noise-Electrical coupling of noise –Shielding- Good shielding performance ratios- Cable ducting or raceways- Cable spacing- Earthing and grounding requirements- Suppression technique- Filtering

Unit IV- Modem and Multiplexer

Modes of operation- Synchronous or asynchronous- Interchange circuits- Flow control-Distortion- Modulation techniques- Components of a modem- Types of modem- Radio modems- Error detection/correction- Data compression techniques- Modem standards-Troubleshooting a system using modems- Multiplexing concepts- Terminal multiplexers-Statistical multiplexers

Unit V- Industrial Protocol
Flow control protocols- XON/OFF- Binary synchronous protocol- HDLC and SDLC protocols- File transfer protocols- OSI analogy- Industrial control application- ASCII based protocol- ANSI-X3.28-2.5-A4- Modbus protocol- HART and smart instrumentation- Highway addressable remote transducer (HART) Physical layer- Data link layer- Application layer

Text Books

1. Steve Mackay, John Park and Edwin Wright, “Practical Data Communication for Instrumentation and Control”, Newnes Elsevier,2002.
2. A.S. Tanenbaum, Computer Networks, Third Edition, Prentice-Hall of India, 1996.

Reference Books

1. Romilly Bowden, “HART Application Guide”, HART Communication Foundation, 1999.
2. G.K. Mc-Millan, “Process / Industrial Instrument and Controls and Hand Book”, Mc-Graw Hill, New York. 1999.
3. William A Shay, “Understanding Data Communications and networks”, Cole Publishing Company, A division of Thomson Learning.

ADDITIONAL SUBJECTS

Code	Subject Name	Credit
EI250	Electric Circuit Analysis	3:1:0
EI251	Power Electronics	4:0:0
EI252	Biomedical Instrumentation	4:0:0
EI253	Neural Network and Fuzzy Logic Control	4:0:0
EI254	Aircraft Instrumentation	4:0:0
EI255	Electron Devices	4:0:0
EI256	Industrial Instrumentation	4:0:0
EI257	Ultrasonic Instrumentation	4:0:0
EI258	Signal Conditioning Circuits	3:1:0
EI259	Digital Control Systems	4:0:0
EI340	Advanced Digital Signal Processing	3:1:0
EI341	Advanced Control System	3:1:0
EI342	Instrumental Analysis	4:0:0

EI250 ELECTRIC CIRCUIT ANALYSIS

Credits 3:1:0 **Marks 40+60**

Unit I : Basic Circuit Concepts
Lumped circuits -Kirchoffs Laws -VI relationships of R, L and C -independent sources -dependent sources –simple resistive circuits -network reduction -voltage division -current division -source transformation.

Unit II : Sinusoidal Steady State Analysis
Phasor- sinusoidal steady state response -concepts of impedance and admittance -analysis of simple circuits- power and power factor -series resonance and parallel resonance - bandwidth and Q factor. Solution of three-phase balanced circuits -power measurements by two-wattmeter methods.

Unit III : Mesh-Current And Node-Voltage Methods
Formation of matrix equations and analysis of complex circuits using mesh-current and nodal-voltage methods - mutual inductance- coefficient of coupling -ideal transformer.

Unit IV : Network Theorems And Applications
Superposition theorem -reciprocity theorem –compensation theorem -substitution theorem -maximum power transfer theorem -Thevenin's theorem. -Norton's theorem and Millman's theorem with applications.

Unit V : Transient Analysis
Forced and free response of RL, RC and RLC circuits with D.C. and sinusoidal excitations.

Text Book
1. Paranjothi S.R., 'Electric Circuit Analysis', New Age International Ltd. , Delhi, 2nd Edition, 2000.

2. Edminister, J.A., 'Theory and Problems of Electric Circuits', Schaum's outline series McGraw Hill Book Company, 2^{nd} Edition, 1983.

Reference

1. Hyatt, W.H. Jr. and Kemmerly, J.E., 'Engineering Circuit Analysis', McGraw Hill International Editions, 1993.
2. Sudhakar, A. and Shyam Mohan S.P., 'Circuits and Network Analysis and Synthesis', Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1994

EI251 POWER ELECTRONICS

Credits:4:0:0 **Marks 40+60**

Unit I: Power Semiconductor Devices
Principle of operation -characteristics and modeling of power diodes, SCR, TRIAC, GTO, power BJT, power MOSFET and IGBT.

Unit II : Phase Controlled Converters
2 pulse, 3 pulse and 6-pulse converters- inverter operation - effect of source inductance and firing circuits.

Unit III : DC To DC Choppers
Voltage, current and load-commutated choppers -step up chopper and firing circuits.

Unit IV : Inverters
Series inverter- voltage source inverters- current source inverters -PWM inverters.

Unit V : AC Voltage Controllers
Single phase AC voltage controller -multi stage sequence. Control - step up and step down cyclo-converters -three phase to single phase cyclo-converters – Switched Mode Power Supply.

Text Book

1. Rashid, M.H., 'Power Electronics -Circuits Devices and Applications', Prentice Hall International, 1995.

Reference

1. Dubey, G.K., Doradla, S.R., Joshi, A. and Sinha, R.M., 'Thyristorised Power Controllers', Wiley Eastern Limited, 1986.
2. Landle, W., Power Electronics', McGraw Hill and Company, Third Edition, 1993

EI252 BIOMEDICAL INSTRUMENTATION

Credit: 4: 0 :0 **Marks: 40 + 60**

UNIT I : Electrophysiology and Biopotential Recorders
Neuron - Axon - Action potential - Electrophysiology of Cardiovascular system- ECG - Phonocardiography - Central nervous system - EEG - Respiratory system - Muscular system - EMG – ERG

UNIT II : Measurement of Physiological Parameters

Physiological transducers - Measurement of Blood pressure - Blood flow - Cardiac output measurement - heart rate - respiration rate - measurement of lung volume - Oximeters - Audiometer.

UNIT III : Therapeutic and Surgical Equipments

Electro Surgical unit - short wave & microwave diathermy - Laser surgical unit - Anesthesia machine - Pacemakers - Total artificial heart (TAH) - Dialyser - Heart lung machine - Defibrillators - Ventilators - Nerve stimulators - centralized and Bedside patient monitoring system - Nerve stimulators.

UNIT IV : Biochemical Equipments and Electrical Safety

Flame photometer - spectrophotometer - chromatography- PH, PCO2 and PO2 analysis - sterilizers - Electrical safety hazards in hospitals

UNIT V : Imaging Systems and Telemetry

Computerized tomography (CT) - MRI instrumentation - Ultrasound scanner - X-ray machine - Fluroscopic techniques - angiography - Echo cardiograph - vector cardiograph - Biotelemetry.

Text Book:

1. Arumugam.M., " Biomedical Instrumentation", Anuradha Agencies Publishers, Kumbakonam, 1992.

Reference Books:

1. Geddes. L.A., and Baker, L.E., "Principles of Applied Biomedical Instrumentation", John Wiley, 1989.
2. Kandpur R.S., "Handbook of Biomedical Instrumentation", TMH, 1987.
3. Richard Aston., "Principles of Biomedical Instrumentation and Measurement", Merrill Publishing Company, 1990.

EI 253 NEURAL NETWORK AND FUZZY LOGIC CONTROL

Credit: 4:0:0 **Marks: 40 + 60**

UNIT : I

Introduction to biological neuron, Introduction to artificial neural networks, Classification of neural networks, activation functions and their types, single layer and multilayer neural networks, Rosenblatt's perceptrons , back propagation algorithm.

UNIT : II

Hopfield's networks, Kohonen's self organizing maps, adaptive resonance theory, associative memory -bi-directional associative memories- BAM structure

UNIT : III

Neural networks for control systems: Schemes of neuro-control, identification and control of dynamical systems, case studies (Inverted Pendulum, Articulation Control)

UNIT : IV

Introduction to fuzzy logic: Fuzzy sets, fuzzy relations, fuzzy conditional statements, fuzzy rules, fuzzy learning algorithms.

UNIT : V

Fuzzy logic for control systems : Fuzzy logic controllers, fuzzification interface, knowledge/rule base, decision making logic, defuzzification interface, design of fuzzy logic controllers, case studies(Inverted Pendulum, Articulation Control)

Text Books

1. Kosko, B, Neural Networks and Fuzzy Systems : A Dynamical Approach to Machine Intelligence, Prentice Hall, New Delhi , 1991.
2. Wasserman P.D, Neural Computing Theory & Practice ,Van Nortland Reinhold,1997.
3. J.Ross,Fuzzy Logic with Engineering Applications, 1997 – ISBN-0-07-144711-X

References

1. Jacek M. Zurada, 'Introduction to Artificial Neural Systems', Jaico Publication House, 1995.

EI254 AIRCRAFT INSTRUMENTATION

Credit: 4: 0 :0 **Marks: 40 + 60**

UNIT I: Introduction

Classification of aircraft - instrumentation - instrument displays, panels, cock- pit layout.

UNIT ll: Flight Instrumentation

Static & pitot pressure source -altimeter -airspeed indicator -mach meters -maximum safe speed indicator- Vertical Speed Indicator.

UNIT III: Gyroscopic Instruments

Gyroscopic theory -directional gyro indicator artificial horizon - turns and slip indicator.

UNIT IV: Aircraft Computer Systems

Terrestrial magnetism, aircraft magnetism, Direct reading magnetic compass- Compass errors- gyro magnetic compass.

UNIT V : Power Plant Instruments

Fuel flow -Fuel quantity measurement, exhaust gas temperature measurement and pressure measurement.

Text Books

1. Pallett, E.B.J., : " Aircraft Instruments -Principles and applications", Pitman and sons, 1981.

EI255 ELECTRON DEVICES

Credit: 4:0:0 **Marks: 40 + 60**

Unit I : Introduction

Energy band Theory of Crystals – Conductors, Insulators and Semiconductors – Mobility and Conductivity – Electrons and holes in an Intrinsic semiconductor – Donor and Acceptor Impurities – The Hall Effect – Generation and recombination of Charges – Drift and Diffusion in semiconductors – The Continuity equation – Injected Minority-Carrier Charge

Unit II : PN Junction Diode

Open-Circuited PN Junction – The PN Junction as a Rectifier – The Current Components in a PN Diode – Volt-Ampere Characteristic – Static and Dynamic Resistance – Temperature Dependence of the VI Characteristic – Transition and diffusion capacitance – Varactor Diodes – Breakdown Diodes – Tunnel diodes – Photo diode – LED – The Diode as circuit element – A Half-wave Rectifier – A Full-wave Rectifier.

Unit III : The Bipolar Junction Transistor

Transistor Current Components – CB, CE, CC Configuration – Input, Output Characteristics – Active, Cut-Off, Saturation Region – Ebers-Moll Model – Photo transistors – The Operating Point – AC, DC load lines – Bias Stability – Self Bias – Bias Compensation – Thermal runaway.

Unit IV : Transistor Models

Transistor Hybrid Model – T equivalent pi equivalent circuits – Small signal single stage amplifiers – analysis of CE, CB and CC circuits – Voltage gain – Current gain – Input impedance – Output impedance – dependence on source and load impedance.

Unit V : Theory Of FET, UJT And SCR

Junction FET Transistor – Static characteristics – FET structure – The Pinch-Off voltage – The FET Small Signal Model – Enhancement MOSFET, Depletion MOSFET – Comparison of JFET and MOSFET – UJT : Operation, Static characteristics – SCR: Construction, Static Characteristics – TRIAC: Construction, Static Characteristics.

Text Books

1. Millman & Halkias,"Integrated Electronics",Tata McGraw Hill,1997.
2. Malvino A P, “Electronic Principles”, McGraw Hill International, 1998.

Reference Books

1. David.A.Bell, "Electronic Devices & Circuits ", PHI, 1998.
2. Robert Boylestad, "Electronic Devices & Circuit Theory", Sixth Edition, PHI, 1998.
3. Allen Mottershead, "Electronic Devices & Circuits", PHI, 1998.

EI256 INDUSTRIAL INSTRUMENTATION

Credit: 4: 0: 0 **Marks: 40 + 60**

UNIT: I -Pressure Measurement

Pressure standards - Dead weight tester - Different types of manometers - Elastic elements-Electrical methods using strain gauge-High pressure measurement-Vacuum gauges - Mcleod gauge - Thermal conductivity gauges -Ionization gauge- Differential pressure transmitters

UNIT: II -Flow Measurement

Positive displacement flowmeters - Inferential flowmeter-Turbine flowmeter-Variable head flowmeters -Rotameter - Electromagnetic flowmeter - Ultrasonic flowmeter-Coriolis mass flowmeter- Calibration of flowmeters

UNIT: III. -Temperature Measurement

Temperature standards - fixed points -filled-system thermometers - Bimetallic thermometer-Thermocouple - Laws of thermocouple - Cold junction compensation- Measuring circuits - Speed of response -linearization - Resistance thermometer- 3 lead and 4 lead connections - thermistors - IC temperature sensors - Radiation pyrometer- Optical Pyrometer

UNIT: IV -Level Measurement

Visual techniques - Float operated devices - Displacer devices - Pressure gauge method - Diaphragm box-Air purge system-Differential pressure method – Hydro-step for boiler drum level measurement - Electrical methods - Conductive sensors - capacitive sensors -Ultrasonic method -Solid level measurement

UNIT: V -Smart and Virtual Instrumentation

Smart transmitters: Introduction- Terminology- Introduction of Field Bus Standard - Features of smart and intelligent transmitters- Smart transmitter with HART communicator-Virtual Instrumentation: definition- parts of the system- PC based DAS for instrumentation and control.

Text Books

1. 1.Doeblin E.O.I, Measurement Systems: Application and Design, Fourth Edition, MC RAN Hill, Newyaork, 1992 ISBN 0-07-100697-4.
2. Renganathan.S, Transducer Engineering, Allied publishers, Chennai 1999
3. Eckman, D.P., Industrial Instrumentation, Wiley Eastern Ltd., 1990 ISBN 0-85226-206.
4. Noltingk, B.E., “Instrumentation Reference Book”, II Edition Butterworth Heinemann,1996.

Reference Books

1. Liptak B. Process Measurement and Analysis, 3rd Edition Chiton book company Radnor, pennsylvania, 1995 ISBN 0-7506-2255.
2. Patranabis, D., Principles of Industrial Instrumentation, Second Edition Tata McGraw Hill Publishing Co. Ltd.. New Delhi. 1997.
3. Barney G.C.V., Intelligent Instrumentation;, Prentice Hall of India Pvt. Ltd., New Delhi
4. Tatamangalam R., Industrial Instrumentation Principles and Design, Springer Verlog, 2000 ISBN 1-85-233-208-5

EI257 ULTRASONIC INSTRUMENTATION

Credit : 4:0:0 **Marks: 40+60**

UNIT – I

Ultrasonic waves: Principles and propagation of various waves, characterization of ultrasonic transmission, reflection and transmission coefficients, intensity and attenuation of sound beam. Power level, medium parameters.

UNIT – II

Generation of ultrasonic waves: Magnetostrictive and piezoelectric effects, search unit types, construction and characteristics.

UNIT – III

Ultrasonic test methods: Pulse echo, transit time, resonance, direct contact and immersion type and ultrasonic methods of flaw detection.

UNIT – IV

Ultrasonic measurement: Ultrasonic method of measuring thickness, depth and flow, variables affecting ultrasonic testing in various applications.

UNIT – V

Ultrasonic applications: Ultrasonic applications in medical diagnosis and therapy, acoustical holography.

Text Book

1. Science and Technology of Ultrasonics-Baldev Raj, V.Rajendran, P.Palanichamy, Narosa Publishing House.
2. Transducers for Ultrasonic Flaw Detection-V.N. Bindal

EI258 SIGNAL CONDITIONING CIRCUITS

Credit: 3: 1: 0 **Marks:40 + 60**

Unit I : Operational Amplifier

Operational amplifier-ideal op-amp- op amp internal circuit - DC characteristics –bias- offset –frequency-slew rate - AC characteristics- frequency compensation techniques-Non inverting and inverting amplifier - differential amplifier

Unit II : Operation Amplifier And Applications:

Scale Changer-Inverter Adder- Subtractor- Integrator- Differentiator- Multiplier- Divider-Comparator-Applications-Logarithmic Amplifier -Current To Voltage Converter-Voltage To Current Converter –Precision Rectifier-Clipper – Clamper - Sample And Hold Circuit -555 Timers- Astable- Monostable Operation

Unit III : Amplifiers and Filters
Buffer amplifier- Use of op-amp with capacitive displacement transducer-charge amplifier-instrumentation amplifier- isolation amplifier- filters -Low pass-high pass- band pass – band reject filter-first order and second order transformations- state variable filter- switched capacitor filter

Unit IV : Voltage Regulators and Multipliers
Series op amp regulator- IC voltage regulator- 723 general-purpose regulator- frequency doubling- phase angle detection – Precision Reference Regulator.

Unit : PLL
Basic principle- phase detector and comparator- analog and digital - voltage controlled oscillator - Monolithic PLL - Application of PLL – frequency multiplication- division-frequency – translation-AM,FM,FSK modulation and demodulation

Text Books

1. Roy Choudhury and Shail Jain.," Linear integrated circuits" ,Wiley Eastern Ltd,1991
2. Ramkant Gaykwad, "Op amps & Linear Integrated Circuits" PHI III Edition,ISBN-81-203-0807-7

Reference Books:

1. Denton J. Dailey, "Operational Amplifier and Liner integrated Circuits", McGraw Hill,1989.
2. Coughlin and Driscol., "Operational Amplifier and Liner integrated Circuits". Prentice Hall of India Pvt., Ltd 1992
3. A.K Sawhney.," Course in Electrical and Electronic Measurement & Instrumentation" , Dhanpat Rai & sons,1982

EI259 DIGITAL CONTROL SYSTEMS

Credit: 4:0:0 **Marks: 40 + 60**

Unit I : Sample Theory and Converters
Review of Sample theory - Shannon's sampling theorems - Sampled Data Control system, Digital to Analog conversion – Analog to Digital conversion, Ramp type A/D, Dual slope A/D, Successive approximation A/D. - A/D & D/A converters - Reconstruction - Zero Order Hold.

Unit II : System Response
Review of Z and Inverse Z transform - Response of sampled data systems to step and ramp inputs - Steady state errors - Z domain equivalent

Unit III : Function Realisation
Pulse transformation function by direct, cascade and parallel realization - Sampled data model for continuous system - Controllability and observability.

Unit IV: Stability of Digital Control Systems
Stability studies - Bilinear transformation - Jury's stability test. - Digital quantization.

State sequences for sampled data systems - solutions

Unit V : Digital Process Control Design

Digital PID algorithm - Positional and incremental forms - Dead-beat algorithm- Dahlin's and Kalman's algorithms - Ringing - Implementation of control algorithms using microcontroller – Block diagram study of digital implementation.

Text Book

1. Gopal.M: "Digital Control Engineering",Wiley Eastern Publications, 1988

Reference Books

1. Nagrath, J.J, and Gopal, M, " Control System Engineering" , Wiley & Sons., 1985
2. Constantine Houpis, and Garry Lamont., "Discrete Control systems" - Theory, Hardware and Software, McGraw Hill,1985.
3. Alson, S.I., : " Microprocessors with Applications in Process Control" , TMH, 1984.

EI340 ADVANCED DIGITAL SIGNAL PROCESSING

Credit: 3:1:0 **Marks: 40+60**

UNIT I : Introduction to DSP:

Signals and their orgin, Noise-Classification of continuous time signals and Discrete time signals classification and properties of systems. Sampling Theoram-sampling- digitizing-aliasing-anti-alias filter. Convolution theorem-linear convolution and circular convolution Applications of Digital Signal Processing (DSP).

UNITII : Fundamentals:

Z-Transform and its properties –Inverse Z-transform –Discrete Fourier Transforms (DFT) and its properties-Radix 2FFT, Computational advantages of FFT over DFT-Decimation in time FFT algorithm-Decimation-in Frequency FFT algorithm.

UNIT III : IIR Digital Filter Design

Block diagram Representation of digital filter-Basic IIR digital filter structures- Structure Realization Using MATLAB-Preliminary consideration in digital filter design – Bilinear

UNIT IV : FIR Digital Filter Design

Basic FIR Filter Structure, Structure realization using MATLAB, FIR Filter design based on windowed Fourier series, Frequency sampling method, equiripple linear phase FIR filter design using MATLAB, window based FIR filter design using MATLAB, Least square error FIR filter design using MATLAB

UNIT V : DSP Processor- TMS320F2407

Introduction to programmable DSPs, Basic Architecture of TMS 320 F2407 Assembly language Instructions.

Convolution using MAC and MACD Instructions, Sine wave generation, Ramp signal generation, Triangular wave generation.

Text Books

1. Sanjit .K. Mitra "Digital Signal Processing A Computer based approach 'Tata McGraw Hill Edition ,2001,ISBN 0-07-044705-5
2. B.Venkataramani, M Bhasker, Digital Signal Processors, Tata Mc Graw-Hill Publishing company limited ,2002,ISBN 0-07-047334-X

References

1. John .G.Proakis ,Digital Signal Processing Principles,Algorithms and Applications , Addision – Wesley 2002,ISBN-81-203-1129-9.
2. Emmanuel C.Ifeachor Digital Signal Processing A Practical Approach ,Pearson Education Asia,2002,ISBN 81-7808-609-3.
3. MS 3205X User's Manual, Texas Instruments, 1993.

EI341 ADVANCED CONTROL SYSTEM

Credit : 3:1:0 **Marks: 40+60**

UNIT I : Modeling of Dynamic Systems

Definition of System- Mathematical modeling- State space representation of system- Centrifugal Governor – Ground vehicle- Permanent Magnet stepper motor- Inverted Pendulum

UNIT II : Analysis of Mathematical models

State space method- Phase plane- Isoclines- Numerical methods- Taylor Series- Euler's method- Predictor Corrector method- Runge Kutta method- Principle of Linearization of Differential Equation

UNIT III : Linear System Analysis

Reachability and controllability – Observability and constructability –Companion forms– Controller / Observer form – State feed-back control – State estimator – Full order and reduced order Estimator- Combined controller estimator compensator

UNIT IV : Stability of Linear System

Definition of stability – Stability of linear system – Asymptotically Stable System- - Hurwitz and Routh stability criteria

UNIT V : Stability of Nonlinear System

Stability of Nonlinear system – Lyapunov stability theorems- Lyapunov function for nonlinear system- Stability analysis by describing function method

Text Books

1. Stanislaw Zak, Systems and Control, Oxford University Press, 2003 ISBN 0195150112
2. Gopal M., 'Digital Control and State Variable Methods', Tata McGraw Hill Pub., 2003. ISBN 0070483027

Reference Books

1. Godwin. C, Graebe.F, and Salgado., Control system design, Prentice Hall, New Jersey, 2001 ISBN 0139586539
2. William S. Levine, The Control hand book, IEEE and CRC Press, USA, 1996 ISBN 0849385709
3. Norman S. Nice, Control Systems Engineering, John Wiley and Sons, 2000 ISBN 0471366013
4. Ogata.K, Modern Control Engineering , Prentice-Hall Publication, 2001 ISBN 0130609072

EI342 INSTRUMENTAL ANALYSIS

Credit 4:0:0 **Marks : 40+60**

Unit I : UV-Visible Spectroscopy

The electromagnetic spectrum – fundamental laws of photometry-deviation from Beer's law –presentation of spectra – correlation of electronic absorption spectra with molecular structure –molar absorptivity – structural effects – effect of temperature and solvents – quantitative methods – photometric titrations – electron spectroscopy for chemical analysis (ESCA).

Unit II : IR-Spectroscopy and Raman Spectroscopy

Selection rules for IR absorption , fundamental, overtone and hot bands – Normal modes of vibration of molecules such as carbon dioxide and water – factors influencing the number and energy of absorption bands- characteristic group vibrations- - factors causing shifts in group vibrations – skeletal vibrations – finger printing – double beam IR spectrometer – components and functions –sample handling – Nujolmull and potassium bromide pellet technique – Applications of IR spectroscopy in structural elucidation of molecules.

Raman spectroscopy – vibrational mode – group frequencies of organic ,inorganic and organometallic compounds, factors affecting the group frequencies, study of hydrogen bonding effects, vibraitonal spectra of ionic, coordination and metal carbonyl compounds.

Unit III : Nuclear Magnetic Resonance & Electronic Spin Resonance Spectroscopy

Basic definitions of magnetic moment and spin quantum numbers – the chemical shift – factors affecting the magnitude of chemical shift – the TMS scale, tau and delta values – spin – spin splitting of AB, A2B2 and ABX systems- some examples of spin- spin splitting, - internal rotation and NMR –Deuterium exchange reaction – NMR of nuclei other than hydrogen –mainly C13 and applications – FT NMR and its advantages over conventional NMR

EPR – principles, factors affecting the intensity, position and multiplet structure of the spectra – hyperfine splitting of some simple systems, zero field splitting- Krammers degeneracy-Applications.

Unit IV: Mass Spectrometry & Thermogravimetry

Mass spectrometry – basic principles instrumentation – the mass spectrometer – isotope abundances – molecular ion – metastable ions – fragmentation process - fragmentation associated with functional groups – alkanes, alkenes, aromatic hydrocarbons, alcohols,aldehydes,carboxylic acids and esters – Mclafferty rearrangement and applications –

thermogravimetry (TG) – derivative thermogravimetry(DTG) – Differntial thermal analysis (DTA) – Differential Scanning Calorometry(DSC) – instrumentation and applications.

Unit V: Diffraction methods for structural studies

X-ray diffraction – a brief account of the principles of molecular structure determination by X-ray diffraction from single crystal – structure factor, phase problem and heavy atom methods, Patterson synthesis, Fourier synthesis, Interpretation of Fourier Maps and results.neutron diffraction – applications of neutron diffraction to studies of molecular structure, advantages over X-ray diffraction studies.

Electron diffraction – principles of electron diffraction and applications.

Text Books

1. Willar,Merritt and Dean,"Instrumental Methods of Analysis",sixyh edition,Williard.H.H,1881.
2. W.Kemp, "Organic Spectroscopy",third edition,ELBS,1991.

Reference books:

1. C.N.Banwell, "Fundamentals of Molecular spectroscopy", third edition, McGrawHill, New Delhi, 1983.
2. J.Dyer,"Absorption Spectroscopy of organic molecules", Prentice Hall of India, third edition,Macmillam,1991.
3. R.M.Silverstien,G.C.Bassler,T.C.Morril,"Spectrometric Indentification of organic compounds", John Wiley,NewYork,1991.

ADDITIONAL SUBJECTS

Code	Subject Name	Credit
EI101	Basic Electronics Workshop	0:0:1
EI260	Electrical Measurements and Instruments	4:0:0
EI261	Electronic Instrumentation	4:0:0
EI262	Digital Signal Processing	3:1:0
EI263	Electrical Machines Laboratory	0:0:1
EI264	Electron Devices Laboratory	0:0:1
EI265	Measurements Laboratory	0:0:1
EI266	Sensors and Transducers Laboratory	0:0:1
EI267	Control Systems Laboratory	0:0:1
EI268	Signal Conditioning Circuits Laboratory	0:0:1
EI269	Embedded Systems Laboratory	0:0:1
EI270	Computer Based Process Control Laboratory	0:0:1
EI271	Digital Control Laboratory	0:0:1
EI272	Digital Signal Processing Laboratory	0:0:1

EI 101 Basic Electronics Workshop

Credit: 0:0:1

10 experiments will be notified by the HOD from time to time

EI260 ELECTRICAL MEASUREMENTS AND INSTRUMENTS

Credit: 4:0:0

Unit I Different Types of Ammeters and Voltmeters
Galvanometers – Principle of operation, construction and sources of errors and compensation in PMMC & moving iron instruments – dynamometer and rectifier type ammeter and voltmeters – Calibration of ammeters and voltmeters.

Unit II Wattmeters and Energy Meters
Electrodynamics type wattmeter – theory and its errors – methods of correction – LPF wattmeter – phantom loading – induction type Kwh meter – theory and adjustments – calibration of wattmeters and energy meters.

Unit III Potentiometers and Instrument Transformers
Student type potentiometer û L and N type potentiometer – precision potentiometer – polar and co-ordinate type – A.C. potentiometers – their applications – construction and theory of operation C.T. and V.T. – Phasor diagrams - characteristics – applications.

Unit IV Resistance Measurement
Measurement of low, medium and high resistances – ammeter – voltmeter method – Wheatstone bridge-precision form of Wheatstone bridge – Kelvin double bridge – Ohmmeter – series and shunt type ohmmeters – high resistance measurement – Megger – direct deflection methods –Earth Resistance measurement.

Unit V Impedance Measurement
A.C. Bridges – measurement of inductance, capacitance – Q of coil – Maxwell bridge – Wien bridge – Hay's bridge – Schering bridge – Anderson bridge – Desaughty's bridge – errors in A.C. bridge methods and their compensations – detectors – excited field A.C. galvanometer – Vibration galvanometer.

References

1. Stout M.B. Basic Electrical measurements, Prentice Hall of India, New Delhi, 1992.
2. Golding E.W. and Widdis F.E., Electrical measurements and measuring instruments, Sir Issac Pitman and Sons Pvt., Ltd., 2001.
3. Sawhney A.K., A Course in Electrical and Electronics Measurements and Instrumentation, Dhanpat Rai and Sons, New Delhi, 1999.
4. David A Bell, Electronic Instrumentation and measurements, Prentice Hall of India, New Delhi, 2006.

EI261 ELECTRONIC INSTRUMENTATION

Credit: 4:0:0

Unit I Electronic Analog Meter:
DC and AC voltmeter – FET input voltmeter – Vector impedance meter – Wave analyzer – Signal generator – Harmonic distortion analyzer – Spectrum analyzer – Correlator – Power meter

Unit II Analog Instruments:
General purpose oscilloscope – CRT screen characteristics – Vertical and Horizontal amplifiers – Time base generator – Trigger pulse circuit – Delay line – Sampling Oscilloscope - Measurement of frequency and Phase by Lissajous method Electromagnetic Interference – Grounding and Shielding Techniques

Unit III Digital Instruments:
ADC and DAC – Types – Digital Voltmeters and Multi-meters – Digital frequency counters – Digital waveform generator – Digital storage Oscilloscope – Three bit Flash converter – Digital Q meter – Digital IC tester – Digital LCR meter

Unit IV Digital Measurement:
Digital Displacement transducer: Incremental and Absolute – Digital method of measuring Displacement, Velocity, Capacitance, Frequency and Phase difference

Unit V Digital Displays:
Digital Alpha Numeric Displays – 7 Segment displays – Dot matrix displays – XY Plotter – UV recorder – Magnetic tape recorder – Digital recording and Data Loggers.

Text Books

1. Cooper W.D., Electronic Instrumentation and measurement techniques, Prentice Hall of India, New Delhi, 1998.
2. Bouwens A.J., Digital Instrumentation, McGraw Hill Ltd., USA, 2002.

References

1. Rangan, C.S., Sarma G.R. and Mani V.S.V., Instrumentation Devices and Systems, Tata McGraw Hill, New Delhi, 1998
2. Byers T.J., Electronic Test Equipment: Principle and Applications, McGraw Hill, USA 1987.
3. Oliver B.H., and Cage J.M., Electronics Measurements and Instrumentation, McGraw Hill, 1999.

EI 262 DIGITAL SIGNAL PROCESSING

Credit: 3:1:0

Unit I : Introduction
Concepts of signal processing - typical applications -advantages of digital signal processing compared with analog processing.
Review of Discrete Time LTI Systems – Linear, circular and sectioned convolutions - DFS, DTFT, DFT – FFT computations using DIT and DIF algorithms - Time response and frequency response analysis of discrete time systems to standard input signals.

Unit II: Finite Impulse Response Digital Filters
Symmetric and Antisymmetric FIR filters - FIR filter design using window method – frequency sampling method – realization of structures of FIR filters – transversal and linear phase structures**.**

Unit III: Infinite Impulse Response Digital Filters
Review of classical analog filters-Butterworth,Chebyshev and Elliptic filters–Transformation of analog filters into equivalent digital filters using impulse invariant method and Bilinear Z transform method-Realization of stuctures of IIR filters-Direct,cascade,parallel forms

Unit IV: Introduction to programmable DSPs
Multiplier and Multiplier Accumulator Unit – Modified Bus Structure and memory Access in P-DSPs – Multiple Access Memory – Multiported memory – VLIW Architecture – Pipelining - Special addressing modes – P-DSPs with RISC and CISC processors

Unit V: Architecture of TMS 320C5X

Introduction – Architecture of TMS320C5X – On-chip peripherals – Instruction set of TMS320C5X – Simple Programs

Text Books

1. John G. Proakis and Dimitris G.Manolakis, 'Digital Signal Processing, Algorithms and Applications', PHI of India Ltd., New Delhi, 3rd Edition, 2000.
2. Sanjit K.Mitra, 'Digital Signal Processing - A Computer Based Approach', Tata McGraw-Hill, New Delhi, 2nd Edition, 2001
3. B. Venkatramani, M. Bhaskar, 'Digital Signal Processors Architecture, Programming and Applications', Tata McGraw-Hill Publishing Company Limited, New Delhi, 2002

References

1. Openheim and Schafer, 'Digital Time Signal Processing', Prentice Hall of India, Reprint, 2002
2. Emmanuel C. Ifeacher and Barrie W. Jervis, 'Digital Signal Processing – A Practical Approach', Addition – Wesley Longman Ltd., UK, 2nd 2004 Low Price Edition
3. Texas Instruments Manuel for TMS320C5XProcessor.

EI 263 ELECTRICAL MACHINES LABORATORY

Credit: 0:0:1

10 experiments will be notified by the HOD from time to time

EI 264 ELECTRON DEVICES LABORATORY

Credit: 0:0:1

10 experiments will be notified by the HOD from time to time

EI 265 MEASUREMENTS LABORATORY

Credit: 0:0:1

10 experiments will be notified by the HOD from time to time

EI 266 SENSORS AND TRANSDUCERS LABORATORY

Credit: 0:0:1

10 experiments will be notified by the HOD from time to time

EI 267 CONTROL SYSTEMS LABORATORY

Credit: 0:0:1

10 experiments will be notified by the HOD from time to time

EI 268 SIGNAL CONDITIONING CIRCUITS LABORATORY

Credit: 0:0:1

10 experiments will be notified by the HOD from time to time

EI 269 EMBEDDED SYSTEMS LABORATORY

Credit: 0:0:1

10 experiments will be notified by the HOD from time to time

EI 270 COMPUTER BASED PROCESS CONTROL LABORATORY

Credit: 0:0:1

10 experiments will be notified by the HOD from time to time

EI 271 DIGITAL CONTROL LABORATORY

Credit: 0:0:1

10 experiments will be notified by the HOD from time to time

EI 272 DIGITAL SIGNAL PROCESSING LABORATORY

Credit: 0:0:1

10 experiments will be notified by the HOD from time to time

ADDITIONAL SUBJECTS

Code	Subject Name	Credit
09EI101	Basic Electronics And Instrumentation (Common to All Branches)	4: 0:0
09EI201	Analytical Instrumentation	3:0:0
09EI202	Biomedical Instrumentation	3:0:0
09EI203	Fiber Optics and Laser Instrumentation	3:0:0
09EI204	Ultrasonic Instrumentation	3:0:0
09EI205	Aircraft Instrumentation	3:0:0
09EI206	Telemetry and Telecontrol	3:0:0
09EI207	Automotive Instrumentation	3:0:0
09EI208	Robotics and Automation	3:0:0
09EI209	Instrumentation and Control in Petrochemical Industries	3:0:0
09EI210	Instrumentation and Control in Paper Industries	3:0:0
09EI211	Instrumentation and Control in Iron and Steel Industries	3:0:0
09EI212	Instrumentation for Pollution Control	3:0:0
09EI213	Instrumentation and Control Systems	3:0:0
09EI214	Instrumentation and Control Laboratory	0:0:1
09EI215	Instrumentation and Process Control	3:0:0
09EI216	Robotics and Automation	4:0:0
09EI217	Telemetry and Telecontrol	4:0:0
09EI218	Signals and Systems	4:0:0
09EI219	Control Systems	3:1:0
09EI220	Electrical Machines	3:1:0
09EI221	Electronic Circuits	4:0:0
09EI222	Microprocessors and Microcontrollers	4:0:0
09EI223	Microprocessors and Microcontrollers Laboratory	0:0:1
09EI224	Logic and Distributed Control Systems	4:0:0
09EI225	Embedded Instrumentation	4:0:0
09EI226	Networks & Protocols for Instrumentation & Control	4:0:0
09EI301	Industrial Instrumentation	4:0:0
09EI302	Process Control	3:1:0
09EI303	Real Time and Embedded Systems	4:0:0
09EI304	Digital Instrumentation	4:0:0
09EI305	Advanced Digital Process Control	4:0:0
09EI306	Computer Architecture	4:0:0
09EI307	Embedded Networking	4:0:0
09EI308	Mobile Communication	4:0:0
09EI309	Mobile Computing	4:0:0
09EI310	Embedded System Software Design	4:0:0
09EI311	Intelligent Controllers	4:0:0
09EI312	Digital Image Processing Techniques	4:0:0
09EI313	Optimal Control	4:0:0
09EI314	System Identification And Adaptive Control	4:0:0

09EI315	Advanced Instrumentation & Process Control For Food Processing	4:0:0
09EI316	Virtual Instrumentation Laboratory	0:0:2
09EI317	Industrial Instrumentation and Process Control Laboratory	0:0:2
09EI318	Embedded Systems Laboratory	0:0:2
09EI319	Artificial Intelligence and AI Programming	3:1:0

09EI101 BASIC ELECTRONICS AND INSTRUMENTATION
(Common to All Branches)

Credit: 4: 0 :0

Course objective:

To equip the student with relevant knowledge about Basic Analog and Digital Electronics, Transducers and Measurement techniques.

Course Outcome:

- To review the theory of semiconductors.
- An exposure is given to Analog and Digital Electronics and Devices
- To provide the details of various transducers which are used to measure flow, temperature etc.
- A clear idea has been given about electronic instruments with emphasis on display devices.

UNIT I: ANALOG ELECTRONICS

PN junction - Zener diode - Rectifiers - Voltage Regulators - Bipolar junction transistor- CB, CE, CC configuration and characteristics - FET, SCR, Diac, Triac, UJT – Characteristics

UNIT II : DIGITAL ELECTRONICS

Binary number system – Logic gates - Boolean algebra- Flip flops - Half and full adders- Registers-Counters

UNIT III: INTRODUCTION TO MEASUREMENT

Instrument classification – Standards - Static and dynamic characteristics – Calibration - Measurement errors

UNIT IV: SENSORS AND TRANSDUCERS

Classification of transducers, Principles of measuring instruments for Temperature, Pressure, Flow, Level, Displacement, Velocity and Acceleration, Viscosity, Moisture and pH

UNIT V : MEASURING INSTRUMENTS

Galvanometer – Ammeter – Voltmeter - Ohmmeter - (series and shunt) - Multimeter - Calibration of meters - A/D and D/A conversion - Digital methods of measurement - Measurement of Frequency and time interval - CRT Displays - Seven Segment Displays

TEXT BOOKS

1. Salivahanan S, Suresh Kumar N, Vallavaraj A, “Electronic Devices and Circuits” First Edition, Tata McGraw-Hill, Fourth Reprint, 2008

2. H.S Kalsi, ‘Electronic Instrumentation’, Tata McGraw – Hill, II Edition

REFERENCES

1. Malvino and Leach, ‘Digital Principles and Applications’, Tata McGraw-Hill, Fifth Edition.
2. Mehta V.K, ‘Principles of Electronics’, S. Chand and Company Ltd, 8th Edition, 2003.
3. Alan. S. Morris, ‘Principles of Measurements and Instrumentation’, Prentice Hall of India, 2nd edition, 2003.
4. S. Renganathan, ‘Transducer Engineering’, Allied Publishers Limited, 1999

09EI201 ANALYTICAL INSTRUMENTATION

Credit: 3: 0: 0

Course Objective:

The course is designed to equip the students with an adequate knowledge of a number of analytical tools which are useful for clinical analysis in hospitals, drugs and pharmaceutical laboratories and above all for environmental pollution monitoring and control.

Course Outcome:

- To understand basic principles of various analytical instruments
- To understand instrumentation required for different types of analytical instruments
- To know the typical clinical and industrial applications of analytical instruments

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: CHROMATOGRAPHY

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 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

UNIT V: RADIO CHEMICAL AND MAGNETIC RESONANCE TECHNIQUES

Nuclear radiations – Detectors – GM counter – Proportional counter – Solid state detectors – Gamma cameras – X-ray spectroscopy – Detectors – Diffractometers – 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 McGraw Hill publishing Co. Ltd., 2006.
2. H.H.Willard, L.L.Merritt, J.A.Dean, F.A.Settle, ‘Instrumental methods of analysis’, CBS publishing & distribution, 1995.

REFERENCE BOOKS

1. Robert D. Braun, ‘Introduction to Instrumental Analysis’, McGraw Hill, Singapore, 1987.
2. G.W.Ewing, ‘Instrumental Methods of Chemical Analysis’, McGraw Hill, 1992.
3. DA Skoog and D.M.West, ‘Principles of Instrumental Analysis’, Holt, Saunders Publishing, 1992.

09EI202 BIOMEDICAL INSTRUMENTATION

Credit: 3: 0: 0

Course Objective:

To learn the physiology of the human body and the Instrumentation related to Biomedical Systems.

Course Outcome:

- To introduce the concepts of physiology and the Electrical Components of a Biomedical System.
- To discuss the measurement of physiological parameters.
- To understand the concepts of Imaging System and Telemetry ad the various Therapeutic Equipments used in Medicine.

UNIT I: PHSYIOLOGY

Cell and its structure-Action and Resting Potential - propagation of action potential-Sodium pump-Nervous system-CNS-PNS –Nerve cell-Synapse-Cardio pulmonary system-Physiology of heart and lungs Circulation and respiration.

UNIT II: BASIC COMPONENTS OF BIOMEDICAL SYSTEM

Electrodes-Micro, needle and surface electrodes. Amplifiers- Preamplifiers, differential amplifiers, chopper amplifiers-isolation amplifier.

UNIT III: MEASUREMENT OF PHYSIOLOGICAL PARAMETERS

ECG-EEG-EMG-ERG- Lead systems and recording methods-Typical waveforms. Measurement of blood pressure-Cardiac output-Cardiac rate-Heart sound-Respiratory rate- Gas volume-Flow rate of CO2, O2 in exhaust air-pH of blood, GSR measurements- Plethysmography.

UNIT IV: IMAGING SYSTEM AND TELEMETRY
X-ray machine-Radio graphic and fluoroscopic techniques-Computer tomography-MRI Ultrasonography-Endoscopy-Thermography-Different types of biotelemetry systems and patient Monitoring-Electrical safety.

UNIT V: ASSISTING AND THERAPEUTIC EQUIPMENTS
Pace makers-Defibrillators-Ventilators-Nerve and muscle stimulators-Diathermy-Heart Lung Machine-Audiometers-Dializers.

TEXT BOOKS
1. Lesilie Cromwell, Fred J.Weibell,Erich A.Pfeiffer, "Bio-Medical Instrumentation and Measurements" II edition, Pearson Education,2002/PHI
2. R.S.Khandpur, "Handbook of Bio-Medical Instrumentation" Tata Mc Graw Hill Publishing Co.Ltd.2003.

REFERENCE BOOKS
1. M.Arumugam,Bio-Medical Instrumentation, Anuradha Agencies,2—3.
2. L.A.Geddes and L.E.Baker,"Principles of Applied Bio-Medical Instrumentation John Wiley & Sons 1989.

09EI203 FIBER OPTICS AND LASER INSTRUMENTATION

Credit: 3: 0:0

Course Objective:
To introduce the basic concepts of Optical Fibers and Lasers and their applications in the field of Instrumentation.

Course Outcome:
- To give an insight into the principle of operation and applications of Optical fibers
- To understand the LASER operation and its applications in Instrumentation and Biomedical Fields

UNIT I: OPTICAL FIBERS AND THEIR PROPERTIES
Principles of light propagation through a fiber-Different types of fibers and their properties - Transmission characteristics of optical fiber-absorption losses-Scattering losses-Dispersion - Optical sources - Optical detectors - LED -LD - PIN and APD

UNIT II : INDUSTRIAL APPLICATION OF OPTICAL FIBERS
Fiber optic sensors - Fiber optic Instrumentation system - Different types of modulators- Detectors- Application in Instrumentation - Interferometric method of measurement of length- Moire fringes - measurement of pressure, temperature, current, voltage, liquid level and strain - fiber optic gyroscope

UNIT III: LASER FUNDAMENTALS
Fundamental characteristics of Lasers - three level and four level lasers - properties of laser- laser modes - resonator configuration - Q- switching and mode locking - cavity dumping - Types of lasers Gas lasers, solid lasers, liquid lasers - semi conductor lasers

UNIT IV: INDUSTRIAL APPLICATION OF LASERS
Laser for measurement of distance, length, velocity, acceleration, current, voltage and atmospheric effect - material processing - laser heating, welding, melting and trimming of materials - removal and vaporization

UNIT V: HOLOGRAM AND MEDICAL APPLICATION
Holography - Basic principle; methods; Holographic Interferometry and applications, Holography for non-destructive testing -Holographic components - Medical applications of lasers; laser and tissue interaction - Laser instruments for surgery, removal of tumors of vocal cords, brain surgery, plastic surgery, gynecology and oncology.

Text Books

1. Jasprit Singh, Semi Conductor Optoelectronics, McGraw Hill,1995 ISBN 0070576378
2. Ghatak A.K. and Thiagarajar K, Optical Electronics Foundation book , TMH, Cambridge University Press, 1989 ISBN 052134089

Reference Books

1. John and Harry, Industrial Lasers and their Applications, McGraw Hill 1974 ISBN 0070844437
2. John F Ready,. Industrial Applications of Lasers, Academic Press, 1997 ISBN 0125839618
3. Monte Ross, Laser Applications, McGraw Hill, 1968 ISBN 0124319025

09EI204 ULTRASONIC INSTRUMENTATION

Credit : 3:0:0

Course Objective:
To discuss the transducer technology and electronics instrumentation

Course Outcome:

- To study the fundamental aspects of wave propagation
- To discuss the principles and generation of ultrasound by different methods
- To discuss different ultrasonic test methods
- To discuss the ultrasonic measurement
- To discuss different applications of ultrasonics

UNIT I: INTRODUCTION TO ULTRASONIC WAVES
Ultrasonic Waves: Principles And Propagation Of Various Waves, Characterization Of Ultrasonic Transmission, Reflection And Transmission Coefficients, Intensity And Attenuation of Sound Beam. Power Level, Medium Parameters.

UNIT II: ULTRASONIC WAVE GENERATION
Generation Of Ultrasonic Waves: Magnetostrictive And Piezoelectric Effects, Search Unit Types, Construction And Characteristics.

UNIT III: ULTRASONIC TESTING
Ultrasonic Test Methods: Pulse Echo, Transit Time, Resonance, Direct Contact And Immersion Type And Ultrasonic Methods Of Flaw Detection.

UNIT IV: ULTRASONIC MEASUREMENT
Ultrasonic Measurement: Ultrasonic Method Of Measuring Thickness, Depth And Flow, Variables Affecting Ultrasonic Testing In Various Applications.

UNIT V: ULTRASONIC APPLICATIONS
Ultrasonic Applications: Ultrasonic Applications In Medical Diagnosis And Therapy, Acoustical Holography.

TEXT BOOK
1. Science And Technology Of Ultrasonics-Baldev Raj, V.Rajendran, P.Palanichamy, Narosa Publishing House, First Edition 2004.

REFERENCE BOOK
1.Alan E Crawford, 'Ultrasonic Engineering', Academic Press Inc, Second Edition.
2.Josef Krautkramer Ultrasonic Testing Of Materials', Narosa Publishing House, Fourth Edition.
3.Julian R Frederick, 'Ultrasonic Engineering', John Wiley & Sons Inc, First edition

09EI205 AIRCRAFT INSTRUMENTATION

Credit : 3:0:0

Course Objective:
To introduce the basics of Aircraft and the Instrumentation involved in Aircraft Systems

Course Outcome:
- To give an introduction about the Aircraft and the Display Equipments
- To learn the working of various sensors used in the Flight
- To analyze in detail about the Gyroscopic Instruments and Power Plant Instruments

UNIT I: INTRODUCTION
Classification of aircraft - instrumentation -instrument displays, panels, cock- pit layout.

UNIT II: FLIGHT INSTRUMENTATION
Static & pitot pressure source -altimeter -airspeed indicator -machmeter -maximum safe speed indicator- accelerometer.

UNIT III: GYROSCOPIC INSTRUMENTS
Gyroscopic theory -directional gyro indicator artificial horizon -turn and slip indicator.

UNIT IV: AIRCRAFT COMPUTER SYSTEMS
Terrestrial magnetism, aircraft magnetism, Direct reading magnetic components- Compass errors gyro magnetic compass.

UNIT V : POWER PLANT INSTRUMENTS
Fuel flow -Fuel quantity measurement, exhaust gas temperature measurement and pressure measurement.

Text Book

1. Pallett, E.B.J ., : " Aircraft Instruments -Principles and applications", Pitman and sons, 1981.

09EI206 TELEMETRY AND TELECONTROL

Credit: 3:0:0

Course Objective:
To expose Fundamental concepts in Telemetry and to give idea where it can be used in control applications.

Course Outcome:

- To know the basic concepts of telemetry system.
- To know the different techniques used in radio telemetry.
- To understand the concept of optical telemetry system.
- To analyze the methods used for tele control.

UNIT I : TELEMETRY FUNDAMENTALS CLASSIFICATION:
Fundamental concepts: significance, principle, functional blocks of telemetry and tele control system - methods of telemetry- electrical, pneumatic, hydraulic and optical telemetry- state of the art-telemetry standards. Electrical telemetry- current systems-voltage systems synchro systems - example of a landline telemetry system.

UNIT III : RADIO TELEMETRY
Block diagram of a radio telemetry system transmitting and receiving techniques- AM,FM,PM multiplexing -transmitting and receiving techniques- digital coding methods advantages of PCM,PWM,PPM,FSK-Delta modulation coding and decoding equipment - example of a radio telemetry system.

UNIT IV : OPTICAL TELEMETRY
Optical fibres for signal transmission -sources for fiber optic transmission - optical detectors trends in fibre optic device development-example of an optical telemetry system.

UNIT V : TELECONTROL METHODS

Analog and digital techniques in telecontrol, telecontrol apparatus-remote adjustment. Guidance and regulation Tele control using information theory- example of a telecontrol system.

TEXT BOOKS

1. Sawhney, K.A., "Course in Electrical & Electronics Measurement & Instrumentation", Dhanpat Rai & Sons, 2005.
2. Handbook Of Telemetry And Remote Control 1)Elliot L. Gruenberg 34075 629.8 - First L8 - Na L 2
3. Gerd Keiser., "Optical Fiber Communications", Mcgraw Hill, 2003.

REFERENCES

1. Tomasi W, "Advanced Electronic Communication Systems", Phi, Fifth Edition Second Indian Reprint 2003.
2. Anokh Singh, "Principles Of Communication Engineering" S.Chand Co., 2008
3. Wilbur L.Pritchard & Joseph A.Sciulli, "Satellite Communication Systems Engineering", Prentice Hall Inc, 2nd Edition, 1st Indian Print, 2003
4. John M. Senior., " Optical Fiber Communications Principles And Practice" Second Edition This Indian Reprint 2004

09EI207 AUTOMOTIVE INSTRUMENTATION

Credit: 3:0:0

Course Objective:

To introduce the various meters and Instrumentation used in Automobiles.

Course Outcome:

- To learn the design and construction of panel meters
- To understand the design and working of Indicating Instruments, Warning Instruments
- To learn the various Dashboard Amenities, Switching and Control Devices.

UNIT: I -AUTOMOBILE PANEL METERS AND SENSOR DESIGN

Ergonomics- Panel Meters- Controllers- Sensor for Fuel Level in Tank - Engine Cooling Water Temperature Sensors Design - Engine Oil Pressure Sensor Design - Speed Sensor - Vehicle Speed Sensor Design - Air Pressure Sensors - Engine Oil Temperature Sensor.

UNIT II -INDICATING INSTRUMENTATION DESIGN

Moving Coil Instrument Design - Moving Iron Instruments - Balancing Coil Indicator Design - Ammeter and voltmeter - Odometer and Taximeter Design - Design of Alphanumeric Display for Board Instruments

UNIT III -WARNING AND ALARM INSTRUMENTS

Brake Actuation Warning System. Trafficators - Flash System - Oil Pressure Warning System - Engine Overheat Warning System - Air Pressure Warning System - Speed Warning System -

Door Lock Indicators - Gear Neutral Indicator - Horn Design - Permanent Magnet Horn - Air Horn - Music Horns

UNIT IV-DASH BOARD AMENITIES
Car Radio Stereo - Courtesy Lamp – Timepiece - Cigar Lamp - Car Fan - Windshield Wiper - Window Washer - Instrument Wiring System and Electromagnetic Interference Suppression - Wiring Circuits for Instruments - Dash Board Illumination

UNIT V -SWITCHES AND CONTROLS
Horn Switches - Dipper Switches - Pull and Push Switches - Flush Switches - Toggle Switches -
Limit Switches - Ignition Key - Ignition Lock - Relay and Solenoid - Non-contact Switches

TEXT BOOKS

1. Walter E, Billiet and Leslie .F, Goings, ‘Automotive Electric Systems’, American Technical Society, Chicago, 1971.
2. Judge.A.W, ‘Modern Electric Equipments for Automobiles’, Chapman and Hall, London, 1975.

REFERENCE BOOKS

1. Sonde.B.S., ‘Transducers and Display System’, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1977.
2. W.F. Walter, ‘Electronic Measurements’, Macmillan Press Ltd., London.
3. E.Dushin, ‘Basic Metrology and Electrical Measurements’, MIR Publishers, Moscow 1989

09EI208 ROBOTICS AND AUTOMATION

Credit : 3:0:0

Course Objective:
To introduce the Basic concepts of robots, the instrumentation involved, Robot Dynamics and Kinematics and Applications

Course Outcome:

- To introduce the basic concept of Robots
- To learn the principle of operation of sensors used in Robotics
- To understand the working of End Effectors
- To study the Robot motion Analysis
- To discuss the applications of robots
-

UNITI I : INTRODUCTION
Robots introduction -Basic components.-Classification—Characteristics-Drives & Control systems –Actuators-Control loop

UNIT II: TRANSDUCERS AND SENSORS

Transducers & Sensors-Tactile sensors-Proximity & Range sensors-Image Processing & Analysis-Image Data reduction-Feature extraction-Object Recognition

UNIT III : END EFFECTORS
End effectors – Types-Mechanical Grippers-Vacuum Cups-Magnetic Grippers-Robot/End effector Interface- Robot programming Languages.

UNIT IV : ROBOT MOTION ANALYSIS
Robot motion analysis–Kinematics-Homogenous Transformations-Robot Dynamics Configuration of Robot controller

UNIT V : APPLICATIONS
Industrial Robots –welding painting-Assembly-Remote Controlled Robots for Nuclear, Thermal, Chemical plants-Industrial Automation.

TEXT BOOKS

1. Yoram Koren, "Robotics for Engineers", McGraw Hill, 1980. ISBN-0-07-100534-X
2. Mikell P. Groover etal, "Industrial Robots – Technology Programming & Applications" McGraw Hill Ltd., 1986. ISBN-0-07-100442-4

09EI209 INSTRUMENTATION AND CONTROL IN PETROCHEMICAL INDUSTRIES

Credit : 3:0:0

Objective

To expose the students to the Instrumentation field and control applied in petrochemical industries.

Course outcome

- To expose the students to the control applied in distillation column.
- To provide adequate knowledge about the chemical reactors and dryers.
- To provide adequate knowledge about the measurement of various parameters in petrochemical industry.
- To expose the students to the various control loops in Petrochemical Industry.

UNIT I : DISTILLATION COLOUMNS
Instrumentation and control in distillation columns: Distillation equipment, variables and degrees of freedom, measurement and control of column pressure, liquid distillate, vapour distillate and inserts, control of feed in reboiler and reflux, cascade and feed forward controls.

UNIT II: CHEMICAL REACTORS
Instrumentation and control in chemical reactors: Temperature and pressure control in batch reactors. Instrumentation and control in dryers: Batch dryers and continuous dryers..

UNIT III: HEAT EXCHANGERS

Instrumentation and control in heat exchangers: Variables and degrees of freedom , liquid to liquid heat exchangers, steam heaters, condensers, reboilers and vaporisers, use of cascade and feed forward control

UNIT IV: EVAPORATORS
Instrumentation and control in evaporators: Types of evaporators, measurement and control of absolute pressure, density, conductivity, differential pressure and flow.

UNIT V: EFFLUENT AND WATER TREAMENT
Instrumentation and control in effluent and water treatment: Chemical oxidation, chemical reduction, neutralization, precipitation and biological control.

TEXT BOOK
Béla G. Lipták. 'Instrumentation in the Processing Industries: Brewing, Food, Fossil Power, Glass, Iron and Steel, Mining and Minerals, Nuclear Power, Paper, Petrochemical, Pharmaceutical', Chilton Book Co., Reprint 2003 Original from the University of California, ISBN 0801956595.

Reference Books
1. Liptak B. G, Process Control , Third edition , Chilton Book Company, Pennsylvania, 1995. ISBN–0–7506–2254-7
2. Liptak B. G, Process Measurement and Analysis, Third edition , Chilton Book Company, Pennsylvania, 1995. ISBN-07506-2255-5
3. Considine D.M., 'Process / Industrial Instruments and Control Handbook', Fourth edition, McGraw Hill, Singapore, 1993. ISBN-0-07-012445-0

09EI210 INSTRUMENTATION AND CONTROL IN PAPER INDUSTRIES

Credit : 3:0:0

Course Objective

To expose the students to the Instrumentation applied in Paper industries.

Course Outcome

- To expose the students to the basic processing in paper industry.
- To provide adequate knowledge about the measurement of various parameters in paper industry
- To provide adequate knowledge about the Unit operations.
- To expose the students to the various control loops in Paper Industry.
- To expose the students to the various control loops application in Paper Industry.

UNIT I: PAPER MAKING PROCESS
Raw materials-pulping process – chemical recovery process – paper making process – Converting.

UNIT II: INSTRUMENTATION

Measurements of basic weight – density – specific gravity – flow – level of liquids and solids– pressure – temperature – consistency – moisture – pH – oxidation – reduction potential –graphic displays and alarms

UNIT III: CONTROL SYSTEMS
Blow tank controls – digester liquor feed pump controls – brown stock watcher level control – stock chest level control – basic weight control – dry temperature control

UNIT IV: DENSITY AND FLOW CONTROL
Dissolving tank density control – white liquor classifier density control – white liquor flow control – condensate conductivity control

UNIT V: COMPUTER APPLICATIONS
Computer applications in pulping process control, liquid level control and input stock control

TEXT BOOK

1. B.G Liptak, 'Instrumentation in Process Industries', Chilton Book Company, 1994.

09EI211 INSTRUMENTATION AND CONTROL IN IRON AND STEEL INDUSTRIES

Credit : 3:0:0

Course Objective:

To expose Fundamental concepts in Instrumentation and to study how it can be used in Iron And Steel Industries.

Course Outcome:

- To know the basic requirements of the iron making process.
- To know the basic requirements of the steel making process.
- To understand the concept of different measurement techniques.
- To know the different control systems used in the industries.
- To analyze the method which can be used in computer applications.

UNIT I: DESCRIPTION OF PROCESS
Flow diagram and description of the processes: Raw materials preparation, iron making, blast furnaces , stoves, raw steel making , basic oxygen furnace, electric furnace.

UNIT II: CASTING OF STEEL
Primary rolling , cold rolling and finishing.

UNIT III: INSTRUMENTATION
Measurement of level, pressure, density, temperature, flow weight, thickness and shape, graphic displays and alarms.

UNIT IV: CONTROL SYSTEMS
Blast furnace stove combustion control system, gas and water controls in BOF furnace . Sand casting old control.

UNIT V: COMPUTER APPLICATIONS
Model calculation and logging, rolling mill control, annealing process control Computer (center utilities dispatch computer).

TEXT BOOKS
1. Tupkary R.H, Introduction to Modern Iron Making , Khanna Publishers, New Delhi, 1988
2. Tupkary R.H., Introduction to Modern Steel Making, Khanna Publishers, New Delhi, 1988.

REFERENCE BOOKS
1. Liptak B. G, Instrument Engineers Handbook, volume 2, Process Control, Third edition, CRC press, London, 1995
2. Considine D.M, Process / Industrial Instruments and Control Handbook, Fourth edition, McGraw Hill, Singapore, 1993 – ISBN-0-07-012445-0
3. Swahney, K.A., "Course in Electrical & Electronics Measurement & Instrumentation", Dhanpat Rai & Sons, 2005.
4. Steel Designers Handbook 1)Branko 2)Ron Tinyou 3) Arun Syam Gorenc Seventh Edition First Indian Reprint 2006

09EI212 INSTRUMENTATION FOR POLLUTION CONTROL

Credit : 3:0:0

UNIT I : ENVIRONMENTAL MONITORING
Classification, ambient environmental monitoring –source monitoring –implant environment monitoring-personal monitoring.

UNIT II : AIR POLLUTION MONITORING
Air Pollutants- basics of monitoring technologies like conductimetry, coulemetry – pizeo eletric oscillations methods-paper tape method- optical method-air pollution monitoring instruments.

UNIT III : WATER POLLUTION MONITORING
Water pollutants –basic techniques –spectrometric methods- emission spectrograph- atomic absorption spectra photometry- water pollution monitoring instruments.

UNIT IV : NOISE POLLUTION MONITORING
Noise pollution and its measurement

UNIT V : INDUSTRIAL POLLUTANTS AND ITS MONITORING
Monitoring Instruments of industrial pollution.

TEXT BOOKS

1. Soli J. Arceilala, “Waste Water Treatment for Pollution Control”, Tata McGraw Hill, 1998, ISBN-0-07-463002-4
2. M.N.Rao, HVN Rao, “Air Pollution”, Tata McGraw Hill, 2000,ISBN-0-07-457871-2
3. B.C. Punmia, Ashok Jain, “Waste Water Engineering”, Laxmi Publication, 1998, ISBN – 81-7008-091-6
4. V.P. Kuderia, “Noise Pollution & Its Control”, Pragari Prakasan, 2000, ISBN-81-7556-186-6.

REFERENCE BOOK

1. Faith W.L., and Atkinson A.A., : “Air pollution”, 2nd edition Wiley Interscience Inc., New York, 1972.

09EI213 INSTRUMENTATION AND CONTROL SYSTEMS

Credit: 3:0:0

Course Objective:

To give an idea about the general Concepts of Mechanical Instrumentation, the sensors for various physical variables and the basic concepts of Control Systems and Stability.

Course Outcome:

- To understand the concepts of Mechanical Instruments.
- To study the principle of operation of different types of sensors used in the measurement of various physical variables.
- To learn the basics of Control Systems and the concept of Stability

UNIT I: INTRODUCTION TO MEASUREMENT

General Concepts of Mechanical Instrumentation, generalized measurement system. Classification of instruments as indicators, recorders and integrators – their working principles, Precision and accuracy. Measurement of error and analysis.

UNIT II: MEASUREMENT OF PHYSICAL VARIABLES

Measurement of displacement, speed, frequency, acceleration – vibrometer, accelerometer etc. Pressure measurement: bourdon, elastic transducers, strain gauge, pressure cells, measurement of high and low pressure. Temperature measurement: Bimetallic, resistance thermometer, thermocouples, pyrometer and thermistors, Hot-wire anemometer, magnetic flow meter, ultrasonic flow meter, calibration.

UNIT III: INSTRUMENTS FOR VISCOSITY AND STRAIN MEASUREMENT

Viscosity: capillary tube viscometer, efflux viscometer, humidity: absorption hydrometer, dew point meter. Strain: strain gauges, types, wheat stone bridge circuit, temperature compensation, gauge rosettes calibration. Force measurement: scales and torque measurement: mechanical torsion meter, electrical torsion meter.

UNIT IV: CONTROL SYSTEMS

Open and closed systems, servomechanisms, transfer functions, signal flow graphs, block diagram algebra, and hydraulic and pneumatic control systems, Two way control, proportional control, differential and integral control. Simple problems.

UNIT V: TIME RESPONSE AND STABILITY ANALYSIS
Time response of first order and second order systems, concept of stability, necessary condition for stability, routh stability criterion, simple problems.

TEXT BOOKS:

1. Sawhney, A.K., ‘Electrical and Electronics Measurements & Instrumentation’, Dhanpat Rai & Co., 2005
2. Nagrath, M. and Gopal, I.J, ‘Control Systems Engineering’, Wiley Eastern Limited, 2006.

REFERENCE BOOKS:

1. Thomas G Beckwith, Lewis Buck, N.Roy D. Maragoni, ‘Mechanical Measurements’, Narosa Publishing House, New Delhi, 1989.
2. Collet, C.V. and Hope, A.D., ‘Engineering Measurements’, 2nd Ed., ELBS.
3. Nagoor Kani. A., ‘Control Systems’, RBA Publications, 2002

09EI214 INSTRUMENTATION AND CONTROL LABORATORY

Credit: 0: 0: 1

1. Study of characteristics of strain gauge and Load Cell
2. Study of characteristics of LVDT
3. Study of characteristics of RTD
4. Study of characteristics of Thermocouple
5. Study of characteristics of Resistive potentiometer
6. Study of characteristics of Loudspeaker
7. Study of characteristics of Microphone
8. Study of characteristics of Pressure transducer
9. Study of Tachogenerator characteristics
10. Study of ON-OFF Temperature Controller

09EI215 INSTRUMENTATION AND PROCESS CONTROL

Credit : 3:0:0
Course Objective:
To learn the basics of Control Systems, Process Control, Stability analysis, and about the various sensors
Course Outcome:

- To introduce the concepts o Process control and Laplace transforms
- To understand the basic concepts of Controllers
- To learn the concept of stability and stability analysis

- To discuss the various sensors for various physical variables

UNIT I: INTRODUCTION TO PROCESS CONTROL
System – steady state design – process control – process control block diagram – definition of a process, measurement, controller, and control element, loop – damped and cyclic response- feedback control – transient responses – lap lace transform – transforms of simple functions – step function, exponential function, ramp function and sine function.

UNIT II: CONTROL SYSTEMS
Open and closed loop systems, servo- mechanisms, hydraulic and pneumatic control systems, two-way control, proportional control, differential control and integral control.

UNIT III: STABILITY ANALYSIS
Signal flow graph – Mason's Gain formula, Block diagram algebra.
Stability – concept of stability, definition of stability in a linear system, stability criterion, characteristic equation, Routh test for stability

UNIT IV: PRESSURE AND TEMPERATURE SENSORS
Pressure measurement – Construction and working of capacitive pressure sensor, Inductive pressure sensor, strain gauge, pressure sensor, diaphragm, bourdon tube, differential pressure cell
Temperature sensors –Construction and working of RTD, Thermistors, Thermocouples, bimetallic strips

UNIT V:MEASUREMENT OF LEVEL, DENSITY AND COMPOSITION
Level sensor - Simple float systems, capacitive sensing element, radioactive methods (nucleonic level sensing) – ultrasonic level sensor**.**
Measurement of density – U-type densitometer, Buoyancy meter
Measurement of composition – Electrical conductivity cell, non-dispersive photometers, pH meter, Zirconia oxygen analyser, dumbbell O2 analyser, Gas chromatograph, Mass spectrometer

TEXT BOOKS:
1. J.F Richardson A D.G.Peacock, Coulson & Richardson's " Chemical Engineering", Volume 3,(Chemical and Biochemical reactors and process control) Butherworth – Heinemann, an imprint of Elsevier ,2006.
2. Nagrath, M and Gopal, I.J, "Control Systems Engineering", Wiley Eastern Limited, 2006.

REFERENCES:
1. Donald R. Coughanowr., "Process System analysis and control" Mc- Graw Hill International Edition , Second Edition, 1991.
2.Nagoor kani.A "Control Systems", RBA publications, 1998.

09EI216 ROBOTICS AND AUTOMATION

Credit : 4:0:0
Course Objective:

To provide comprehensive knowledge of robotics in the design, analysis and control point of view.

Course outcome

- To study the various parts of robots and fields of robotics.
- To study the various sensors used in robots.
- To study the End efectors
- To study the Kinematics and dynamics of robots.
- To discuss some applications of robots in industry.

UNIT I: INTRODUCTION

Robots introduction -Basic components.-Classification—Characteristics-Drives & Control systems –Actuators-Control loop

UNIT II: SENSORS AND TRANSDUCERS

Transducers & Sensors-Tactile sensors-Proximity & Range sensors-Image Processing & Analysis-Image Data reduction-Feature extraction-Object Recognition

UNIT III: END EFFECTORS

End effectors – Types-Mechanical Grippers-Vacuum Cups-Magnetic Grippers-Robot/End effector Interface-Software for industrial robots positive stop PGM, PTP, CP

UNIT IV: ROBOT MOTION ANALYSIS

Robot motion analysis–Kinematics-Homogenous Transformations-Robot Dynamics
Configuration of Robot controller

UNIT V: APPLICATIONS

Industrial Robots –welding painting-Assembly-Remote Controlled Robots for Nuclear, Thermal, Chemical plants-Industrial Automation-Typical EGS of automated industries.

Text Books

1. Yoram Koren, “Robotics for Engineers”, McGraw Hill, 1980. ISBN-0-07-100534-X
2. Mikell P. Groover etal, “Industrial Robots – Technology Programming & Applications” McGraw Hill Ltd., 1986. ISBN-0-07-100442-4

09EI217 TELEMETRY AND TELECONTROL

Credit: 4:0:0
Course Objective:

To expose Fundamental concepts in Telemetry and to give idea where it can be used in control applications.

Course Outcome:

- To know the basic concepts of telemetry system.
- To know the different techniques used in radio telemetry.
- To understand the concept of optical telemetry system.
- To analyze the methods used for tele control.

UNIT I : TELEMETRY FUNDAMENTALS CLASSIFICATION:

Fundamental concepts: significance, principle, functional blocks of telemetry and tele control system methods of telemetry- electrical, pneumatic; hydraulic and optical telemetry-state of the art-telemetry standards. Electrical telemetry'- current systems-voltage systems synchro systems-frequency systems position and pulse systems-example of a landline telemetry system.

UNIT III : RADIO TELEMETRY

Block diagram of a radio telemetry system transmitting and receiving techniques-AM,FM,PM multiplexing -transmitting and receiving techniques- digital coding methods advantages of PCM,PWM,PPM,FSK-Delta modulation coding and decoding equipment -example of a radio telemetry system.

UNIT IV : OPTICAL TELEMETRY

Optical fibres for signal transmission -sources for fiber optic transmission - optical detectorstrends in fibre optic device development-example of an optical telemetry system.

UNIT V : TELECONTROL METHODS

Analog and digital techniques in telecontrol, telecontrol apparatus-remote adjustment. Guidance and regulation Tele control using information theory- example of a telecontrol system.

TEXT BOOKS

1. Sawhney, K.A., “Course in Electrical & Electronics Measurement & Instrumentation”, Dhanpat Rai & Sons, 2005.
2. Handbook Of Telemetry And Remote Control 1)Elliot L. Gruenberg 34075 629.8 - First L8 - Na L 2
3. Gerd Keiser., “Optical Fiber Communications”, Mcgraw Hill, 2003.

REFERENCES

1. Tomasi W, “Advanced Electronic Communication Systems”, Phi, Fifth Edition Second Indian Reprint 2003.
2. Anokh Singh, “Principles Of Communication Engineering” S.Chand Co., 2008
3. Wilbur L.Pritchard & Joseph A.Sciulli, “Satellite Communication Systems Engineering”, Prentice Hall Inc, 2nd Edition, 1st Indian Print, 2003
4. John M. Senior., “ Optical Fiber Communications Principles And Practice” Second Edition This Indian Reprint 2004

09EI218 SIGNALS AND SYSTEMS

Credit: 4 : 0 : 0

Course Objective:

To study the signals and systems and analyze this using Fourier series and transforms

Course Outcome:

- To study the different types of signals and systems
- To study the difference and differential equations
- To study the Fourier analysis of Continuous Time and Discrete Time signals and systems
- To study the representation of signal by samples-Sampling theorem
- To study the Z transform and properties

UNIT I : INTRODUCTION

Continuous Time (CT) signals – CT signal operations – Discrete Time(DT) signals – Representation of DT signals by impulses – DT signal operations – CT and DT systems – Properties of the systems – Linear Time Invariant(LTI) and Linear Shift Invariant(LSI)systems – Continuous and Discrete Convolutions – CT system representations by differential equations – DT System representations by difference equations.

UNIT II: FOURIER ANALYSIS OF CT SIGNALS AND SYSTEMS

Fourier series representation of periodic signals – Properties – Harmonic analysis of LTI systems – Convergence of Fourier series – Representation of a periodic signals by Continuous Time Fourier Transform (CTFT) – Properties – Frequency response of systems characterized by Differential Equations – Power and Energy Spectral Density – Parseval's Relation.

UNIT III: DISCRETISATION OF CT SIGNALS

Representation of CT signals by samples – Sampling Theorem – Sampling Methods – Impulse, Natural and Flat Top Sampling – Reconstruction of CT signal from its samples – Effect of under sampling – Aliasing Error – Discrete Time processing of CT signals.

UNIT IV : FOURIER ANALYSIS OF DT SIGNALS AND SYSTEMS

Discrete Time Fourier series representation of DT periodic signals – Properties –Representation of DT aperiodic signals by Discrete Time Fourier Transform(DTFT) –Properties – Frequency response of systems characterized by Difference Equations –Power and Energy Spectral Density concepts related to DT signals – Parseval's Relation.

UNIT V : TRANSFORM OPERATIONS OF DT SIGNALS AND SYSTEMS

Z transform and its properties – Inverse Z transform – Solution of Difference equations – Analysis of LSI systems using Z transform.

TEXT BOOKS

1. Alan V Oppenheim, Alan S Wilsky and Hamid Nawab S, "Signals & Systems", II Edition,Reprint PHI, New Delhi, 2005.
2. Simon Haykin and Barry Van Veen, "Signals & Systems", John Wiley and Sons Inc.,II Edition,Reprint 2008.

REFERENCES:

1. Ashok Ambardar, "Introduction to Analog and Digital Signal Processing", PWS Publishing Company, Newyork, Second Edition Second Reprint 2002.
2. Samir S Solimon and Srinath M.D., "Continuous and Discrete Signals and Systems", II Edition, PHI, 1998.
3. Rodger E Zaimer and William H Tranter, "Signals & Systems – Continuous and Discrete", McMillan Publishing Company, Fourth Edition - Indian Reprint 2005.

09EI219 CONTROL SYSTEMS

Credit: 3: 1 :0

Course Objective:

To introduce the fundamental concepts of control systems, time and frequency response analysis, stability analysis and applications.

Course Outcome:

- To understand the methods of representation of systems and to derive their transfer function models.
- To provide adequate knowledge in the time response of systems and steady state error analysis.
- To give basic knowledge in obtaining the open loop and closed–loop frequency responses of systems.
- To study the three ways of designing compensation for a control system.
- To understand the concept of stability of control system and methods of stability analysis.
- To provide adequate knowledge in the Fuzzy controller and its application in control.

UNIT I: INTRODUCTION

System concept -Open loop and closed loop systems - Basic components of control systems - Mathematical representation, block diagram, signal flow graph and transfer function of electrical systems. Translational and rotational mechanical systems.

UNIT II: TIME DOMAIN ANALYSIS

Time response - step response of first order and second order systems - time domain
Specifications - type and order of a system - steady state error - static error and generalized error coefficients -estimation of the specifications for a second order system.

UNIT III: FREQUENCY DOMAIN ANALYSIS

Frequency response analysis - frequency domain specifications. Lead, Lag and Lead-Lag compensator design - Bode plot - Polar plot - Nichol's chart - Nyquist stability criterion.

UNIT IV: STABILITY ANALYSIS

Stability - characteristic equation - location of roots in s plane for stability – Routh
Hurwitz criterion - Root Locus Techniques. P, PI, PD and PID controllers Design and applications

UNIT V: APPLICATIONS

Synchros - tachogenerator - a.c and d.c servo motor. Fuzzy controller introduction –Fuzzy controllers to reduce settling time, overshoot and oscillations – Temperature controller – Pressure controller – flow and level controller using fuzzy network controllers.

TEXT BOOKS

1. Ogata, K., "Modern Control Systems Engineering", 4th Edition, International Edition, PHI, 2006.
2. Nagrath and Gopal.,"Control System Engineering"3rd Edition, Wiley & Sons.2003.
3. Barapate, "Control System", Tech Max publications, 2006.

REFERENCE BOOKS

1. Gopal, M., "Control System", Principles & Design", TMH, 2003.
2. Benjamin C. Kuo., "Automatic Control Systems", 4th Edition, PHI, 2004.
3. B.S.Manke, "Linear Control Systems", Hanna Pub., Delhi, 2002.

09EI220 ELECTRICAL MACHINES

Credit: 3:1:0

Course Objective:

To expose the students to the concepts of various types of electrical machines and applications of electrical machines.

Course Outcome:

To impart knowledge on

- Constructional details, principle of operation, Performance, starters and speed control of DC Machines
- Constructional details, principle of operation of Transformers.
- Constructional details, principle of operation of AC Machines
- Constructional details, principle of operation of Special Machines.
- Utilization of electrical Energy.

UNIT I: DC MACHINES

Principle and theory of operation of D.C. generator – Constructional features of D.C. Machines– Characteristics of shunt, series and compound generators – Principle of operation of D.C. motor – Back E.M.F – Torque equation – Characteristics of shunt, series and compound motors – Losses and efficiency calculations – Applications of D.C. Motors – Motor starters – Speed control of D.C. motors.

UNIT II: TRANSFORMERS

Principle, constructional details of shell and core type transformer – EMF equation – No + load and on load operation – Test on Transformer – Equivalent circuit – Regulation –Testing-Load test, Open Circuit and Short Circuit test.

UNIT III: INDUCTION & SYNCHRONOUS MACHINES

Induction Motor:

Construction and principle of operation – classification of induction motor– Torque equation – Torque slip characteristics – starting and speed control.

Synchronous Motor:

Construction and principle of operation – EMF equation–V curves – Synchronization.

UNIT IV: SPECIAL MACHINES
Tachogenerator - AC and DC servomotor – Linear induction motor -Single phase motor – Double field revolving theory – Capacitor start capacitor run motors – Shaded pole motor – Repulsion type motor – Universal motor – Stepper motor.

UNIT V: UTILIZATION OF ELECTRICAL ENERGY
Electric heating-Methods of heating, Welding Generator, Electric traction-traction motors and control, Recent trends in Electric traction

Text Books

1. Albert.E.Clayton, N.N. Hancock, "The Performance and Design of Direct Current Machines", Oxford ad IDh Publishing Co. Pvt. Ltd, New Delhi,
2. Say. M. G., " Alternating Current Machines", ELBS & Piman, London, 5th
3. Rajput, R.K., "Utilisation of Electrical Power" Laxmi publications, New Delhi.,2006

Reference Books

1. Theraja, B.L. and Theraja, A.K., "Electrical Technology", Nirja Construction & Development Company Pvt. LTD, New Delhi, Vol. II, 22nd Edition, 2005.

2. Nagrath, I.J., "Electric Machines", Tata McGraw hill Edition, 2002.

09EI221 ELECTRONIC CIRCUITS

Credit: 4: 0: 0
Course Objective:
To introduce the concepts of Power Supplies, amplifiers, oscillators and their design.
Course Outcome:

- To learn the basics of power supplies
- To study and analyse wave shaping circuits
- To study the design of various amplifiers, power amplifiers and oscillators.

UNIT – I : POWER SUPPLIES

Rectifiers – Half Wave and Full Wave Rectifiers - Average and RMS Value – Ripple Factor – Regulation –Rectification efficiency – Transformer Utility Factor – Filters _ Inductor, Capacitor, L Type,PI Type, Ripple factor and regulation- Need for voltage regulator – Series and Shunt regulators – Comparison – Current limiting and protection circuits - Switched mode power supplies.

UNIT – II : WAVE SHAPING
Response of High Pass and Low Pass RC circuit for sinusoidal, step,pulse, square, ramp and exponential inputs – Linear Wave Shaping – Integrator, Differntiator, Applications – Non-linear wave Shaping – Clipping and clamping circuits, calmping circuit theories, Applications, Attenuator – Introduction to pulse transformers

UNIT – III : AMPLIFIER

BJT and FET amplifiers – Cascaded BJT amplifiers – RC coupled amplifier- Analysis at low, medium and high frequencies – BIFET amplifiers – DC amplifiers – Problems in DC amplifiers - Differential and Common mode gain – CMRR – Cascade and Darlington Amplifiers –Chopper Amplifiers.

UNIT – IV : POWER AMPLIFIERS AND FEED BACK AMPLIFIERS

Power Amplifiers – Classification – Class A/B/C – Single ended and Push ended – Configuration – Power Dissipation and output power- Conversion efficiencies- Complementary symmetry power amplifiers- Class AB operation –Power FET(NMOS)- Basic concepts of feedback amplifiers – Effect of negative feedback on input, output resistances, gain, stability, distortion and bandwidth – Voltage and current feedback circuits

UNIT – V : OSCILLATORS

Barkhausen criteria – RC and LC oscillators – Frequency stability of oscillators – Crystal oscillators – Non-sinusoidal oscillators – Review of switching Characteristics of Transistor – Multivibrators- Bistable, Monoslable, Astable and Schmitt trigger.

TEXT BOOKS:

1. Jacob Millman and Arvind Grabel, 'Microelectronics', 2nd edition, Mc Graw hill international edition , 1997.
2. Jacob Millman and Halkias C.,'Integrated Electronics', Mc Graw hill, 5th reprint, 2008

REFERENCES:

1. David A Bell, 'Electronic Devices and Circuits', Prentice hall of India, New Delhi, 2004
2. Thomas Floyd, "Electronic Devices", Prentice Hall of India, 2003
3. Boylestad L. Robert and Nashelsky Louis, 'Electronic Devices and Circuits', Prentice hall of India, New Delhi, 2003

09EI222 MICROPROCESSORS AND MICRO CONTROLLERS

Credit: 4: 0: 0

Course Objective:

To equip the students with relevant knowledge about the functions of a central processing unit on a single integrated circuit (IC)

Course Outcome:

- Adequate knowledge about functions of a microprocessor and microcontroller.
- Details of instructions used in microprocessor and microcontroller for the execution of program.
- Exposure in the applications of the processor in interfacing of LED, Keyboard, stepper motor.
- To write the assembly language program by using different instructions.

UNIT I: ARCHITECTURE OF 8085

Architecture of 8085 Microprocessor : Functional Block Diagram – Registers, ALU, Bus systems – Timing and control signals Machine cycles and timing diagrams.

UNIT II: PROGRAMMING OF 8085
Instruction formats – Addressing modes – Instruction set –Need for assembly language programmes.

UNIT III: I/O INTERFACING
Memory mapped I/O scheme – I/O mapped I/O scheme – Input and Output cycles _ Simple I/O ports – Programmable peripheral interface(8255). Data transfer schemes – Interfacing simple keyboards and LED displays.

UNIT IV: INTERRUPTS AND DMA
Interrupt feature – Need for Interrupts – Characteristics of Interrupts – Interrupt structure – Methods of servicing Interrupts – Development of Interrupt service subroutines – Multiple Interrupt requests and their handling – Need for direct memory access – Devices for Handling DMA – Typical DMA Controller features.
APPLICATIONS: Multiplexed seven segment LED display systems – Waveform generators – Stepper motor control – Measurement of frequency, phase angle and power factor – Interfacing ADC0801 A/D Converter –DAC 0800 D/As Converters.

UNIT V: INTEL 8051 MICROCONTROLLER
Architecture of 8051 – Memory Organization –Addressing modes – Instruction set – Boolean processing – Simple programmes.
8051 PERIPHERAL FUNCTIONS : 8051 interrupt structures – Timer and serial functions – Parallel port features : Modes of operations – Power control, features – Interfacing of 8051 – Typical applications – MCS 51 family features 8031/8051/8751

TEXT BOOKS

1. Ramesh S. Gaonkar, "Microprocessor Architecture, Programming, and Applications with the 8085", Fifth Edition, Prentice Hall, 2002.
2.Barry B. Brey, "Intel Microprocessors-Architecture, Programming, and Interfacing", Seventh Edition, Prentice Hall, 2006
4. The 8051 Microcontroller Architecture, Programming & Applications II Edition
Kenneth J Ayala PRI ISBN 81-900828-4-1, 2005

REFERENCES:

1. Muhammad Ali Mazidi, Janice Mazidi, Janice Gillispie Mazidi "The8051 Microcontroller and Embedded Systems, SBN 81-203.2751-9, Prentice Hall, 2005.
2.Microcontroller Hand Book, INTEL, 2008.
3.Douglas V. Hall, "Microprocessors And Interfacing: Programming And Hardware", Third Edition, Tata Mc Graw Hill, 2003.

09EI223 MICROPROCESSORS AND MICRO CONTROLLERS LABORATORY
Credit: 0:0:1

10 experiments will be notified by the HOD from time to time

09EI224 LOGIC AND DISTRIBUTED CONTROL SYSTEMS

Credit: 4: 0: 0

Course Objective:

To introduce the fundamental concepts of ladder logic programming and Distributed control Systems.

Course Outcome:

- To introduce the use of computers in control applications
- To learn Programmable Logic Controllers and PLC programming
- To study the concepts of DCS.

UNIT-I : REVIEW OF COMPUTERS IN PROCESS CONTROL

Data loggers: Data acquisition systems (DAS): alarms, computer control hierarchy levels. Direct Digital control (DDC). Supervisory digital control (SCADA). Characteristics of digital data. Controller software. Linearization. Digital Controller modes, error, proportional, derivative and composite controller modes.

UNIT-II : PROGRAMMABLE LOGIC CONTROLLER(PLC) BASICS

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

UNIT-III : PLC INTERMEDIATE FUNCTIONS

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

UNIT-IV : INTRODUCTION TO DCS

Evolution of DCS - building blocks - detailed descriptions and functions of field control units - operator stations - data highways - redundancy concepts.

UNIT-V: IMPLEMENTATION OF DCS

DCS - supervisory computer tasks and configuration - DCS- system integration with PLC and computers. Communication in DCS. DCS in Steel and Cement Industries.

Text Books:

1. John Webb, W, Ronald Reis, A.,: “ Programmable logic controllers principles and applications”, 3/e, Prentice hall Inc., New Jersey, 1995.
2. Krishna Kant.,: “ Computer based industrial control”, Prentice Hall India. 1997.

Reference Books:

1. 1. Lukcas , M.P.,: “ Distributed control systems”, Van Nostrand Reinhold Co., New York ,1986.
2. Moore., : “ Digital control devices” , ISA Press, 1986.

3. Hughes, T, “ Programmable logic controllers”, ISA Press 1994.
4. Mckloni, D.T.,: “Real time control networks” , ISA Press 1994.
5. Deshpande, P.B, and Ash ,R.H.,: “ Elements of process control applications” , ISA Press 1995.

09EI225 EMBEDDED INSTRUMENTATION

Credit: 4: 0: 0

Course Objective:

To equip the students with relevant knowledge about Real-Time Operating System (RTOS) concepts which is a multitasking operating system intended for real-time applications.

Course Outcome:

- Adequate knowledge about Real time systems.
- Details of Architecture, interrupt handling mechanism in 68HC11 microcontroller.
- Exposure in RTOS concepts.
- Applications of Real time systems in the navigation, communication purposes.

UNIT I : INTRODUCTION

system evolution trends – basic real time concepts – real time design Microcontrollers – architecture – instruction set – interrupt handling – integrating system – examples – the shared data problem – software architecture.

UNIT II : REAL TIME OPERATING SYSTEMS (RTOS)

Real time specifications – real time kernels – inter-task communications and synchronizations – real time memory management.

UNIT III : SYSTEM PERFORMANCE, ANALYSIS AND OPTIMIZATION

Response – time calculation – interrupt latency – time loading and its measurement – scheduling – reducing response times and time loading – analysis of memory requirements – reducing memory loading – input – output performance.

UNIT IV : DEBUGGING TECHNIQUES AND DEVELOPMENT TOOLS

Faults, failures, bugs and effects – reliability – testing – fault tolerance – host and target machines – linker / locators for embedded software – getting embedded software into target system.

UNIT V : REAL TIME APPLICATIONS

Real time system as complex systems – real time databases – real time image processing – real time Unix – building real time applications with real time programming languages. An example : The tank monitoring system

TEXT BOOKS

1. Philip A. Laplante, “Real Time Systems Design and Analysis: An Engineer’s Handbook”, edition, Prentice Hall of India, New Delhi, Second Edition 2005.
2. David E. Simon, “An Embedded Software Primer”, Addision Wesley, New Delhi, 2005

REFERENCE BOOKS

1. Raj Kamal, “Embedded Systems” McGraw Hill, 2nd Edition, 2008.

2. John B.Peatman, "Design with Microcontrollers", McGraw Hill Book Co., Newyork,1988.
3.W. Valvano ,Thomson Brroks, "Embedded Microcomputer Systems", Jonathan, 1st Edtion, 2002
2. Jane W.S. Liu, "Real Time Systems", Pearson International Edition, 1st Indian Reprint, 2001.

09EI226 NETWORKS & PROTOCOLS FOR INSTRUMENTATION & CONTROL

Credit: 4: 0: 0

Course Objective:

To equip the students with relevant knowledge about network that allows computers to communicate with each other and share resources and information.

Course Outcome:

- Adequate knowledge about protocols and standards of OSI model.
- Details of different interface standards.
- Exposure in the industrial protocol.
- Clear idea about the network topologies, internetworking connections.

UNIT I: INTRODUCTION AND BASIC PRINCIPLES

Protocols, physical standards, modern instrumentation, Bits, Bytes and characters, Communication principles, Communication modes. Synchronous and Asynchronous systems, Transmission Characteristics Data Coding, UART.

UNIT II: SERIAL COMMUNICATION STANDARDS :

Standards organizations , Serial data communications interface standards, Balanced and unbalanced transmission lines, RS232,422,,423,449,485 interface standard ,Troubleshooting, The 20mA current loop, Serial interface converters ,Interface to printers, IEEE 488,USB.

UNIT III: INTRODUCTION TO PROTOCOLS

Flow control Protocols ,BSC Protocols, HDLC,SDLC,Data communication for Instrumentation and Control, Individual OSI layers, OSI Analogy-example

UNIT IV: INDUSTRIAL PROTOCOLS

Introduction, ASCII based protocols, Modbus Protocols,Allen Bradley Protocol, HART, field bus.

UNIT V: LOCAL AREA NETWORKS:

Circuit and packet switching, Network Topologies, LAN Standards, Ethernet,MAC,Token bus,Internet work connections, NOS, Network Architecture and Protocols.

TEXT BOOK.

1. Practical Data Communications for Instrumentation and Control by John Park, Steve Mackay, Edwin Wright. Elseiver Publications. I Edition ISBN 0750657979,2003.

REFERENCE BOOKS:

1. Stallings W. "High speed Networks TCP/IP and ATM Design Principles " PHI , Second edition,2002.
2. Behrouz A. Forouzan " Data Communication and Networking" IV Edition TMH, 2006

09EI301 INDUSTRIAL INSTRUMENTATION

Credit: 4: 0: 0

Course Objective:

To provide sound knowledge about various techniques used for the measurement of industrial parameters.

Course Outcome:

- To have an adequate knowledge about pressure transducers.
- To have an idea about the temperature standards, thermocouples and pyrometry techniques.
- To study about area flow meters, mass flow meters and calibration.
- To know about various types of level measurements adopted in industry environment.
- To know about the features of smart instruments and reliability.

UNIT I: PRESSURE MEASUREMENT

Pressure standards - Dead weight tester - Different types of manometers - Elastic elements-Electrical methods using strain gauge-High pressure measurement-Vacuum gauges – Mcleod gauge - Thermal conductivity gauges -Ionization gauge- Differential pressure transmitters - Installation and maintenance of pressure gauges

UNIT II: FLOW MEASUREMENT

Positive displacement flowmeters - Inferential flowmeter-Turbine flowmeter-Variable head flowmeters -Rotameter - Electromagnetic flowmeter - Ultrasonic flowmeter-Coriolis mass flowmeter- Calibration of flowmeters - Installation and maintenance

UNIT III: TEMPERATURE MEASUREMENT

Temperature standards - fixed points -filled-system thermometers - Bimetallic thermometer-Thermocouple - Laws of thermocouple - Cold junction compensation- Measuring circuits - Speed of response -linearization - Resistance thermometer- 3 lead and 4 lead connections - thermistors - IC temperature sensors - Radiation pyrometer- Optical Pyrometer-Installation, maintenance and calibration of thermometers and thermocouples.

UNIT IV: LEVEL MEASUREMENT

Visual techniques - Float operated devices - Displacer devices - Pressure gauge method - Diaphragm box-Air purge system-Differential pressure method – Hydro-step for boiler drum level measurement - Electrical methods - Conductive sensors - capacitive sensors –Ultrasonic method - Point level sensors-Solid level measurement

UNIT V: SMART INSTRUMENTATION AND RELIABILITY ENGINEERING

Smart intelligent transducer- Comparison with conventional transducers- Self diagnosis and remote calibration features- Smart transmitter with HART communicator- Reliability Engineering- Definition of reliability -Reliability and the failure rate – Relation between reliability and MTBF- MTTR - Maintainability - Availability – Series and parallel systems

TEXT BOOKS

1. Doeblin E.O.I, Measurement Systems: Application and Design, Fifth Edition, McGraw-Hill Publishing Co.; 5th edition (2003)
2. Patranabis, D., 'Principles of Industrial Instrumentation', Second Edition Tata McGraw Hill Publishing Co. Ltd.. New Delhi. 1997, ISBN 0074623346

REFERENCE BOOKS

1. Liptak B. 'Process Measurement and Analysis', 3rd Edition Chilton book company Radnor, pennsylvania, 1995 ISBN 0-7506-2255.
2. Tatamangalam R., 'Industrial Instrumentation Principles and Design', Springer Verlag, 2000 ISBN 1852332085
3. Noltingk, B.E., "Instrumentation Reference Book", II Edition Butterworth Heinemann, 1996
4. R. K. Jain, 'Mechanical and Industrial Measurements', Khanna Publishers, New Delhi, 1999
5. S.K. Singh, 'Industrial Instrumentation and Control', Tata McGraw Hill

09EI302 PROCESS CONTROL

Credit : 3:1:0

Course Objective:

To provide basic knowledge of controllers, find control elements and the processes.

Course Outcome:

- To study the basic characteristics of various processes.
- To get adequate knowledge about the characteristics of various controller modes and methods of tuning of controller.
- To study about various complex control schemes.
- To study about the construction, characteristics and application of control valves.
- To study some industrial applications.

UNIT: I -INTRODUCTION TO PROCESS CONTROL

Process dynamics- Elements of process control- Process variables- Degrees of freedom- Modeling of liquid process, gas process, flow process, thermal process, mixing process- Chemical reaction-Modeling

UNIT: II. -CONTROL ACTION AND CONTROLLER TUNING

Basic control action- Characteristic of ON-OFF, proportional floating control, integral and derivative models- Response of Controllers for different types of test inputs-selection of control mode for different process with control scheme-Optimum controller settings- Tuning of controllers by process reaction curve method- Continuous cycling method, damped oscillation method- Ziegler Nichol's tuning-Cohen Coon method -Pole placement method

UNIT: III -DESIGN OF CONTROLLERS FOR NONLINEAR SYSTEMS

Design of PI, PID controller for integrator, dead time, time delay systems- Design of non-linear controller with input multiplicities

UNIT: IV -DESIGN OF CONTROLLERS FOR MULTIVARIABLE SYSTEMS

Introduction to multivariable system-evolution of loop interaction –evolution of relative gains- single loop and overall stability- model equations for a binary distillation column- Transfer function matrix- Method of inequalities- Decoupling control- Centralized controller

UNIT: V -COMPLEX CONTROL TECHNIQUES

Feed forward control- Ratio control- Cascade control- Split range control- Averaging control- Inferential control-Model predictive control- Adaptive control- Internal model control- Dynamic matrix control-model -Generalized predictive control

Text Books
1. Harriot P, ‘Process control’, Tata McGraw Hill Publishing Co., New Delhi, 1995 ISBN 8170237963
2. M.Chidambaram, ‘Non-Linear Process Control’, Allied Publishers, 1998 ISBN 8170237963

Reference Books
1. Norman A Anderson, Instrumentation for process measurement and control, CRC Press LLC, Florida, 1998 ISBN 0849398711
2. Marlin. T.E., Process Control, Second Edition McGraw Hill NewYork, 2000 ISBN 0070404917
3. D.P. Eckman, Automatic Process Control, Wiley Eastern Limited, New Delhi ISBN 0852262051
4. Sinskey, Process Control System, Forth Edition, McGraw Hill, Singapore, 1996 ISBN 0876645295
5. Curtis D. Johnson, Process Control Instrumentation Technology, Seventh Edition, Prentice Hall, New Delhi, 2000 ISBN 8120309871
6. Stepanopoulos, ‘Chemical Process Control: An Introduction Theory and Practice’, Prentice Hall, New Delhi 1999 ISBN 8120306651

09EI303 REAL TIME AND EMBEDDED SYSTEMS

Credit : 4:0:0

Course Objective:

To introduce the basic concepts of Embedded Systems and the various techniques used for Embedded Systems with real time examples.

Course Outcome:

- To discuss the basics o embedded systems and the interface issues related to it.
- To learn the different techniques on embedded systems
- To discuss the real time models, languages and operating systems
- To analyze real time examples

UNIT I: SYSTEM DESIGN

Definitions - Classifications and brief overview of micro-controllers microprocessors and DSPs - Embedded processor architectural definitions - Typical application scenario of embedded systems

UNIT II: INTERFACE ISSUES RELATED TO EMBEDDED SYSTEMS

A/D, D/A converters - Interfacing to External Devices – Switches – LED/LCD Displays – Relays – Dc Motor – Stepper Motor.

UNIT III: TECHNIQUES FOR EMBEDDED SYSTEMS

State Machine and state Tables in embedded design – Event based, Process based and Graph based models – Petrinet Models - Simulation and Emulation of embedded systems - High level language descriptions of S/W for embedded system - Java based embedded system design.

UNIT IV: REAL TIME MODELS, LANGUAGE AND OPERATING SYSTEMS

Real time languages - Real time kernel, OS tasks, task states, task scheduling, interrupt processing, clocking communication and synchronization, control blocks, memory requirements and control, kernel services.

UNIT V: CASE STUDIES
Case Studies of Embedded System Design – Automatic Chocolate Vending machine – Digital Camera – Adaptive Cruise Control System in a Car – Smart Card.

TEXT BOOKS
1. RajKamal, "Embedded Systems Architecture, Programming and Design", Tata McGrawHill , Second Edition, 2008
2. Tim Wilhurst, "An Introduction to the Design of Small Scale Embedded Systems, Palgrave, 2004.

REFERENCE BOOKS

1. Tammy Noergaard, "Embedded Systems Architecture", Elsevier, 2005.
2. Frank Vahid, Tony Givargis, "Embedded Systems Design", Wiley India, 2006

09EI304 DIGITAL INSTRUMENTATION

Credit: 4:0:0
Course Objective:
To introduce the basic concepts of digital techniques and digital instrumentation.
Course Outcome:
- To review the basics of digital electronics
- To learn the various digital methods of measurement
- To discuss the digital display and recording devices
- To understand the concept of digital signal analysis
- To discuss the current trends in digital instrumentation

UNIT I : INTRODUCTION
Digital codes - memory devices - basic building blocks - gates, FF and counters – discrete data handling - sampling - sampling theorem - aliasing errors -reconstruction - extrapolation - synchronous and asynchronous sampling.

UNIT II : DIGITAL METHODS OF MEASUREMENTS
Review of A/D, D/A techniques –F/V and V/F conversion techniques -digital voltmeters and multimeters-automation and accuracy of digital voltmeters and multimeters - digital phase meters -digital tachometers -digital frequency, period and time measurements-Low frequency measurements -automatic time and frequency scaling - sources of error -noise -inherent errors in digital meters, Hidden errors in conventional ac measurements- RMS detector in digital multimeters- mathematical aspects of RMS.

UNIT III : DIGITAL DISPLAY & RECORDING DEVICES
Digital storage oscilloscopes -digital printers and plotters -CDROMS -digital magnetic tapes, dot matrix and LCD display CROs, Colour Monitor, Digital Signal Analyser, and Digital Data Acquisition.

UNIT IV : SIGNAL ANALYSIS

Amplifiers, filters, transmitter, receiver, wireless base and mobile station test sets, noise figure meters, RF network analyser, and high frequency signal sources.

UNIT V : CURRENT TRENDS IN DIGITAL INSTRUMENTATION

Introduction to special function add on cards -resistance card -input and output cards -counter, test, and time of card and Digital Equipment construction with modular designing; interfacing to microprocessor, micro-controllers and computers. Computer aided software engineering tools (CASE) -use of CASE tools in design and development of automated measuring systems -interfacing IEEE cards -intelligent and programmable instruments using computers.

TEXT BOOKS

1. D.Patranabis, Principles of Electronic Instrumentation ,PH,2008
2. Bouwens, A.J. "Digital instrumentation" McGraw Hill 1984
3. John Lenk, D. "Handbook of Microcomputer Based Instrumentation and Control"; PH, 1984.

REFERENCES

1. Doebelin, Measurement System, Application & Design, IV Ed, McGraw Hill, 1990.
2. Albert.D.Helfrick, William D.Cooper, Modern Electronic Instrumentation and Measurement Techniques
3 Oliver&Cage , Electronic measurements & Instrumentation, McGraw Hill,1987
4. T.S.Rathore, Digital Measurement Techniques, Narosa Publishing House

09EI305 ADVANCED DIGITAL PROCESS CONTROL

Credit: 4:0:0
Course Objective:

To learn the basic concepts of computer based process control.

Course Outcome:

- To review the concept of sampling and pulse transfer function
- To learn the design techniques for digital controllers
- To introduce the Programmable Logic controller and its functions.

UNIT: I INTRODUCTION TO COMPUTER PROCESS CONTROL

Review of sample theory-Response of sample data system to step and ramp input- steady state error-Z domain equipment- Linear transformation- Pulse transfer function-Modified Ztransform-Sample data model for continuous system bilinear transformation- Jury's Stability Test

UNIT: II DESIGN OF DIGITAL CONTROLLER

Digital PID –Deadbeat- Dahlin's algorithms-Kalman's algorithms-Implementation of control algorithm using microprocessor- Position and Velocity forms-Dead time compensation and smith predictor algorithm

UNIT: III PROGRAMMABLE LOGIC CONTROLLER
Introduction- Overview of PLC systems- I/O Modules- Power supplies General PLC programming procedures-Programming ON-OFF outputs- Auxiliary commands and functions- Creating ladder diagrams from process control descriptions- PLC basic functions-Register basics-Timer and counter functions

UNIT: IV PLC INTERMEDIATE FUNCTIONS
Arithmetic functions- Comparison function-SKIP and MCR function-Data move system-PLC - advanced intermediate function- Utilizing digital bits- Sequencer functions- Matrix functions- PLC advanced function- Alternate programming language- Analog PLC operation- Networking of PLC- PLC installation- Design of interlocks and alarms using PLC- Three way traffic light problem- Annunciator problem-Trouble shooting and Maintenance

UNIT: V -APPLICATIONS
Implementation of microprocessor based position and temperature control systems-Operational features of stepping motor- Drive circuits- Interfacing of stepper motor to computer- Interfacing of computer with temperature flow, level process

TEXT BOOKS:
1. Gopal M., ‘Digital Control and State Variable Methods’, Tata McGraw Hill Pub., 2003. ISBN 0070483027
2. HughesT.A., Programmable Logic Controllers, ISA Press, 2000 ISBN 1556177291

REFERENCE BOOKS
1 Despande P.B. and Ash R.H., Computer Process Control, ISA Publication, USA, 1988 ISBN 155617005X
2 Houpis C.H, Lamont G.B., Digital Control Systems - Theory, Hardware, Software, McGraw Hill Book Co., 1991, ISBN 0070305005
3. Kuo.B, Digital Control Systems, Oxford University Press, 1991 ISBN 0030128846
4. John Webb, W, Ronald Reis, A.,: “ Programmable logic controllers principles and applications”, 3/e, Prentice hall Inc., New Jersey, 1995.

09EI306 COMPUTER ARCHITECTURE

Credits: 4 : 0 : 0

Course Objective:
To expose the fundamental concepts of computer architecture.

Course Outcome:
- To know the basics of computer designing.
- To study the pipelining and scheduling.
- To understand the Hardware versus software speculation mechanisms.
- To study the storage devices.
- To analyze the different memory architectures.

UNIT I: FUNDAMENTALS OF COMPUTER DESIGN
Review of fundamentals of CPU, Memory and IO – Performance evaluation – Instruction set principles – Design issues – Example Architectures.

UNIT II: INSTRUCTION LEVEL PARALLELISM
Pipelining and handling hazards – Dynamic Scheduling – Dynamic hardware prediction – Multiple issue – Hardware based speculation – Limitations of ILP – Case studies.

UNIT III: INSTRUCTION LEVEL PARALLELISM WITH SOFTWARE APPROACHES

Compiler techniques for exposing ILP – Static branch prediction – VLIW & EPIC – Advanced compiler support – Hardware support for exposing parallelism - Hardware versus software speculation mechanisms – IA 64 and ltanium processor.

UNIT IV: MEMORY AND I/O
Cache performance – Reducing cache miss penalty and miss rate – Reducing hit time – Main memory and performance – Memory technology. Types of storage devices – Buses – RAID – Reliability, availability and dependability – I/O performance measures – Designing an I/O system.

UNIT V: MULTIPROCESSORS AND THREAD LEVEL PARALLELISM
Symmetric and distributed shared memory architectures – Performance issues – Synchronization – Models of memory consistency – Multithreading.

TEXT BOOK:
1. John L.Hennessey and David A.Patterson, "Computer Architecture: A Quantitative Approach", Third Edition, Morgan Kaufmann, 2006.

REFERENCE :
1. William Stallings, " Computer Organization and Architecture", Prentice Hall of India, 6 Edition Fourth Indian Reprint 2005
2.Kai Hwang " Advanced Computer Architecture ". TMH Edition 2001 Thirteenth Reprint 2006.
3.Nicholas Carter, Raj Kamal, "Computer Architecture" Indian Special Edition 2006, First Reprint 2007.
4.Dezso Sima, Terence Fountain, Peter Kacsuk, Advanced Computer Architectures Eighth Indian Reprint 2005.

09EI307 EMBEDDED NETWORKING

Credits: 4 : 0 : 0
Course Objective:
To expose Fundamental concepts of CAN and the use of it in embedded networking.
Course Outcome:
- To know the Communication requirements of CAN.
- To study the network configuration.
- To study the CAN Controller.
- To analyze the different implementation methods.
- To study the Data types & Data objects.

UNIT I: EMBEDDED NETWORKING
Embedded networking – code requirements – Communication requirements –Introduction to CAN open – CAN open standard – Object directory – Electronic Data Sheets & Device – Configuration files – Service Data Objectives – Network management CAN open messages – Device profile encoder.

UNIT II : CAN OPEN CONFIGURATION
CAN open configuration – Evaluating system requirements choosing devices and tools – Configuring single devices – Overall network configuration – Network simulation – Network Commissioning – Advanced features and testing.

UNIT III : CONTROLLER AREA NETWORK
Controller Area Network – Underlying Technology CAN Overview – Selecting a CAN Controller – CAN development tools.

UNIT IV : IMPLEMENTATION OF CAN
Implementing CAN open Communication layout and requirements – Comparison of implementation methods – Micro CAN open – CAN open source code – Conformance test – Entire design life cycle.

UNIT V :IMPLEMENTATION ISSUES
Implementation issues – Physical layer – Data types – Object dictionary – Communication object identifiers – Emerging objects – Node states.

TEXT BOOK:

1 Glaf P.Feiffer, Andrew Ayre and Christian Keyold "Embedded Networking with CAN and CAN open". Embedded System Academy 2005.

09EI308 MOBILE COMMUNICATION

Credits: 4 : 0 : 0

Course Objective:
To study the Mobile communication.

Course Outcome:
- To study the basics of transmission.
- To study the Telecommunication Systems.
- To study the Broadcast Systems.
- To analyze the different mobile communication layers.
- To study the applications of Mobile communication.

UNIT I: INTRODUCTION
Introduction - Wireless Transmission: Frequencies for radio transmission, Signals, Antennas, Signal Propagation, Multiplexing, Modulation, Spread Spectrum, Cellular Systems Medium Access Control: Motivation, SDMA, FDMA, TDMA, CDMA – Comparison

UNIT II: TELECOMMUNICATION SYSTEMS
Telecommunication Systems: GSM, DECT, TETRA, UMTS and IMT- 2000
Satellite Systems: Basics - Routing - Localization – Handover.

UNIT III: BROADCAST SYSTEMS
Broadcast Systems: Cyclic repetition of data - Digital audio broadcasting, Digital video Broadcasting Wireless LAN: Infrared Vs radio transmission, Infrastructure and ad hoc networks, IEEE 802.11, HYPERLAN, Bluetooth.

UNIT IV: WIRELESS ATM
Wireless ATM: Motivation, Working group, WATM services, Reference model, Functions, Radio access layer, Handover, Location management, Addressing, Quality of service, Access point control protocol Mobile network layer: Mobile IP, Dynamic host configuration protocol, Ad-hoc networks

UNIT V: MOBILE TRANSPORT LAYER
Mobile transport layer: Traditional TCP, Indirect TCP, Snooping TCP, Mobile TCP, Fast retransmission/ fast recovery, Selective retransmission, Transaction oriented TCP
Support for mobility: File systems, World Wide Web, Wireless application protocol.

TEXTBOOK:

Jochen Schiller, Mobile Communications, Second Edition, Pearson Education, 2004.
ISBN 81-297-0350-5.

REFERENCE BOOK:

Yi-Bing Lin and Imrich Chlamtac, Wireless and Mobile Network Architecture, Second Edition, John Wiley and Sons, 2001.

09EI309 MOBILE COMPUTING

Credits: 4 : 0 : 0

Course Objective:

To study the computing techniques of Mobile communication.

Course Outcome:

- To study the Pervasive Computing techniques.
- To study the Smart Sensor applications.
- To study application of JAVA in Mobile Computing.
- To study different protocols.
- To study different security techniques.

UNIT I: INTRODUCTION
Introduction-Pervasive Computing- Principles-Pervasive Information Technology-Information Access Devices-Handheld Computers-Palm OS-Based Devices-Windows CE-Based Handheld Computers-EPOC Based Handheld Computers-Phones-Cellular Phones-Data Transmission Capabilities-Smart Phones-Screen Phones.

UNIT II: SMART IDENTIFICATION
Smart Identification-Smart Cards-Smart Labels- Smart Tokens-Embedded Controls-Smart Sensors and Actuators –Smart Appliances- Appliances and Home Networking-Automotive Computing. Entertainment Systems-Television Systems –Game Consoles.

UNIT III: JAVA

Java- Characteristics- Libraries –Java Editions – Micro Editions- Personal Java & Embedded Java-Development Tool For Java – Operating Systems- Windows CE –Palm OS -Symbian OS- Java Card – Client Middleware – Programming APIS- Smart Card Programming – Messaging Components- Database Components

UNIT IV: COMPUTER NETWORKING

Connecting The World- Internet Protocols And Formats-Http-Html-Xml –Mobile Internet The WAP 1.1 Architecture – Wireless Application Environment 1.1- WAP 2.0 Architecture – I-Mode - Voice – Voice Technology Trends – Voice On The Web –Web Services – Architecture – WSDL – UDDI – Soap- WSRP – Connectivity – Wireless Wan – Short Range Wireless Communication – Home Networks – Universal Plug And Play .

UNIT V : DATA SECURITY

Security- Information Security- Security techniques and algorithms- Security Protocols- Public Key Infrastructure- Trust- Security Models- Security frameworks for Mobile Environment- Services- Home services- Travel services- Business Services- Consumer Services.

TEXT BOOKS:

1. Uwe Hansmann, Lothar Merk, Martin S.Nicklous and Thomas Stober, Principles of Mobile Computing, Second Edition, Springer International Edition, 2003. ISBN 81-8120-073-3.
2. Asoke K Talukder, Roopa R Yavagal, Mobile Computing, Tata McGraw- Hill Publishing Company Limited 2005. ISBN 0-07-058807-4.

REFERENCE BOOK:

1. Yi-Bing Lin and Imrich Chlamtac, Wireless and Mobile Network Architecture, JohnWiley and Sons Inc., 2001. ISBN 0-471-39492-0.
2. Jochen Schiller, Mobile Communication, Pearson Education, 2000. ISBN 81-7808-170-9.

09EI310 EMBEDDED SYSTEM SOFTWARE DESIGN

Credits: 4 : 0 : 0

Course Objective:

To study the software designing used in embedded systems.

Course Outcome:

- To study the basics of C programming.
- To study the programming in assembly.
- To analyse the object oriented concepts.
- To study the Object Behaviour of UML.
- To study embedded applications.

UNIT I: LOW LEVEL PROGRAMMING IN C

Primitive data types – Functions – recursive functions – Pointers - Structures – Unions – Dynamic memory allocations – File handling – Linked lists

UNIT II: C AND ASSEMBLY

Programming in Assembly – Register usage conventions – typical use of addressing options – instruction sequencing – procedure call and return – parameter passing – retrieving parameters – everything in pass by value – temporary variables.

UNIT III: OBJECT-ORIENTED ANALYSIS AND DESIGN

Connecting the Object Model with the Use Case Model. Key Strategies for Object-Identification - Underline the Noun Strategy. Identify the Casual Objects - Identify Services (Passive Contributors) - Identify Real-World Items - Identify Physical Devices - Identify Key Concepts - Identify Transactions - Identify Persistent Information - Identify Visual Elements. Identify Control Elements - Application Scenarios.

UNIT IV: UNIFIED MODELLING LANGUAGE

Object State Behaviour - UML State charts - Role of Scenarios in the Definition of Behaviour - Timing Diagrams - Sequence Diagrams - Event Hierarchies - Types and Strategies of Operations - Architectural Design in UML Concurrency Design - Representing Tasks - System Task Diagram - Concurrent State Diagrams - Threads. Mechanistic Design - Simple Patterns.

UNIT V: APPLICATION

Multi threaded applications – assembling embedded applications – polled waiting loop and interrupt driven I/O – preemptive kernels and shared resources - system timer – scheduling – client server computing.

TEXT BOOK:

1. Bruce Powel Douglas, "Real-Time UML, Second Edition: Developing Efficient Objects for Embedded Systems (The Addison-Wesley Object Technology Series)", 2 edition (2000), Addison-Wesley.
2. Daniel W. Lewis, "Fundamentals of Embedded Software where C and Assembly meet" PHI 2002.

REFERENCE BOOK:

1. Peter Coad, Edward Yourdon, " Object Oriented Analysis, First Indian Reprint 2001
2. Simon Bennett , Steve Mcrobb, Ray Farmer, "Object Oriented Systems Analysis And Design Using Uml, Second Edition
3. Phillip A. Laplante , "Real Time Systems Design And Analysis, Third Edition Second Reprint 20

09EI311 INTELLIGENT CONTROLLERS

Credit: 4:0:0

Course Objective:

To introduce the basic concepts of intelligent controllers and its applications in Control.

Course Outcome:

- To give a solid understanding of Basic Neural Network, Fuzzy Logic and Genetic algorithms.

- To know how to use Soft Computing to solve real-world problems mainly pertaining to Control system applications

UNIT I : INTRODUCTION TO NEURAL NETWORKS
Introduction - biological neurons and their artificial models - learning, adaptation and neural network's learning rules - types of neural networks- single layer, multiple layer- feed forward, feedback networks; back propagation -learning and training -Hopfield network.

UNIT II : NEURAL NETWORKS FOR CONTROL APPLICATIONS
Neural network for non-linear systems -schemes of neuro control- system identification forward model and inverse model- indirect learning neural network control applications – case studies.

UNIT III : INTRODUCTION TO FUZZY LOGIC
Fuzzy sets- fuzzy operation -fuzzy arithmetic -fuzzy relations- fuzzy relational equations -fuzzy measure -fuzzy functions -approximate reasoning -fuzzy propositions - fuzzy quantifiers - if-then rules.

UNIT IV : FUZZY LOGIC CONTROL
Structure of fuzzy logic controller -fuzzification models- data base -rule base –inference engine defuzzification module - Non-linear fuzzy control-PID like FLC- sliding mode FLC -Sugeno FLC -adaptive fuzzy control -fuzzy control applications- case studies.

UNIT V : GENETIC ALGORITHM AND ITS APPLICATIONS
Fundamentals of genetic algorithm: Evolutionary computation - search space –encoding - reproduction-elements of genetic algorithm-genetic modeling-comparison of GA and traditional search methods. Genetic Algorithm in scientific models and theoretical foundations - Applications of Genetic based machine learning-Genetic Algorithm and parallel processors - composite laminates - constraint optimization - multilevel optimization – case studies.

TEXT BOOK:

1. Jacek M Zurada, ‘Introduction to Artificial Neural Systems’, Jaico Publishing House, 1999.
2. S.Rajasekaran and G.A Vijayalakshmi Pai, ‘Neural Networks, Fuzzy logic and Genetic Algorithms, Synthesis and Applications’, Prentice Hall of India, New Delhi-2003.

REFERENCES:

1. Klir G.J. & Folger T.A. ‘Fuzzy sets, uncertainty and Information’, Prentice –Hall of India Pvt. Ltd.,1993.
2. Zimmerman H.J. ‘Fuzzy set theory -and its Applications’ -Kluwer Academic Publishers,1994.
3. Driankov, Hellendroon, ‘Introduction to Fuzzy Control’, Narosa publishers.
4. Farin Wah S.S, Filev, D. Langari, R. ‘Fuzzy control synthesis and analysis’, John
5.Melanie Mitchell, ‘An introduction to Genetic Algorithm’, Prentice-Hall of India,New Delhi, Edition: 2004
6. Kosko, B. ‘Neural Networks and Fuzzy Systems’, Prentice-Hall of India Pvt. Ltd.,1994

09EI312 DIGITAL IMAGE PROCESSING TECHNIQUES

Credit : 4:0:0

Course Objective:

To learn the fundamentals of digital image processing techniques.

Course Outcome:

- To understand the basic concept of image processing
- To learn the Image enhancement techniques
- To understand the theory of Image Morphology, Segmentation
- To analyze the methods of image Representation, Description and Recognition.

UNIT: I –DIGITAL IMAGE FUNDAMENTALS

Fundamental steps in Digital Image processing-Components of an Image Processing Systems-Light and the Electromagnetic Spectrum-Examples of fields that use Digital Image Processing- Visual Perception-Image sensing and Acquisition-Image sampling and Quantization-Imaging Geometry- Basic relationships between pixels.

UNIT: II – IMAGE ENHANCEMENT IN SPATIAL AND FREQUENCY DOMAIN

Basic Gray Level Transformations-Histogram Processing-Arithmetic and Logic Operations-Smoothing Spatial filters- Sharpening Spatial filters-Introduction to Frequency and the Frequency Domain-Smoothing Frequency Domain Filters-Sharpening Frequency filters

UNIT: III –IMAGE MORPHOLOGY AND SEGMENTATION

Dilation and Erosion-Opening and Closing-Hit-or-Miss Transformation-Basic Morphological Algorithms-Detection of Discontinuities-Edge linking and Boundary detection-Thresholding-Region based Segmentation-Use of Motion in Segmentation.

UNIT: IV –IMAGE REPRESENTATION AND DESCRIPTION

Representation Approaches-Boundary Descriptors: Shape Numbers, Fourier Descriptors, Statistical Moments-Regional Descriptors: Topological Descriptors-Texture: Statistical, Structural and Spectral Approaches-Relational Descriptors

UNIT: V –OBJECT RECOGNITION

Patterns and Pattern Classes-Matching-Recognition based on Decision-Theoretic Methods: Optimum Statistical Classifiers-Structural Methods: Matching Shape Numbers, String Matching, Syntactic Recognition of Strings, Syntactic Recognition of Trees.

REFERENCE BOOKS

1. Rafael C. Gonzalez, Richard E. Woods “Digital Image Processing” Third Edition, illustrated, revised Published by Prentice Hall, 2007, ISBN 013168728X, 9780131687288
2. Pratt, W.K “Digital Image Processing, 3rd ed., John Wiley & Sons, New York, 2002.

ISBN-9-814-12620-9

09EI313 OPTIMAL CONTROL

Credit : 4:0:0
Course Objective:
To learn the concepts of Optimal Control Systems and design with MATLAB examples.

Course Outcome:
- To learn the basics of Calculus of Variation
- To introduce the concept of LQR Design and Dynamic programming techniques.
- To discuss certain examples in MATLAB.

UNIT: I –CALCULUS OF VARIATION
Functions and Functional- Maxima and minima of function- Variation of functional- Extremal of functional- Euler Lagrange equation

UNIT: II –OPTIMAL CONTROL INTRODUCTION
Statement of optimal control problem -performance indices- Linear Quadratic Regulator (LQR)- State Regulator- output regulator- Control configuration

UNIT: III –LQR DESIGN
Algebraic Riccati Equation (ARE)- Solving ARE using the Eigen vector method- Discrete Algebraic Riccati Equation- Pontryagin‘s minimum principle

UNIT: IV -DYNAMIC PROGRAMMING NUMERICAL TECHNIQUES FOR OPTIMAL CONTROL
Principle of optimality - computational procedure for solving optimal control problem - Dynamic programming application to discrete and continuous system- Numerical techniques for optimal control- Simplex method - Hill climbing - gradient - penalty function methods

UNIT: V –MATLAB EXAMPLES FOR OPTIMAL CONTROL PROBLEMS
Infinite time Linear Optimal Regulator design- Optimum control of tracking system- Output weighed linear control- Terminal time weighing problem

TEXT BOOKS:
1. Stanislaw Zak, Systems and Control, Oxford University Press, 2003 ISBN 0195150112
2.. Linear System Theory and Design: C. T. Chen, 3rd Edition, Oxford 1999

REFERENCE BOOKS

1. Linear Multivariable Control System: Y. S. Apte, New Age International Publication 1996
2. Rao, S.S. Optimization theory and applications, Wiley Eastern, New Delhi, 1992.

3. Gopal, M. Modern control System Theory, Wiley Eastern Limited, New Delhi, 1992. ISBN-81-224-0503-7
4. Ogata, K. Modern Control Engineering, Prentice Hall of India, New Delhi, 1992. ISBN-0-87692-147

09EI314 SYSTEM IDENTIFICATION AND ADAPTIVE CONTROL

Credit : 4:0:0

Course Objective:
To learn the basic concepts of system identification and adaptive control

Course Outcome:
- To learn the basics of modeling ad simulation of processes.
- To understand the techniques to identify a MIMO system.
- To introduce the concepts of adaptive control and its applications.

UNIT: I -MODELING AND SIMULATION OF PROCESSES
Impulse response - Frequency response - Step response methods - Signal modeling - Discretisation techniques- Runge-Kutta method -Z-transform method - Use of Simulation packages - Simulation of 1st order, 2nd order systems with and without dead time.

UNIT: II –MIMO SYSTEM IDENTIFICATION TECHNIQUES
Off line - On line methods - Recursive least squares - Modified recursive least squares techniques - Fixed memory - RLS algorithm - Maximum likelihood - Instrumental variable Stochastic approximation techniques.

UNIT: II -CLASSIFICATION OF ADAPTIVE CONTROL
Introduction - Uses - Definitions - Auto tuning - Types of adaptive control.

UNIT: IV -MRAS AND STC
Approaches - The Gradient approach - Liapunov functions - Passivity theory - Control policies - pole placement control - Minimum variance control - Predictive control.

UNIT: V -ISSUES IN ADAPTIVE CONTROL AND APPLICATIONS
Stability-Convergence-Robustness-Application of adaptive control.

TEXT BOOKS:
1. Ljung, System Identification Theory for the user, Prentice Hall,1999.
2. Astrom K.J., Wittenmark B.” Adaptive Control”, Addison Wesley,1995.
3. Landau L.D., Lozano.R., M’Saad M., “Adaptive Control”, Springer.1997.

REFERENCE BOOKS
1. Isermann R., Digital Control Systems, Vol. I and II, Narosa Publishing House, Reprint 1993.
2. Wellstead P.E. and Zarrop M.B., Self tuning systems, John Wiley and Sons

09EI315 ADVANCED INSTRUMENTATION & PROCESS CONTROL FOR FOOD PROCESSING

Credit: 4:0:0
Course Objective:
To introduce the concepts of process instruments for measurement of various physical variables, systems, automation and optimal control.
Course Outcome:
To introduce the fundamentals of measurement and the techniques for measurement of various physical variables.
To review the concepts of systems and learn the basic concepts of process automation
To highlight the concepts of optimal control.

UNIT I: INTRODUCTION
Principles of measurement and classification of process control instruments; temperature, pressure fluid flow, liquid level, velocity, fluid density, etc. , instrument scaling; sensors; transmitters and control valves; instrumentation symbols and labels.

UNIT II MEASUREMENTS
Principles of measurements of weight flow rate, viscosity and consistency, pH, concentration, electrical and thermal conductivity, humidity of gases, composition by physical and chemical properties and spectroscopy.

UNIT III: REVIEW OF SYSTEMS
Review of first and higher order systems, closed and open loop response- Response to step, impulse and sinusoidal disturbances. Control valve types-linear, equal percentage and quick opening valve. Design of valves.-Transient response-Block diagrams.

UNIT IV: PROCESS AUTOMATION
Basic concepts; terminology and techniques for process control; control modes; Tuning process controllers.

UNIT V: OPTIMAL CONTROL
Optimisation and simulation; optimisation techniques; single and multivariable constrained optimisation;
dynamic simulation of distillation columns and reactors.

TEXT BOOKS :

1. ‘Process Dynamics and Control’, D.E.Seborg, T.F.Edger, and D.A.Millichamp, John Wiley and Sons, II Edition, 2004.
2. B. Roffel, B.H.L. Betlem, “Advanced Practical Process Control” Springer, 2004.

REFERENCES:

1. . Jean Pierre Corriou, “Process Control: Theory and applications” Springer, 2004.

2. Stephanopoulos, G.; " Chemical Process Control ", Tata McGraw Hill, New Delhi, 1993.
3. Karl J.Astrom, Bjorn Willermans; " Computer Controlled Systems ", Prentice Hall of India Pvt. Ltd., 1994.

09EI316 – VIRTUAL INSTRUMENTATION LABORATORY

Credit: 0:0:2

12 experiments will be notified by the HOD from time to time

09EI317 – INDUSTRIAL INSTRUMENTATION AND PROCESS CONTROL LABORATORY

Credit: 0:0:2

12 experiments will be notified by the HOD from time to time

09EI318 – EMBEDDED SYSTEMS LABORATORY

Credit: 0:0:2

12 experiments will be notified by the HOD from time to time

09EI319 ARTIFICIAL INTELLIGENCE AND AI PROGRAMMING

Credit : 3:1:0

UNIT I: FUNDAMENTALS OF AI
Fundamentals of AI techniques in a practical context. General introduction to artificial intelligence, the roots, goals and main sub-fields of AI, its techniques. Overview of key underlying ideas, knowledge representation, rule based systems, search, and learning.

UNIT II: APPLICATIONS
Demonstration of the need for different approaches for different problems. Study of further specific areas of artificial intelligence. Application of simple search algorithms (depth/breadth-first, heuristic functions, hillclimbing, etc.), processes involved in rule-based Expert Systems and in building such systems.

UNIT III: IMPORTANCE OF LEARNING
Importance of learning in intelligent systems, and its implementation. Study of different types of AI systems, their differences, common techniques, and limitations. Biological Intelligence and Neural Networks, Building Intelligent Agents, Interacting Agent Based Systems

UNIT IV:AI PROGRAMMING STYLES
Introduction to general procedural and functional programming techniques as well as basic AI programming styles (Poplog, XVed, Pop-11 Data types, comments, variables, printing, assignments, arithmetic operators Stack and stack errors, procedures, built-in procedures List manipulation, pattern matching Conditionals, iteration Advanced list manipulation and pattern matching techniques, Recursion

UNIT V: ADVANCED PROGRAMMING TECHNIQUES
More advanced programming techniques involving . Knowledge Representation, databases and the implementation of search strategies, Networks and Frames, Natural Language Processing, grammar and parsing. Planning Expert Systems, planning and rule-based reasoning, Uncertainty, Machine Learning

Reference Books

1. S Russell & P Norvig, “Artificial Intelligence: A Modern Approach” (2nd edn), Prentice Hall, 2003
2. E Rich & K Knight, “Artificial Intelligence”, (2nd edn), McGraw Hill, 1991
3. N J Nilsson, “Artificial Intelligence: A New Synthesis”, Morgan Kaufmann, 1998
4. Online tutorial material, supporting program libraries
5. Dan W. Patterson, “AI & Expert Systems”, Eastern, Economy Edition, 2000

ELECTRONICS AND INSTRUMENTATION ENGINEERING

ADDITIONAL SUBJECTS

1	10EI201	Circuit Analysis & Networks	3:1:0
2	10EI202	Electronic Circuits	4:0:0
3	10EI203	Sensors and Transducers	4:0:0
4	10EI204	Signals and Systems	4 :0:0
5	10EI205	Control Systems	3:1:0
6	10EI206	Signal Conditioning Circuits	3:1:0
7	10EI207	Microprocessors and Microcontrollers	4:0:0
8	10EI208	Process Dynamics and Control	4:0:0
9	10EI209	Industrial Instrumentation	4:0:0
10	10EI210	Logic and Distributed Control Systems	4:0:0
11	10EI211	Biomedical Instrumentation	4:0:0
12	10EI212	Neural Networks and Fuzzy Logic Control	4:0:0
13	10EI213	Digital Control Systems	3:1:0
14	10EI214	Communication Engineering	4:0:0
15	10EI215	Ultrasonic Instrumentation	4:0:0
16	10EI216	Biomedical Instrumentation	3:0:0
17	10EI217	Ultrasonic Instrumentation	3:0:0
18	10EI218	Modern Control Systems	3:1:0

10EI201 CIRCUIT ANALYSIS & NETWORKS

Credits 3:1:0

Course Objective:

- To introduce the concept of circuit elements, lumped circuits, circuit laws and reduction.
- To study the transient response of series and parallel A.C. circuits.
- To study the concept of coupled circuits and two port networks.

Course Outcome:

- Analyze simple DC circuits.
- Find Thevenin and Norton equivalents of circuits.
- Analyze AC steady-state responses and transient response of resistance, inductance and capacitance in terms of impedance.
- Analyze two port networks.

Unit I: Basic Circuit Concepts

Classification of Circuit Elements – Lumped Circuits – VI Relationships of R, L and C Energy Sources – Independent Sources – Dependent Sources – Kirchoff's Voltage Law – Voltage Division – Kirchoff's Current Law – Current Division – Network Reduction – Matrix Representation And Solution Of DC Networks – Node And Loop Basics

Unit II: Network Theorems and transformations

Voltage and current source transformations – Star and delta Transformations – Superposition, Thevenin – Norton – Millman's and Maximum Power Transfer Theorems – Statement and Applications

Unit III: Response of Electric Circuits

Concept of Complex Frequency – Pole – Zero Plots – Frequency Response of RL– RC and RLC Circuits – Transient Response of RL, RC and RLC Series and Parallel Circuits – Free Response – Step and Sinusoidal Responses – Natural Frequency – Damped Frequency, Damping Factor and Logarithmic Decrement – Response of Circuits for Non-Sinusoidal Periodic Inputs

Unit IV: Coupled Circuits

Self and Mutual Inductances – Co-Efficient of Coupling – Analysis of Coupled Circuits – Natural Current – Dot Rule for Coupled Circuits – Equivalent Circuit of Coupled Circuits – Coupled Circuits in Series And Parallel – Tuned Coupled Circuits – Double Tuned Circuits

Unit V: Two Port Networks and Filters

Driving Point and Transfer Impedances / Admittances – Voltage and Current Ratios of Two Port Networks – Admittance, Impedance – Hybrid – Transmission and Image Parameters for Two – Port Networks – Impedance Matching Equivalent Pi and T Networks – Passive Filter as a Two Port Network – Characteristics of Ideal Filter – Low pass and High Pass Filter.

Text Books:

1. M.Arumugam and N.Premkumar, "Electric circuit Theory" , Khanna Publishers , New Delhi, 2006.
2. Sudhakar.A. and Shyam Mohan S.P., "Circuits and Network Analysis and Synthesis", Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2008.

Reference Books:

1. Joseph Edminister, Mahmood Nahvi, "Electric circuits", Mcgraw Hill, New York 2004.
2. Hyatt, W.H. Jr. and Kemmerly, J.E., "Engineering Circuit Analysis", McGraw Hill International Editions, New York, 2002.
3. Charles K.Alexander,Mathew N.O.Sadiku, "Fundamentals of Electric Circuit",McGraw-Hill,New York,2003

10EI202 ELECTRONIC CIRCUITS

Credits: 4: 0: 0

Course Objective:

- To familiarize the student with the analysis and design of basic transistor amplifier circuits, feedback amplifiers, wave shaping and multi vibrator circuits

Course Outcome:

- Analyze the different types of diodes, operation and its characteristics
- Design and analyze the DC bias circuitry of BJT and FET
- Design circuits using the transistors, diodes and oscillators

Unit I: Diode Circuits
Diode as a Circuit Element - Load line – Piecewise Linear Diode model - Clipping circuits-Rectifiers – Half Wave and Full Wave Rectifiers - Average and RMS Value – Ripple Factor-Regulation –Rectification efficiency – Transformer Utility Factor –Capacitor Filters - Ripple factor and regulation

Unit II: Analysis of Transistor Circuits
Load line analysis –Transistor hybrid model – Analysis of transistor amplifier using h parameters – Emitter follower – Millers Theorem – Cascading Transistor amplifier

Unit III: Transistor Circuits as Amplifier
Analysis of transistors at low – medium frequencies - RC coupled amplifier - DC amplifiers – Class A/B/C – Single ended and Push Pull - Class AB amplifier

Unit IV: FET Circuits
FET small signal model – Low frequency common source and common drain amplifiers – Biasing FET amplifiers – Low FET (NMOS) – BIFET Amplifiers

Unit V: Feedback Amplifiers and Oscillators
Basic concepts of feedback amplifiers – Effect of negative feedback on input, output resistances, gain, stability, distortion and bandwidth – Voltage and current feedback circuits - Barkhausen criteria – RC and LC oscillators - Multivibrators- Bistable – Monostable and Astable

Text Books:
1. Jacob Millman and Halkias C.,"Integrated Electronics," Mc Graw hill, New York, 2004.
2.Jacob Millman and Arvind Grabel, "Microelectronics," Mc Graw hill, New York, 2008.

Reference Books:
1. David A Bell, 'Electronic Devices and Circuits', Prentice hall of India, New Delhi, 2008
2. Thomas Floyd, "Electronic Devices", Prentice Hall of India, New Delhi 2003
3. Boylestad L. Robert and Nashelsky Louis, 'Electronic Devices and Circuits', Prentice hall of India, New Delhi, 2008

10EI203 SENSORS AND TRANSDUCERS

Credits: 4: 0: 0

Course Objective:
- To gain knowledge about the measuring instruments and the methods of measurement and the use of different transducers

Course Outcome:
- To get the basic idea of measurements and the errors associated with measurement.
- To differentiate between the types of transducers available
- To gain information about the function of various measuring instruments and using them

Unit I: Science of Measurement
Measurements - Measurement systems - Methods of Measurements - Direct and Indirect Methods-Generalized Measurement System- Classification of Instruments - Deflection and Null Type-Characteristics of Instruments - Static and Dynamic-Calibration of instruments – Errors in measurement

Unit II: Classification and Characteristics of Transducer

Primary sensing elements - Mechanical Devices and Primary detectors – Transducer – Definition, Classification of Transducer –Characteristics and choice of transducer – Factors influencing choice of transducer – Mathematical model of transducer- I and II order- Response to step – impulse – ramp and sinusoidal inputs

Unit III: Resistive and Inductive Transducers
Resistance Transducer-Basic principle – Potentiometer – Loading effects, Resolution, Linearity, Resistance strain gauge –Types – Resistance thermometer – Thermistors – characteristics, Thermocouple –Compensation circuits – junction and lead compensation, merits and demerits. Inductance Transducer:- Basic principle – Linear variable differential transformer - RVDT-Synchro – Induction potentiometer-variable reluctance accelerometer-microsyn. Torque measurement on rotating shafts – shaft power measurement (dynamometers)

Unit IV: Transducers based on Capacitance and other Transducers
Capacitance Transducer – Basic principle- transducers using change in area of plates - distance between plates- variation of dielectric constants-frequency response - Piezoelectric transducer-Basic principle, Mode of operation - properties of piezoelectric crystals-loading effect, Magnetostrictive Transducer- Hall effect transducer

Unit V: Digital and other Miscellaneous sensors
Digital Transducer – shaft encoder, optical encoder – digital speed transducer. sound sensors, vibration sensors- chemical sensor – PH sensor-Ultra sonic sensors – Smart sensors – Fibre optic sensors – Semiconductor IC sensors

Text Books:
1. A.K. Sawhney “A course in Electrical and Electronics Measurements and Instrumentation”, Dhanpat Rai & Co., Delhi , 2000.
2. S. Renganathan “Transducer Engineering”, Allied publishers Limited, Chennai, 2003.

Reference Book:

1. Doebelin. E.O., “Measurement Systems Application and Design”, McGraw Hill International, New York, 2004.

10EI204 SIGNALS AND SYSTEMS

Credits: 4: 0: 0

Course Objective:
- Coverage of continuous and discrete-time signals and systems, their properties and representations and methods that are necessary for the analysis of continuous and discrete-time signals and systems.
- Knowledge of time-domain representation and analysis concepts as they relate to difference equations, impulse response and convolution, etc.
- Knowledge of frequency-domain representation and analysis concepts using Fourier Analysis tools, Z-transform
- Concepts of the sampling process
- Mathematical and computational skills needed in application areas like communication, signal processing and control, which will be taught in other courses.

Course Outcome:
- Characterize and analyze the properties of CT and DT signals and systems

- Analyze CT and DT systems in Time domain using convolution
- Represent CT and DT systems in the Frequency domain using Fourier Analysis tools like CTFS, CTFT, DTFS and DTFT.
- Conceptualize the effects of sampling a CT signal
- Analyze CT and DT systems using Laplace transforms and Z Transforms.

Unit I: Introduction- Continuous and Discrete Time Signals and Systems
Continuous Time (CT) signals – CT signal operations – Discrete Time(DT) signals – Representation of DT signals by impulses – DT signal operations – CT and DT systems – Properties of the systems – Linear Time Invariant(LTI) and Linear Shift Invariant(LSI) systems

Unit II: Time Domain Representation of Continuous and Discrete Time Systems
Continuous and Discrete Convolutions – CT system representations by differential equations – DT System representations by difference equations

Unit III: Frequency Domain representation of CT systems
Fourier series representation of periodic signals – Properties – Harmonic analysis of LTI systems – Convergence of Fourier series – Representation of a periodic signals by Continuous Time Fourier Transform (CTFT) – Properties – Frequency response of systems characterized by Differential Equations – Power and Energy Spectral Density – Parseval's Relation

Unit IV: Frequency Domain representation of DT systems
Discrete Time Fourier series representation of DT periodic signals – Properties – Representation of DT aperiodic signals by Discrete Time Fourier Transform(DTFT) – Properties – Frequency response of systems characterized by Difference Equations – Power and Energy Spectral Density concepts related to DT signals – Parseval's Relation – Sampling Theorem

Unit V: Transform Operations of CT and DT Signals and Systems
Review of Laplace Transforms-Z transform and its properties – Inverse Z transform – Solution of Difference equations – Analysis of LSI systems using Z transform

Text Books:

1. Alan V Oppenheim, Alan S Wilsky and Hamid Nawab S, "Signals & Systems", Prentice Hall, New Delhi, 2005.
2. Simon Haykin and Barry Van Veen, "Signals & Systems", John Wiley and Sons Inc., New Delhi, 2008.

Reference Books:

1. Ashok Ambardar, "Introduction to Analog and Digital Signal Processing", PWS Publishing Company, Newyork, 2002.
2. Rodger E Zaimer and William H Tranter, "Signals & Systems – Continuous and Discrete", McMillan Publishing Company, Bangalore ,2005.
3. John .G.Proakis , "Digital Signal Processing Principles, Algorithms and Applications , Prentice Hall, New Delhi 2006,.
4. Sanjit .K. Mitra "Digital Signal Processing A Computer based approach" 'Tata McGraw Hill Edition ,New Delhi,2001,
5. Emmanuel C.Ifeachor "Digital Signal Processing A Practical Approach", Pearson Education Limited, England, 2002.

10EI205 CONTROL SYSTEMS

Credits: 3: 1:0

Course Objective :

- To teach the fundamental concepts of Control systems and mathematical modeling of the system
- To study the concept of time response and frequency response of the system
- To teach the basics of stability analysis of the system

Course Outcome:

- Represent the mathematical model of a system
- Determine the response of different order systems for various step inputs
- Analyse the stability of the system

Unit I: Introduction
Systems and their representation: Basic structure of control system, Open loop and Closed loop systems- Electrical analogy of physical systems-transfer function- Block diagram representation-Block diagram reduction technique-Signal Flow graph and Mason's formula

Unit II: Components of Control System
Components of Automatic Control systems - Potentiometer - Synchros - Controllers-Tachogenerator - AC and DC servo motor- Stepper motors - Gyroscope

Unit III : Time Domain Analysis
Types of test inputs-Response of first and second order system-Time domain specifications- type and order of a system-response with P, PI, PD, and PID controllers-steady state error-static error and generalized Error coefficients- correlation between static and dynamic error coefficients

Unit IV: Frequency Domain Analysis
Frequency response- Frequency domain specifications –correlation between time and frequency response- Lead, lag and lead-lag compensators-Frequency response plots- Bode and Nyquist plots-Polar plot- Nichol's chart and M and N circles

Unit V: Stability Analysis
Concepts of stability: Characteristic equation- location of roots in s-plane for stability- asymptotic stability and relative stability- Routh-Hurwitz stability criterion-Root locus techniques

Text Books:

1. Barapate, "Control System" Tech Max publications, Pune,2006
2. Nagoorkani A " Control System," RBA publications, Chennai, 2006
3. Ogata K, "Modern Control Engineering", Prentice Hall, New Delhi, 2002.

Reference Books:

1. Richard Dorf & Robert Bishop, "Modern control system", Pearson Education, New Jersey 2005.
2. Gopal M, Digital Control and State variable Methods, Tata McGrawHill, New Delhi, 2003
3. B.S Manke, "Linear Control Systems," Hanna Publications, Delhi 2002
4. B.C Kuo, "Automatic control systems", Prentice Hall, New Delhi, 2002.
5. I.J.Nagrath and M.Gopal,"Control System Engineering," New Age international (P) Ltd, New Delhi, 2006.

10EI206 SIGNAL CONDITIONING CIRCUITS

Credits: 3: 1: 0

Course Objective:

- To understand the basic concepts in the design of electronic circuits using linear integrated circuits and their applications in the processing of analog signals.

Course Outcome:

- Explain the general properties of an operational amplifier and design different feedback circuit
- Design different amplifier circuits
- Discuss the operation of multiplier and voltage regulator circuits
- Discuss the operation and applications of PLL

Unit I: Operational Amplifier

Operational amplifier-ideal op-amp - op-amp internal circuit - DC characteristics –bias- offset – frequency-slew rate - AC characteristics- frequency compensation techniques-Non inverting and inverting amplifier - differential amplifier with active loads-current sources

Unit II: Operation Amplifier and Applications:

Inverter – Adder – Subtractor – Integrator – Differentiator – Multiplier – Divider – Comparator – Applications - Logarithmic Amplifier - Current To Voltage Converter - Voltage To Current Converter - Precision Rectifier - Clipper - Clamper - Sample And Hold Circuit - 555 Timers – Astable - Monostable Operation

Unit III: Amplifiers and Filters

Buffer amplifier - Use of op-amp with capacitive displacement transducer - charge amplifier - instrumentation amplifier - isolation amplifier - filters - Low pass - High pass - Band Pass - Band reject filter - First order and second order transformations - state variable filter - switched capacitor filter

Unit IV: Voltage Regulators and Multipliers

Series op amp regulator- IC voltage regulator - 723 general-purpose regulators - Precision Reference Regulator - Four quadrant multiplier & its applications - frequency doubling - phase angle detection

Unit V: PLL

Basic principle - phase detector and comparator - analog and digital - voltage controlled oscillator - Monolithic PLL - Application of PLL as - frequency multiplication & division-frequency translation – AM – FM – FSK modulation and demodulation

Text Books

1 Roy Choudhury and Shail Jain, “Linear integrated circuits” ,Wiley Eastern Ltd,2002
2 Ramkant Gaykwad, “Op amps & Linear Integrated Circuits” , 2008

Reference Books

1 Denton J. Dailey, “Operational Amplifier and Liner integrated Circuits”, McGraw Hill, New York, 2000.

2 Coughlin and Driscoll, “Operational Amplifier and Liner integrated Circuits,” Prentice Hall of India Pvt**.,** New Jersey, Ltd 2003
3 A.K Sawhney, “Course in Electrical and Electronic Measurement & Instrumentation” , Dhanpat Rai & sons, Delhi, 2005.

10EI207 MICROPROCESSORS AND MICRO CONTROLLERS

Credits: 4:0:0

Course Objective:

- To develop an in-depth understanding of the operation of microprocessors and microcontrollers, machine language programming & interfacing techniques.

Course Outcome:

- The student will learn the internal organization of some popular microprocessors/microcontrollers.
- The student will learn hardware and software interaction and integration.
- The students will learn the design of microprocessors/microcontrollers-based systems.

Unit I: Introduction to 8085
Functional Block Diagram – Registers – ALU- Bus systems -Timing and control signals - Machine cycles- instruction cycle and timing states - instruction timing diagrams - Memory interfacing

Unit II: Programming, Interrupts and DMA
Addressing modes- Instruction set - simple programs in 8085- Interrupt feature – Need for Interrupts Interrupt structure - Multiple Interrupt requests and their handling – Typical programmable interrupt controller-Need for direct memory access – Devices for Handling DMA – Typical DMA Controller features

Unit III: Interfacing peripherals with 8085
Programmable peripheral interface (8255)—Interfacing ADC0801 A/D Converter –DAC 0800 D/As Converters - Multiplexed seven segments LED display systems – Waveform generators– Stepper motor control

Unit IV: Introduction to 8051 Microcontroller
Architecture of 8051 – Memory Organization- interrupt structures – Timer and counters –Serial Data I/O- Addressing modes – Instruction set -Simple programmes in 8051

Unit V: Application of 8051
Typical applications – Keyboard and Display interfaction, pulse measurement, D/A and A/D conversions,MCS 51 family features 8031/8051/8751.Typical applications – MCS 51 family features 8031/8051/8751

Text Books:
1. Ramesh S.Gaonkar, “Microprocessor - Architecture, Programming and Applications with the 8085”, Penram International publishing private limited, 2002.
2. The 8051 Microcontroller Architecture, Programming & Applications II Edition
Kenneth J Ayala ,2005.

Reference Books :

1. A.P.Godse,G.P.Godse"Microprocessor & applications",Technical Publication, Pune, 2004.
2. Douglas V.Hall, "Microprocessors and Interfacing: Programming and Hardware", Tata Mcgraw Hill, New Delhi, 2003.
3. Microcontroller Hand Book, INTEL, 2008.

10EI208 PROCESS DYNAMICS AND CONTROL

Credits: 4: 0: 0

Course Objective:

- To equip the students with the knowledge of modelling a physical process
- To design Various control schemes
- To apply the control system in various processes

Course Outcome:

- Students will be able to model a physical process.
- Students will have the knowledge of various controller designs, and methods of controller tuning.
- Students will be exposed to various complex control schemes, characteristics and application of control valves.

Unit I: Process dynamics
Process Control System: Terms and objectives - piping and Instrumentation diagram - instrument terms and symbols- Process characteristics: Process equation- degrees of freedom- modeling of simple systems – thermal – gas – liquid systems- Self- regulating processes- interacting and non-interacting processes

Unit II: Basic control actions
Controller modes: Basic control action- two position- multi position- floating control modes- Continuous controller modes: proportional, integral, derivative. PI – PD – PID – Integral wind-up and prevention- Auto/Manual transfer- Response of controllers for different test inputs- Selection of control modes for processes like level-pressure-temperature and flow

Unit III: Optimum controller settings
Controller tuning Methods: Evaluation criteria - IAE, ISE, ITAE. Process reaction curve method,- Ziegler –Nichol's tuning- damped oscillation method- Closed loop response of I & II order systems with and without valve -measuring element dynamics

Unit IV: Final control elements
Pneumatic control valves- construction details- types- plug characteristics- Valve sizing- Selection of control valves- Inherent and installed valve characteristics- Cavitation and flashing in control valves- Valve actuators and positioners

Unit V: Advanced control system
Cascade control- ratio control- feed forward control- Split range and selective control- Multivariable process control- interaction of control loops - Case Studies: Distillation column- boiler drum level control- Heat Exchanger and chemical reactor control

Text Books:
1. Stephanopoulos, “Chemical Process Control”, Prentice Hall, New Delhi, 2003.
2. Coughanowr D.R., “Process Systems Analysis and Control”, McGraw Hill, Singapore, 2008.
3. Curtis D .Johnson,”Process control instrumentation technology,” Prentice Hall , New Jersey 2006.

Reference Books:
1. Smith C.L and Corripio. A..B, “Principles and Practice of Automatic Process Control”, John Wiley and Sons, New York, 2006.
2. Dale E. Seborg, Thomas F. Edgar, Duncan A. Mellichamp, “Process Dynamics and Control,” John Willey and Sons, Singapore, 2006.
3. B. Wayne Bequette, “Process control: modeling, design, and simulation” Prentice Hall , New Jersey-2003
4. Peter Harriott, “Process Control”, Tata McGraw Hill, New Delhi, 2008.

10EI209 INDUSTRIAL INSTRUMENTATION

Credits: 4: 0: 0

Course Objective:
- To equip the students with the basic knowledge of Pressure, Temperature, flow, level, density and viscosity measurements.
- To understand the construction and working of measuring instruments.

Course Outcome:
- The student will be equip with the basic knowledge of Pressure, Temperature, flow, level, density and viscosity measurements.
- The student knows to calibrate the various instruments also he knows to apply the instrument in various fields.

Unit I: Pressure Measurement
Pressure measurement basics, standards- Manometers – Elastic elements- Electrical methods using strain gauge-High pressure measurement-Vacuum gauges - Mcleod gauge - Thermal conductivity gauges -Ionization gauge selection and application – Capacitance Pressure measurement- Piezo-electric - Calibration of Pressure gauge using Dead Weight Tester

Unit II: Flow Measurement
Flow measurement: Introduction - definitions and units- classification of flow meters- pitot tubes- orifice meters- venturi tubes- flow tubes- flow nozzles- positive displacement liquid meters-Anemometers: Hot wire/hot film anemometer- laser doppler anemometer (LDA)-electromagnetic flow meter- turbine and other rotary element flow meters- ultrasonic flow meters - Measurement of mass flow rate: radiation- angular momentum- impeller- turbine - Target flow meters-Flow meter selection- application- calibration

Unit III: Temperature Measurement
Temperature standards - fixed points -filled-system thermometers - Bimetallic thermometer-Resistance temperature detector (RTD) - principle and types - construction requirements for industry - measuring circuits- Thermistors - Thermocouple - Cold junction compensation- IC temperature sensors - Radiation pyrometer- Optical Pyrometer -Sensor selection- calibration and application

Unit IV: Level Measurement

Visual techniques - float level devices- displacer level detectors- rotating paddle switches- diaphragm - Air purge system and differential pressure detectors - resistance - capacitance and RF probes - radiation - conductivity - field effect - thermal – ultrasonic - microwave - radar and vibrating type level sensors – Solid level measurement - Sensor selection - calibration and application

Unit V: Viscosity and Density Measurement

Measurement of viscosity: definitions – units - Newtonian and Non-Newtonian behavior measurement of viscosity using laboratory viscometers - industrial viscometers - Viscometer selection and application- Measurement of density: Definitions – units - liquid density measurement - gas densitometers - online measurements - application and selection

Text Books:

1. Doebelin E.O, “Measurement Systems: Application and Design”, McGraw Hill, New York, 2003.

Reference Books:

1. Liptak B.G, “Process Measurement and Analysis,” Chilton Book Company, Radnor, Pennsylvania, 2003.
2. Walt Boyes, “Instrumentation Reference Book,” Butterworth Heinemann, United States, 2003.

10EI210 LOGIC AND DISTRIBUTED CONTROL SYSTEMS

Credits: 4:0:0

Course Objective

- To study the fundamentals of Data Acquisition system
- To teach the concept of PLC and the Programming using Ladder Diagram
- To understand the basics of DCS and communication standards

Course Outcome

- Students will have the knowledge of data acquisition System
- Students will be able to write Programs using ladder diagrams
- Students will have the knowledge of DCS and communication standards

Unit I : Review of Computers in Process Control

Data loggers – Data Acquisition Systems (DAS) – Direct Digital Control (DDC) – Supervisory Control and Data Acquisition Systems (SCADA) – sampling considerations – Functional block diagram of computer control systems

Unit II : Programmable Logic Controller(PLC) Basics

Definition – overview of PLC systems- input/output modules- power supplies and isolators- General PLC programming procedures-programming on-off inputs/ outputs-Auxiliary commands and functions- PLC Basic Functions- register basics- timer functions- counter functions

Unit III: PLC Intermediate Functions

PLC intermediate functions: Arithmetic functions - comparison functions - Skip and MCR functions - data move systems. PLC Advanced intermediate functions: Utilizing digital bits- sequencer functions- matrix functions- PLC Advanced functions: Alternate programming languages- analog PLC operation- networking of PLC- PID functions-PLC installation- troubleshooting and maintenance- Design of interlocks and alarms using PLC

Unit IV : Introduction to (DCS)
Distributed Control Systems (DCS): Definition - Local Control Unit (LCU) architecture - LCU languages - LCU - Process interfacing issues - communication facilities - redundancy concept

Unit V: Communication standards
Introduction – Evolution of signal standards – HART communication protocol – communication modes – HART networks – Introduction – General Field bus architecture – basic requirements of field bus standard. Industrial Field bus: PROFIBUS - Foundation Field bus

Text Books:

1. John.W. Webb, Ronald A Reis, "Programmable Logic Controllers - Principles and Applications", Prentice Hall Inc., New Jersey, 2003.
2. B.G. Liptak, "Instrument Engineers Hand, Process control and Optimization", CRC press- Radnor, Pennsylvania, 2006.
3. M.Chidambaram, "Computer Control of Process," Narosa Publishing, New Delhi, 2003

Reference Books:

1. B.G. Liptak, "Process software and digital networks," CRC press,Florida-2003.
2. Curtis D. "Johnson Process control instrumentation technology," Prentice Hall , New Jersey 2006.
3. Krishna Kant, "Computer-Based Industrial Control,“ PHI, New Delhi, 2004
4. Frank D. Petruzella, "Programmable Logic Controllers", McGraw Hill, New York, 2004.

10EI211 BIOMEDICAL INSTRUMENTATION

Credits: 4: 0:0

Course Objective:

- With widespread use and requirements of medical instruments, this course gives knowledge of the principle of operation and design of biomedical instruments.
- It attempts to render a broad and modern account of biomedical instruments.
- It gives the introductory idea about human physiology system which is very important with respect to design consideration

Course Outcome:

- Students will have a clear knowledge about human physiology system.
- They will have knowledge of the principle operation and design and the background knowledge of biomedical instruments and specific applications of biomedical engineering

Unit I: Anatomy & Physiology of human body

The cell & its electrical activity- principle physiological system: Cardiovascular - Nervous system - Respiratory system- Muscular system - Origin of bioelectric signal - Bioelectric signals: ECG- EMG – ECG - EOG and their characteristics

Unit II: Measurement of Physiological Parameters
Physiological transducers - Measurement of Blood pressure - Blood flow - Cardiac output measurement - heart rate - respiration rate - measurement of lung volume - Oximeters - Audiometer

Unit III: Therapeutic and Surgical Equipments, Patient safety
Electro Surgical unit: short wave & microwave diathermy - Laser surgical unit-Defibrillators, pacemaker - heart-lung machine – Dialysis - Anesthesia machine – Ventilators - Nerve stimulators - Total artificial heart (TAH). Patient Safety: Electric Shock Hazards - Leakage Current

Unit IV: Clinical Laboratory Instruments
Clinical Flame photometer - spectrophotometer – Colorimeter- chromatography- Automated Biochemical analysis system - Blood Gas Analyzer: Blood pH Measurement- Measurement of Blood pCO_2- Blood pO_2 Measurement- Blood Cell Counters: Types and Methods of cell counting

Unit V: Imaging technique & Telemetry
X-ray – C.T. scan - MRI instrumentation - Ultrasound scanner - vector cardiograph - Echo cardiograph – angiography - Telemetry: Wireless telemetry- single channel and multichannel telemetry system- Multi patient Telemetry- Implantable Telemetry systems

Text Books:

1. Arumugam.M. “Biomedical Instrumentation", Anuradha Agencies Publishers, Kumbakonam, 2006.
2. R.B.Khandpur, “Handbook of Biomedical Instrumentation”, Prentice Hall of India, New Delhi, 2003.
3. Cromwell, “Biomedical Instrumentation and Measurements”, Prentice Hall of India, New Delhi, 2007.

Reference Books:

1. Joseph J. Carr and John M. Brown, “Introduction to Biomedical Equipment Technology”, Pearson Education India, Delhi, 2004.
2. Myer Kutz, “Standard Handbook of Biomedical Engineering & Design,” McGraw-Hill Publisher, New York, 2003.
3. Webster, “Medical Instrumentation – Application & Design,” John Wiley and sons Inc, Netherlands, 2009.

10EI212 NEURAL NETWORKS AND FUZZY LOGIC CONTROL

Credits: 4: 0:0

Course Objective:

- To cater the knowledge of Neural Networks and Fuzzy Logic Control and use these for controlling real time systems.

Course Outcome:

- To expose the students to the concepts of feed forward neural networks.
- To provide adequate knowledge about feedback neural networks.

- To teach about the concept of fuzziness involved in various systems. To provide adequate knowledge about fuzzy set theory.
- To provide comprehensive knowledge of fuzzy logic control and adaptive fuzzy logic and to design the fuzzy control using genetic algorithm.
- To provide adequate knowledge of application of fuzzy logic control to real time systems.

Unit I: Architectures
Introduction – Biological neuron – Artificial neuron – Neuron modeling – Learning rules – Single layer – Multi layer feed forward network – Back propagation – Learning factors

Unit II: Neural Networks For Control
Feedback networks – Discrete time hop field networks – Schemes of neuro-control, identification and control of dynamical systems-case studies (Inverted Pendulum, Articulation Control)

Unit III: Fuzzy Systems
Classical sets – Fuzzy sets – Fuzzy relations – Fuzzification – Defuzzification – Fuzzy rules

Unit IV: Fuzzy Logic Control
Membership function – Knowledge base – Decision-making logic – Optimisation of membership function using neural networks – Adaptive fuzzy system – Introduction to genetic algorithm

Unit V: Application of FLC
Fuzzy logic control – Inverted pendulum – Image processing – Home heating system – Blood pressure during anesthesia – Introduction to neuro fuzzy controller

Text Books:

1. Kosko, B, "Neural Networks and Fuzzy Systems: A Dynamical Approach to Machine Intelligence," Prentice Hall, New Delhi, 2004.
2. Timothy J Ross ,"Fuzzy Logic With Engineering Applications," John Willey and Sons, West Sussex, England, 2005.
3. Jacek M. Zurada, "Introduction to Artificial Neural Systems," PWS Publishing Co.,Boston, 2002.

Reference Books:

1 Klir G.J. & Folger T.A.,"Fuzzy sets, uncertainty and Information," Prentice –Hall of India Pvt. Ltd., New Delhi, 2008.

2 Zimmerman H.J.,"Fuzzy set theory and its Applications," Kluwer Academic Publishers, Dordrecht, 2001.

3 Driankov, Hellendroon, "Introduction to Fuzzy Control," Narosa publishers, Pune, 2001.

4 Laurance Fausett, Englewood cliffs, N.J., 'Fundamentals of Neural Networks', Pearson Education, New Delhi, 2008.

10EI213 DIGITAL CONTROL SYSTEMS

Credits: 3:1:0

Course Objective:
- To equip the students with the basic knowledge of A/D and D/A conversion
- To understand the basics of Z- Transform
- To study the stability analysis of digital control system

- To equip the basic knowledge of digital process control design

Course Outcome:
- Students will have the basic knowledge of A/D and D/A conversion
- Students will have the knowledge of Z- Transform
- Students will have knowledge of digital process control design

Unit I: Sample Theory and Converters
Review of Sample theory - Shannon's sampling theorems - Sampled Data Control system, Digital to Analog conversion – Analog to Digital conversion- Ramp type A/D-Dual slope A/D-Successive approximation A/D - A/D & D/A converters - Reconstruction - Zero Order Hold

Unit II: System Response
Review of Z and Inverse Z transform - Response of sampled data systems to step and ramp inputs - Steady state errors - Z domain equivalent- Modified Z transform

Unit III: Function Realisation
Pulse transformation function by direct, cascade and parallel realization - Sampled data model for continuous system - Controllability and observability- Design of state feedback and output feedback control

Unit IV: Stability of Digital Control Systems
Stability studies - Bilinear transformation - Jury's stability test - Digital quantization. State sequences for sampled data systems - solutions

Unit V: Digital Process Control Design
Digital PID algorithm - Positional and incremental forms - Dead-beat algorithm- Dahlin's and Kalman's algorithms - Ringing - Implementation of control algorithms using microcontroller – Block diagram study of digital implementation.

Text Books:

1. Ogata, "Discrete Time Control Systems", Prentice-hall Of India, New Delhi 2008.
2. Gopal M, "Digital Control and State variable Methods", Tata McGrawHill, New Delhi, 2003

Reference Books:

1. Gene F. Franklin, J. David Powell, "Digital control of dynamic systems", Pearson Education Limited, New Delhi,2002.
2. Richard C. Dorf, Robert H. Bishop, "Modern control systems," Pearson Education inc, New Delhi, 2008

10EI214 COMMUNICATION ENGINEERING

Credits: 4: 0: 0
Course Objective:
- To equip students with various issues related to analog and digital communication such as modulation, Demodulation, Noise handling, Data conversion and Multiplexing

Course Outcome:
- Students will be familiar with the techniques involved in the transfer of information in the field of Radio communication

- Students will be able to detect and correct the errors that occur due to noise during transmission
- Students will be able to understand the concepts of Facsimile, Television, Cellular and Satellite Communication

Unit I: Radio Communication Systems
Need for Modulation - Principle of AM – FM and PM – modulation index– signal power – DSBSC-SSBSC-Independent sideband-vestigial sideband

Unit II: Transmitters and Receivers
AM and FM transmitters and receivers – AM and FM modulators and demodulators – Comparison of AM, FM and PM – Noise –Sources and Types of noise -Effects of noise in AM and FM systems

Unit III: Digital Communication Systems
PAM, PPM, PDM, PCM – delta modulation – differential PCM – merits and demerits – comparison of pulse modulation schemes-Digital modulation and demodulation systems: FSK – ASK - PSK

Unit IV: Data Transmission
Twisted pair and coaxial cables – Fiber optics – Sources and detectors – Fiber optic Complete system –A/D and D/A converters- Error detection and correction – Multiplexing introduction – TDM & FDM

Unit V: Facsimile & Television
Facsimile- Modem functions – RS232 operation - TV signals – TV receivers – Color TV-Radar concepts- Basic concepts of Satellite communication and cellular communication

Text Books:

1. Roody and Coolen , “Electronic Communication”, Prentice Hall of India LTD., New Delhi, 2007.
2. William Scheweber, “Electronic Communication Systems”, Prentice Hall of India LTD, New Delhi, 2004
3. Wayne Tomasi, “Electronic communication systems”, Prentice Hall of India LTD, New Delhi, 2004

Reference Books:

1. Kennedy G, “Electronic Communication Systems”, McGraw-Hill, New York,2008.
2. Simon Haykins, “Communication Systems”, John Wiley,Inc., USA, 2006.
3. Bruce Carlson. A “Communication Systems”, Tata McGraw – Hill, New Delhi, 2001.
4. Taub and Schilling “Principles of Communication Systems”, McGraw-Hill, New York, 2008.
5. Anokh Singh, “Principles of Communication Engineering”, S.Chand and Company Ltd., Delhi, 2001.

10EI215 ULTRASONIC INSTRUMENTATION

Credits: 4:0:0

Course Objective:

- To know the basics of Ultrasonic’s, how it can be produced and where it is used.

Course Outcome:

- The students after completion of course they come to know the basics of Sonics with application.

Unit I: Ultrasonic Waves
Principles and propagation of various waves – characterization of ultrasonic transmission, reflection and transmission coefficients – intensity and attenuation of sound beam. Power level – medium parameters

Unit II :Generation/ Detection of Ultrasonic Waves
Magnetostrictive and piezoelectric effects – construction and characteristics – Detection of Ultrasonic Waves: Mechanical method- Optical Method-Electrical Method- Precise Measurement: Pulse-echo Overlap- Cross correlation-Computer Based Automated methods: Pulse-echo Overlap- Cross correlation-search unit types

Unit III: Classification of Ultrasonic Test Methods
Pulse echo- transit time-resonance- direct contact and immersion type and ultrasonic methods of flaw detection – Flow meters – Density measurement- Viscosity measurement, Level measurement – Sensor for Temperature and Pressure measurements

Unit IV :Ultrasonic Application
Measuring thickness-depth-Rail Inspection using Ultrasonic- SONAR- Inspection of Welds and defect detection in welds of anisotropic materials

Unit V :Ultrasonic Applications in Medical Field
Medical Imaging- diagnosis and therapy- acoustical holography

Text Books:

1. Baldev Raj, V.Rajendran, P.Palanichamy, "Science and Technology of Ultrasonics", Alpha Science International, UK, 2004.
2. J.David N.Cheeke,"Fundamentals and Applications of Ultrasonic Waves," CRC Press, Florida, 2002.
3. C.R. Hill,J.C. Bamber, G.R. ter Harr, "Physical Principles of Medical Ultrasonics," John Wiley & sons, England, 2004.
4. Dale Ensminger, Foster B.Stulen, "Ultrasonics Data,Equations and Their Practical Uses," CRC Press,2009.

Reference Books:

1. Lawrence E.Kinsler, Austin R.Frey, Alan B.Coppens, James V. Sanders, "Fundamentals of Acoustics," John Wiley and Sons Inc,USA,2000.
2. L.A. Bulavin, YU.F.Zabashta, "Ultrasonic Diagnostics in Medicine," VSP, Koninklijke Brill,Boston,2007.

10EI216 BIOMEDICAL INSTRUMENTATION

Credit: 3:0:0
Course Objective:
- With widespread use and requirements of medical instruments, this course gives knowledge of the principle of operation and design of biomedical instruments.
- It attempts to render a broad and modern account of biomedical instruments.
- It gives the introductory idea about human physiology system which is very important with respect to design consideration

Course Outcome:

- Students will have a clear knowledge about human physiology system.
- They will have knowledge of the principle operation and design and the background knowledge of biomedical instruments and specific applications of biomedical engineering

Unit I: Physiology of Human Body

Cell & its electrical activity- principle physiological system: Cardiovascular- Nervous system- Respiratory system- vision- Muscular system

Unit II: Electrodes and Bioelectric Signals

Bioelectrodes- types of electrodes – Electrodes for ECG, EMG, ECG and EOG – Bioelectric signals: ECG , EMG , EOG and their characteristics and recording

Unit III: Measurement of Physiological Parameters

Physiological transducers- Classification of Transducer: Displacement- position and Motion- pressure-Photoelectric Transducer – Oximeters- Electromagnetic and ultrasonic blood flowmeter- blood pressure- cardiac output

Unit IV: Bio-Chemical Measurement

Blood pH- Blood pO2- Blood pCO2- Electrophoresis- colorimeter-spectro photometer- Clinical flame photometer- automated Biochemical analyzer– Medical Diagnosis with chemical tests

Unit V: Therapeutic Equipments & Imaging Technique

Defibrillators - pacemaker-heart-lung machine-Dialysis-Anesthesia machine-Ventilators- Nerve stimulators- X-ray- C.T. scan- MRI instrumentation

Text Books:

1. R.B.Khandpur, "Handbook of Biomedical Instrumentation", Prentice Hall of India, New Delhi, 2003.
2. Cromwell, "Biomedical Instrumentation and Measurements", Prentice Hall of India, New Delhi, 2007.

Reference Books:

1. Joseph J. Carr and John M. Brown, "Introduction to Biomedical Equipment Technology", Pearson Education India, Delhi, 2004.
2. Myer Kutz, "Standard Handbook of Biomedical Engineering & Design," McGraw-Hill Publisher, New York, 2003.
3. Webster, "Medical Instrumentation – Application & Design," John Wiley and sons Inc, Netherlands, 2009.
4. Arumugam.M. "Biomedical Instrumentation", Anuradha Agencies Publishers, Kumbakonam, 2006.

10EI217 ULTRASONIC INSTRUMENTATION

Credits 3:0:0

Course Objective:

- To know the basics of Ultrasonics, how it can be produced and where it is used.

Course Outcome:

- The students after completion of course they come to know the basics of Sonics with application.

Unit I: Ultrasonic Waves
Principles and propagation of various waves-characterization of ultrasonic Transmission. Generation of ultrasonic waves: Magnetostrictive and piezoelectric effects- search unit types-phase array-construction and characteristics

Unit II: Ultrasonic Measurement Technique
Detection of Ultrasonic Waves: Mechanical method- Optical Method- Electrical Method- Precise Measurement: Pulse-echo Overlap- Cross correlation- Computer Based Automated methods: Pulse-echo Overlap-Cross correlation- Testing Methods: Pulse echo- transit time- resonance-direct contact and immersion type and ultrasonic methods of flaw detection

Unit III: Ultrasonic Sensor
Flow meters-Density measurement-Viscosity measurement- Level measurement-Sensor for Temperature and Pressure measurements- Thickness measurement

Unit IV: Ultrasonic Application
Non-destructive Testing: Inspection of Welds and defect detection in welds of anisotropic materials- forgings Castings - Rail Inspection- Concrete Testing- Evaluation of Mechanical Properties: Tensile and yield Strength- Hardness- Fracture toughness-SONAR

Unit V: Ultrasonic Medical Application
Medical Imaging-diagnosis and therapy-acoustical holography

Text Books:
1. Science and Technology of Ultrasonics-Baldev Raj, V.Rajendran, P.Palanichamy, Narosa Publishing House, New Delhi, 2004.
2. C.R. Hill,J.C. Bamber, G.R. ter Harr, "Physical Principles of Medical Ultrasonics," John Wiley & sons, England, 2004.
3. L.A. Bulavin, YU.F.Zabashta, "Ultrasonic Diagnostics in Medicine," VSP, Koninklijke Brill,Boston,2007.
4. Dale Ensminger, Foster B.Stulen, "Ultrasonics Data,Equations and Their Practical Uses," CRC Press, Florida, 2009.

Reference Book:
1. Lawrence E.Kinsler, Austin R.Frey, Alan B.Coppens, James V. Sanders, "Fundamentals of Acoustics," John Wiley and Sons Inc,USA,2000.

10EI218 MODERN CONTROL SYSTEMS

Credits: 3:1:0

Course Objective

- To teach the fundamental concepts of Control systems and mathematical modelling of the system
- To study the concept of time response and frequency response of the system
- To teach the basics of stability analysis of the system

Course Outcome

- Students will have the knowledge of mathematical modelling of the system
- Students will be able to find the response of different order systems for a step input
- Students will be able to identify the stability of the system

Unit I: Introduction
Open loop and closed loop systems - transnational and rotational mechanical systems and analogous electrical systems - Basic components of control systems - potentiometer - synchros - tachogenerator - a.c and d.c servo motor – Mathematical representation – block diagram – signal flow graph and transfer function of electrical systems

Unit II :Time Response
Time response - step response of first order and second order systems - time domain specifications - type and order of a system - steady state error - static error and generalized error coefficients

Unit III :Frequency Response
Frequency domain specifications - estimation of the specifications for a second order system. Bode plot - Nichol's chart - Nyquist stability criterion - applications of Bode plots and Nyquist stability criterion – polar plot

Unit IV: Stability Analysis
Stability - characteristic equation - location of roots in s plane for stability - Routh Hurwitz criterion -Root Locus Techniques

Unit V: State Space Analysis of Control Systems
State space representation – The concept of state – State space representation of systems – Solution of state equations – Eigen values and Eigen vectors of n x n nonsingular matrix – Diagonalization of n x n matrix – Transfer matrix – Controllability – Observability

Text Books:
1. Ogata, K., "Modern Control Systems Engineering", Prentice Hall, Eaglewood, New Jersey, 2002.
2. Nagrath and Gopal.,:"Control System Engineering", Wiley & Sons, New Delhi, 2007.

Reference Books:
1. Benjamin C. Kuo., "Automatic Control Systems", John Wiley & Sons, New York,2002.

DEPARTMENT OF ELECTRONICS & INSTRUMENTATION ENGINEERING

REVISED AND NEW SUBJECTS

Sub. Code	Subject	Credit
10EI301	Transducer Engineering	4 : 0 : 0
10EI302	Process Control	3: 1 : 0
10EI303	Advanced Control Systems	3 : 1 : 0
10EI304	Advanced Programmable Signal Processor	4 : 0 : 0
10EI305	Advanced Digital Signal Processing	3 : 1 : 0
10EI306	Advanced Microcontrollers	4 : 0 : 0
10EI307	Digital System Design	4 : 0 : 0
10EI308	Data Communication, Networks and Protocols	4 : 0 : 0
10EI309	Modeling of Physiological Systems	4 : 0 : 0
10EI310	Advanced Medical Instrumentation	4 : 0 : 0
10EI311	Biomaterials	4 : 0 : 0
10EI312	Hospital Management	4 : 0 : 0
10EI313	Communication Theory and Telemetry	4 : 0 : 0
10EI314	Anatomy and Physiology	4 : 0 : 0
10EI315	Discrete Time Control Systems	3 : 1 : 0
10EI316	Medical Sensors	4 : 0 : 0
10EI317	Advanced Instrumentation & Process Control For Food Processing	4 : 0 : 0
10EI318	Embedded Linux	4 : 0 : 0
10EI319	Advanced Embedded Systems Lab	0: 0 : 2
10EI320	Medical Diagnostics And Therapeutic Lab	0: 0 : 2
10EI321	Optimal Control Theory	4 : 0 : 0
10EI322	Networks And Protocols For Medical System	4 : 0 : 0
10EI323	Real Time and Embedded Systems	4 : 0 : 0

10EI301 TRANSDUCER ENGINEERING

Credit: 4:0:0

Course Objective:

- To understand the basic characteristics of Transducers.
- To understand the operation and construction of various transducers.
- To familiarize the sensors used for each application.
- To study the design aspects of the sensor.

Course Outcome:

- The student will be able to find the dynamics of the transducer.
- The student will be able to select a suitable transducer for a given application.
- The student will be able to design a transducer as per the requirement.

Unit I : Generalized Characteristics of Transducers

Introduction-static characteristics-dynamic characteristics-frequency response of first ordertransducer- frequency response of second order transducer-higher order transducer-procedure to determine the constants and transfer function of a system

Unit II : Resistance and Inductance Transducer

Basic principle-potentiometer-resistance strain gauge-measurement of torque-stress measurement on rotating members-semi conductor strain gauges-contact pressure-humidity measurement. Basic principle-linear variable differential transformer-LVDT equations-RVDT-application of LVDT-LVDT pressure transducer-synchros- synchros as position transducer-induction potentiometer-variable reluctance accelerometer- microsyn

Unit III : Capacitance and Piezoelectric Transducers

Basic principle-capacitance displacement transducer- differential pressure transducer-feedback type capacitance proximity pickup-condenser microphone-pulse width modulating circuit. Introduction-material for piezoelectric transducer-equivalent circuit of a piezoelectric crystal - piezoelectric coefficients- modes of deformation-general form of piezoelectric transducers -environmental effects

Unit IV : Magnetic sensors

Introduction- sensors and the principles-magneto resistive sensors-hall effect and sensor – inductance and eddy current sensors - angular movement transducer-electromagnetic flow meter-switching magnetic sensor

Unit V : Design of Electromechanical Transducers

Design of Electromechanical Transducers for: Force, Pressure, Stress, Vibration using ,Strain-gauge, LVDT, Capacitive Elements, Piezoelectric Crystals, typical application in each design case

Reference Books:

1. E.O. Doeblin, "Measurement Systems-Applications and Design", McGraw Hill, New York, 2003.
2. H K P Neubert, "Instrument Transducers", Oxford University Press, Cambridge, 2000.
3. Dr.S.Renganathan, "Transducer Engineering", Allied publishers, New Delhi, 2003.
4. Partranabis.D., "Sensors and Transducers" ,Prentice Hall of India, New Delhi 2003

10EI302 PROCESS CONTROL

Credit: 3: 1: 0

Course Objective:

- To equip the students with the basic knowledge of Process Modeling.
- To understand various controllers and control algorithms.
- To introduce the concept of Multivariable systems and decoupling
- To analyze complex control schemes

Course Outcome:

- Students will be able to develop mathematical model of a physical process.
- Students will be able to design various controllers.
- Students will have the knowledge of MIMO process and decoupling
- Students will be able to demonstrate various control algorithms in the real time complex process

Unit I: Introduction to Process Control
Process Control System: Terms and objectives, piping and Instrumentation diagram, instrument terms and symbols- Regulator and servo control- classification of variables-Process characteristics: Process equation, degrees of freedom, modeling of simple systems – thermal, gas, liquid systems. Process lag, load disturbance and their effect on processes-Self-regulating processes-interacting and non- interacting processes.

Unit II: Control Action and Final Control Element
Controller modes: Basic control action, two position, multi-position, floating control modes. Continuous controller modes: proportional, integral, derivative. Composite controller modes: PI, PD, PID, Integral wind-up and prevention. Auto/Manual transfer, Response of Controllers for different types of test inputs-selection of control mode for different process with control scheme- Control Valve sizing- Control valve types: linear, equal percentage and quick opening valve.

Unit III: Controller Tuning and Advanced Control Strategies
Optimum controller settings- Tuning of controllers by process reaction curve method-damped oscillation method- Ziegler Nichol's tuning-Pole placement method-Feed forward control- Ratio control- Cascade control- Split range control- Averaging control-Inferential control.

Unit IV: Design of Controllers for Multivariable Systems
Introduction to multivariable system-evolution of loop interaction –evolution of relative gains- single loop and overall stability- model equations for a binary distillation column-Transfer function matrix-Method of inequalities- Decoupling control- Centralized controller

Unit V: Complex Control Techniques
Internal model control - Adaptive control- Model predictive control - Dynamic matrix control-model-Generalized predictive control

Reference Books:

1. Stephanopoulos G., "Chemical Process Control, Prentice Hall, New Delhi, 2003.
2. Coughanowr D.R., "Process Systems Analysis and Control", McGraw-Hill Higher Education, Singapore,2008
3. B. Wayne Bequette,' Process control: modeling, design, and simulation' Prentice Hall , New Jersey-2003
4. Smith C.L and Corripio.A..B, "Principles and Practice of Automatic Process Control", John Wiley and Sons, New York, 2006.
5. Dale E. Seborg, Thomas F. Edgar, Duncan A. Mellichamp, "Process Dynamics and Control" ,Willey India, 2006.
6. Marlin. T.E., Process Control, Second Edition McGraw Hill NewYork, 2000

10EI303 ADVANCED CONTROL SYSTEMS

Credit: 3: 1: 0

Course Objective:

- To Understand the basics of mathematical modeling
- To study the stability analysis of linear and non linear systems

Course Outcome:

- At the end of the course students will be able apply the modeling concepts
- Students will be equipped with stability analysis of linear and non linear systems

Unit I: Modeling of Dynamic Systems
Definition of System- Mathematical modeling- State space representation of system-Centrifugal Governor-Ground vehicle- Permanent Magnet stepper motor- Inverted Pendulum

Unit II: Analysis of Mathematical Models
State space method- Phase plane- Isoclines- Numerical methods- Taylor Series- Euler's method- Predictor Corrector method- Runge Kutta method- Principle of Linearization of Differential Equation

Unit III: State Space Analysis
Reachability and controllability - Observability and constructability - Companion forms - Controller / Observer form - State feed-back control - State estimator - Full order and reduced order Estimator- Combined controller estimator compensator

Unit IV: Stability of Nonlinear System
Stability of Nonlinear system - Lyapunov stability theorems - Lyapunov function for nonlinear system- Krasovskii's method- variable gradient method- Phase plane analysis, singular points, constructing phase portraits- limit cycle - describing function analysis.

Unit V: Robust PID Control
Introduction to robust control: PID Tuning- Modifications of PID control scheme- Two Degrees of Freedom Control-Design consideration of Robust Control.

Reference Books:

1. Ogata K, "Modern Control Engineering", Pearson Education, New Jersey 2009
2. Gopal M, Digital Control and State variable Methods, Tata McGrawHill, New Delhi, 2003.
3. Vidyasagar .M, "Nonlinear system analysis", Prentice Hall Inc., New Jersey 2002
4. Singiresu S. Rao, "Applied Numerical Methods" Prentice Hall, Upper Saddle River, New Jersey, 2001.
5. Jean-Jacques E. Slotine, Weiping Li, "Applied nonlinear control", Prentice Hall Inc., New Jersey, 2004.

10EI304 ADVANCED PROGRAMMABLE SIGNAL PROCESSOR

Credit: 4:0:0

Course Objective:
- The course is aimed at providing the advanced programmable processors to meet a range of practical applications.

Course outcomes:

- The students will know the in-depth knowledge in programmable processors and its applications.
- The students can apply object-oriented techniques and FPGA codings to the problem of extending a larger software system to implement digital signal processing techniques

Unit I: Overview of Digital Signal Processing and Applications
Signals and their Origin- Convolution and Inverse Filtering-Sampling theorem and discrete time system- Linearity, shift invariance, Causality and stability of discrete time systems-Z Transform -Advantages of Digital Signal Processing -DSP in the sample and transform domain-Fast Fourier Transform- Digital Filters- Multi-rate Signal Processing.

Unit II: Introduction to Programmable DSPs
Multiplier and Multiplier Accumulator- Modified Bus structures and Memory Access schemes in P-DSPs- Multiple Access Memory- Multiported Memory- VLIW Architecture –Pipelining –Special Addressing Modes in P-DSPs-On-Chip Peripherals.

Unit III: Architecture of TMS320C5X
Introduction – Bus Structure- Central Arithmetic Logic Unit-Auxiliary Register ALU – Index Register-Auxiliary Register Compare Register-Block Move Address Register-Block Repeat Registers-Parallel Logic Unit -Memory –Mapped Registers-Program controller-Some Flags in the status Registers-On-Chip Memory-On –Chip Peripherals

Unit IV: TMS320C5X Assembly Language Instructions and Instruction Pipelining in C5X
Assembly Language Syntax-Addressing Modes- Load / Store Instructions-Addition/ Subtraction Instructions -Move Instructions -Multiplication Instructions- The NORM Instruction-Program Control Instruction -Peripheral Control-Pipeline Structure-Pipeline operation- Normal pipeline operation, Convolution using MAC, MACD instructions- FIR filter implementation.

Unit V: DSP with FPGA
FPGA Technology pros and cons behind FPGA and programmable signal processors, FPGA structure, Implementation of basic MAC unit, FIR filter, IIR filter in FPGA

Reference Books

1. B.Venkataramani & M.Bhaskar, “Digital Signal Processor”, TMH, New Delhi, 2003.
2. U. Meyer-Baese “Digital Signal Processing with Field Programmable Gate Arrays”, Spinger, New York, 2003.
3. Michael John Sabastian Smith, “ Application Specific Integrated Circuits”, Pearson Education,USA,2005
4. Stephen Brown, Zvonko Vranesic, “Fundamentals of Digital Logic with VHDL Design”, McGraw-Hill Higher Education, New Delhi-2005

10EI305 ADVANCED DIGITAL SIGNAL PROCESSING

Credit: 3:1:0

Course objective

- This course covers the techniques of modern signal processing that are fundamental to a wide variety of application areas. We will review the mathematical basis of discrete time signal analysis, discuss the theory and implementation of FFT algorithms, digital filters.

Course outcome

- Students will learn the essential advanced topics in DSP that are necessary for successful Postgraduate level research.
- Students will have the ability to solve various types of practical problems in DSP-

Unit I : Introduction

Signals and their origin- Characterization and Classification of continuous time signals and Discrete time signals, classification and properties of systems, Time domain characterization of DT system – convolution- difference equation.

Unit II : DT Signals in Transform Domain

Discrete Fourier Transforms (DFT) and its properties, power and energy spectral density - Radix 2FFT, Computational advantages of FFT over DFT-Decimation in time FFT algorithm-Decimation-in Frequency FFT algorithm, Z-Transform and its properties – Inverse Z-transform

Unit III : Design of IIR Filters

Block diagram Representation of digital filter-Basic IIR digital filter structures- Structure Realization Using MATLAB-Preliminary consideration in digital filter design – Bilinear transformation

Unit IV : Design of FIR Filters

Basic FIR Filter Structure, Structure realization of FIR filter using MATLAB, FIR Filter design based on windowed Fourier series, Frequency sampling method, equiripple linear phase FIR filter design using MATLAB, window based FIR filter design using MATLAB, Least square error FIR filter design using MATLAB

Unit V Multi-rate Digital Signal Processing

Mathematical description of change of sampling rate-Interpolation and Decimation - Direct digital domain approach - Decimation by an integer factor -Interpolation by an integer factor –sampling rate conversion by a rational factor, filter implementation for sampling rate conversion, direct form FIR structures, polyphase filter structures, multistage implementation of multirate system- application-Phase shifters – audio sub bandcoding

References Books:

1. John .G.Proakis, “Digital Signal Processing Principles, Algorithms and Applications”, Addision Wesley, USA, 2006.
2. Sanjit .K. Mitra “Digital Signal Processing A Computer based approach”, Tata McGraw, New Delhi, 2001.
3. Emmanuel C.Ifeachor “Digital Signal Processing A Practical Approach”, Addison-Wesley, California, 2002

10EI306 ADVANCED MICRO CONTROLLERS

Credit: 4:0:0

Course Objective

- To learn recent trends in advanced microcontroller applications

Course Outcome

- Students will have an ability to program microcontrollers for embedded applications
- Students will have the knowledge of several different processors are employed in order to illustrate architecture differences and to show common characteristics.
- Students can be able to design the microcontroller for their projects.

Unit I: Microcontroller
Introduction – architecture of microcontrollers – types - examples – selection-applications- microcontroller resources – bus width- program and data memory- parallel ports– On chip ADC &DAC – reset – watchdog timer – real-time clock.

Unit II: Intel 8051
Architecture of 8051 – Memory Organization – counters and timers – USART – interrupts – peripherals and interfacing – digital and analog interfacing methods - Addressing modes – Instruction set - – programming examples.

Unit III: 8096/80196 Family
Architecture of 8096 – addressing Modes – instruction set – memory map in Intel 80196 family MCU system – I/O ports – programmable timers – Interrupts.

Unit IV: High Performance RISC Architecture
Introduction to 16/32 bit processor – ARM architecture – The ARM instruction set – The thumb instruction set – programmers model - Operating Mode Selection, Registers.

Unit V: PIC Micro Controller
CPU Architecture – Instruction set – Interrupts – Timers –Memory- I/O port expansion – I^2C bus for peripheral chip access- A/D converter – UART.

Reference Books:

1. Raj Kamal – "Microcontrollers - Architecture, Programming, Interfacing and System Design", Pearson Education, USA, 2005.
2. Steave Furber," ARM system–on–chip architecture" Addison Wesley, New Delhi, 2000.
3. John.B.Peatman, "Design with PIC Micro Controller", Pearson Education, USA, 2003.
4. Mohammad Ali Mazide, Janice Gillispic Mazidi, Rolin D.Mckinlay, " The 8051 micro controller and embedded systems using assembly and C", prentice Hall of India, Hyderabad, 2006
5. Kenneth Ayala ,"The 8051 Microcontroller", Thomson Delmar Learning , New Jersey, 2004

10EI307 DIGITAL SYSTEM DESIGN

Credit: 4:0:0

Course Objective

- To provide an in-depth knowledge of the design of digital circuits and the use of Hardware Description Language in digital system design.

Course Outcome

- Students will be able to design different programmable logic devices.
- Students will have the knowledge of FPGA architecture.
- Students will be able to design the combinational & sequential logic circuits in FPGA.
- Students can be able to write the program in VHDL & Verilog code.

Unit I: Programmable Logic Devices

Basic concepts - Design of combination and sequential circuits using PLD's-Programming techniques - programmable read only memory (PROMs) - Programmable Logic Array (PLA) - Programmable Array Logic (PAL) - Design of state machines using ASM- ASM chart- ASM realization.

Unit II: FPGA and CPLD

Types of ASICs - Semi custom and full custom IC design- Design Flow - Type of FPGA – Xilinx XC3000 Series – Xilinx XC4000 Series -Logic Cell Array (LCA) – Configurable Logic Blocks (CLB) Input/output Blocks (I/OB) – Programmable Interconnects - CPLD-Altera Max 7000 Series.

Unit III: Synchronous Sequential Networks

Structure and operation of clocked synchronous sequential networks (CSSN) - analysis of CSSN – modeling CSSN – state assignment – realization using PLD- Static and Dynamic Hazards – Detecting hazards – Eliminating hazards – Essential hazards

Unit IV: Introduction to VHDL

Basic concepts – identifiers – data operators – data types – data objects –Behavioral modeling – Data flow modeling – structural modeling – subprograms and over loading – packages and libraries.

Unit V: Introduction to Verilog

Typical design flow – basic concepts –data types - data operators- modules and ports – gate level modeling – data flow modeling – behavioral modeling – timing and delays-examples.

Reference Books:

1. Donald G. Givone "Digital principles and Design" Tata McGraw Hill, New Delhi, 2007.
2. Charles H. Roth Jr. "Fundamentals of Logic design" Jaico Publishing House Mumbai, 2004.

3. Stephen Brown and Zvonk Vranesic "Fundamentals of Digital Logic with VHDL Deisgn" Tata McGraw Hill, New Delhi 2002.
4. Parag K Lala, "Digital System design using PLD" BS Publications, Hyderabad, 2003
5. Samir Palnitkar, "Verilog HDL", Pearson Publication, USA, 2006.
6. J. Bhaskar, "A VHDL Synthesis Primer", BS Publications, Hyderabad, 2004.
7. M.J.S .Smith, "Application Specific Integrated Circuits", Addison –Wesley Longman Inc., New Delhi, 2006.

10EI308 DATA COMMUNICATION, NETWORKS AND PROTOCOLS

Credit: 4:0:0

Course Objective

- To understand the System Interconnection and protocols.
- To introduce the concept of communication protocols and give an overview of Data Communication Standards.
- To discuss the types of cables used for transmission.
- To discuss the operation and applications of the Protocols used in Industries.

Course Outcome

- The student will be able to identify the protocol.
- The student will have the ability to chose the require protocol and the communication modes for the given system.
- The student will be able to select a suitable cable for the transmission.

Unit I : Overview & Basic Principles
Open systems interconnection (OSI) model - Protocols - Physical standard – Smart Instrumentation systems- Bits, bytes and characters- Communication principles- Communication modes- Asynchronous systems- Synchronous systems- Error detection- Transmission characteristics- Data coding- The universal asynchronous receiver/transmitter (UART)- The high speed UART (16550).

Unit II: Data Communication Standards
Standards organizations- Serial data communications interface standards- Balanced and unbalanced transmission lines- EIA-232 interface standard - Troubleshooting serial data communication circuits- Test equipment- Ethernet - Ethernet Protocol operation - Ethernet hardware requirements. The RS-485 interface standard- Troubleshooting and testing with RS-485- The 20 mA current loop- Serial interface converters- Interface to serial printers- Parallel data communications interface standards- General purpose interface bus (GPIB) or IEEE-488 or I EC-625- The universal serial bus (USB**)**

Unit III: Cabling, Electrical Noise and Error Detection
Origin of errors- Factors affecting signal propagation- Types of error detection, control and correction- Copper-based cables -Twisted pair cables- Coaxial cables- Fiber-optic cables- Definition of noise- Frequency analysis of noise- Sources of electrical noise- Electrical coupling of noise –Shielding- Good shielding performance ratios- Cable

ducting or raceways- Cable spacing- Earthing and grounding requirements- Suppression technique- Filtering

Unit IV: Modem and Multiplexer
Modes of operation- Synchronous or asynchronous- Interchange circuits- Flow control- Distortion- Modulation techniques- Components of a modem- Types of modem- Radio modems- Error detection/correction- Data compression techniques- Modem standards- Troubleshooting a system using modems- Multiplexing concepts- Terminal multiplexers- Statistical multiplexers

Unit V: Industrial Protocol
PROFIBUS: Basics, architecture, communication model, profile. Modbus protocol- HART Protocol : Physical layer- Data link layer- Application layer - Foundation fieldbus - Use of fieldbuses in industrial plants.

Reference Books:

1. Steve Mackay, John Park and Edwin Wright, "Practical Data Communication for Instrumentation and Control", Newnes Elsevier, USA, 2002.
2. A.S. Tanenbaum, "Computer Networks", Fourth Edition, Prentice-Hall of India, Hyderabad, 2002.
3. William A Shay, "Understanding Data Communications and networks", Pacific Grove, USA, 2003.

10EI309 MODELLING OF PHYSIOLOGICAL SYSTEMS

Credit: 4:0:0

Course Objective

- To understand basic ideas related to modelling and different modelling techniques of certain physiological systems like respiratory system, thermal regulation system and lung model.

Course Outcome

- Able to model any physiological system
- Gain thorough knowledge of modelling of thermal regulation system, Respiratory system
- Pharmacokinetic modeling

Unit I: Principles of Modeling
Physiological processes and principles of their control, Control – Blood flow, gas exchange,Ultra filtration, biomedical reactions pneumatic transport- digestion energy utilization and waste disposal, Linear and non-linear control systems, principles of open loop and feedback systems, techniques for system response of characterization
Mathematical approach, electrical analogues- introduction to various process controls like cardiac rate, blood pressure, respiratory rate, blood glucose regulation electrical model of neural control mechanism

Unit II: Cardiovascular Mechanics

Models of the peripheral circulation - Vascular Resistance, Vascular Capacitance, A Lumped Parameter Model of the Peripheral Circulation, The Windkessel Simplification. The Heart as a Pump - Length Tension relationship, Pressure-Volume relationships in the ventricle, Model of the Heart - The Variable Capacitor Model, Inotropic State, Heart-Lung Pumping Unit – Open Chest Model, Effect of Intrathoracic Pressure. Modelling the intact Cardio vascular system, Normal Functioning of the Cardiovascular System, Cardiac Output Under Abnormal Conditions, Graphical solution - Operating Point Analysis, Sympathetic Stimulation, Tissue oxygen need, Muscular Exercise

Unit III: Respiratory System
Modelling oxygen uptake by RBC and pulmonary capillaries, Mass balancing by lungs, Gas transport mechanisms of lungs, oxygen and carbon dioxide transport in blood and tissues.

Unit IV: Ultra Filtration System
Transport through cells and tubules, diffusion, facilitated - diffusion and active transport,methods of waste removal, counter current model of urine formation in nephron, modelling Henle's loop.

Unit V: Modeling Body Dynamics
Principles of mechanical properties of bones, tissues - modelling bones, stress propagation in bones, Hills model of muscle mechanism.
Current Trends:Pharmacokinetic modelling illustrated with example like drug diffusion, computer aided modeling.

Reference Books

1. Katz, A.M. "Physiology of the Heart", Lippincott Williams & Wilkins, USA,2006.
2. Carson, Cobelli, : "Introduction of Modelling in Physiology and Medicine ", Academic Press, Netherland,2008.
3. Vasilis.Z.Mararelis, " Non linear Dynamic Modelling of Physiological System", John Wiley & Sons, New Jersey,2004.
4. Daniel Weiner, Johan Gabrielsson, "Pharmacokinetic and Pharmacodynamic Data Analysis: Concepts and Applications, Sweden, 2000.

10EI310 ADVANCED MEDICAL INSTRUMENTATION

Credit : 4:0:0

Course Objective
- With widespread use and requirements of medical instruments, this course gives knowledge of the principle of operation and design of biomedical instruments.
- It attempts to render a broad and modern account of biomedical instruments.
- It gives the introductory idea about human physiology system which is very important with respect to design consideration

Course Outcome
- Students will have a clear knowledge about human physiology system.

- They will have knowledge of the principle operation and design and the background knowledge of biomedical instruments and specific applications of biomedical engineering

Unit I: Introduction to Human Physiology
Circulatory system – cardio vascular system-central nervous system – respiratory system – muscular skeletal system – digestive system – excretory system – sensory organs – voluntary and involuntary action.

Unit II: Biopotentials and their Measurements
cell and its structure – resting potentials – action potentials – bioelectric potentials – measurement of potentials and their recording – basic principles of ECG, EEG, EMG– Electrode theory – bipolar and Unipolar electrode-surface electrode – electrode impedance –equivalent circuit for extra cellular electrodes- micro electrodes,

Unit III: Computer based medical instrumentation
Computerised versions of ECG, EEG, EMG, Tread Mill Test ECG– Foetal monitor, cardiac arrthymias and its monitoring through Hotler monitor, Event monitors, Bispectral Index EEG for depth of anesthesia monitoring

Unit IV: Operation theatre equipment and Critical Care instrumentation
Patient monitors, pulse oximetry, ICU ventilators, suction apparatus, anesthesia equipment, electro surgery, operating microscopes, motorized operation table, infusion pumps and syringe pumps, nerve stimulator, defibrillators, Electrical Safety and other safety aspects of medical equipment.

Unit V: Medical Imaging Techniques
X-rays – scanning techniques-ultrasound scanner- color Doppler system, CT, MRI scanning techniques – coronary angiogram, nuclear imaging

Unit VI: Specialized Therapeutic and diagnostic equipment
Cardiac pacemakers, heart lung machines, haemodialysis, clinical laboratory instrumentation, Audiometer, Phonocardiogram,

Reference Books:

1. John G. Webster, "Medical Instrumentation Application and Design", John Wiley and sons, New York, 2009.
2. Leslie Cromwell, "Biomedical Instrumentation and measurement", Prentice hall of India, New Delhi, 2007.
3. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw-Hill, New Delhi, 2003.
4. Standard Handbook of Biomedical Engineering & Design – Myer Kutz, McGraw-Hill Publisher, UK,2003.

10EI311 BIOMATERIALS

Credit: 4:0:0

Course Objective:
- To study the characteristics and classification of Biomaterials

- To study about the different metals and ceramics used as biomaterials
- To learn about polymeric materials and combinations that could be used as a tissue replacement implants
- To study the artificial organ developed using these materials

Course Outcome:
- To understand the properties of the Bio-compatible materials
- To know the different types of Biomaterials
- To design artificial organs using tissue materials

Unit I: Structure of Bio-Materials and Bio-Compatibility
Definition and classification of bio-materials, mechanical properties, visco elasticity, wound-healing process, body response to implants, blood compatibility, Biological evaluation of materials based on ISO 10993, Physical characterization, Surface characterization, Thermal characterization, SEM, TEM, X-ray difractometry.

Unit II: Implant Materials
Metallic implant materials, stainless steels, co-based alloys, Ti-based alloys, ceramic implant materials, aluminum oxides, hydroxyapatite glass ceramics carbons, medical applications.

Unit III: Polymeric Implant Materials
Polymerisation,-polyolefin-polyamicles-Acryrilic- polymers- rubbers-high strength thermoplastics-medical applications.

Unit IV: Tissue Replacement Implants
Soft-tissue replacements, sutures, surgical tapes, adhesive, percutaneous and skin implants, maxillofacial augmentation, blood interfacing implants, hard tissue replacement implants, internal fracture fixation devices, joint replacements.
Unit V: Artificial Organs
Artificial Heart, Prosthetic Cardiac Valves, Limb prosthesis, Externally Powered limb Prosthesis, Dental Implants

Reference Books

1. Joon Bu Park, Roderic S. Lakes, "Biomaterials: an introduction", New York, 2007.
2. B.D.Rater, "Biomaterials Sciences – An Introduction to Materials in Medicine" Academic Press ,China 2004.
3. Jonathan Black, "Biological Performance of Materials Fundamentals of Biocompatibility", USA, 2004.
4. Joon Bu Park, Joseph D. Bronzino, 'Biomaterials: principles and applications', CRC press, USA, 2003.
5. Teoh Swee Hin, Swee Hin Teoh, 'Engineering materials for biomedical applications' World Scientific Publishing Co, USA, 2004.
6. Sujata V. Bhat, 'Biomaterials', Narosa Publishing House, New Delhi, 2002.

10EI312 HOSPITAL MANAGEMENT

Credit: 4:0:0

Course Objective:

- To understand the need and significance of Clinical Engineering and Health Policies
- To familiarize the training strategies, quality management policies and information technology used in medicine and health care.

Course outcome:

- The student will appreciate the need for standard health policies and quality management in hospitals.
- The student will apply the knowledge of computer and information technology in health care.

Unit I Need And Scopes Of Clinical Engineering

Clinical engineering program, educational responsibilities, role to be performed by them in hospital, staff structure in hospital

Unit II National Health Policies

Need for evolving health policy, health organization in state, health financing system, health education, health insurance, health legislation

Unit III Training And Management Of Technical Staff In Hospital

Difference between hospital and industrial organization, levels of training, steps of training, developing training program, evaluation of training, wages and salary, employee appraisal method.

Unit IV Standards, Codes and quality management in Health Care

Quality management in hospitals and clinical laboratories, Necessity for standardization and quality management, NABH and NABL standards, FDA, Joint Commission of Accreditation of hospitals, ICRP and other standard organization, methods to monitor the standards, Overview of Medical Device regulation and regulatory agencies.

Unit V Computers and Information Technology in Medicine and healthcare

Computer application in ICU, Picture Archival System (PACS) for Radiological images department, Clinical laboratory administration, patient data and medical records, communication, simulation.

Reference Books

1. Webster J.C. and Albert M.Cook, “Clinical Engineering Principle and Practice”, Prentice Hall Inc., Englewood Cliffs, New Jersey, 1979 .
2. Goyal R.C., “Handbook of hospital personal management”, Prentice Hall of India, 1996

10EI313 COMMUNICATION THEORY AND TELEMETRY

Credit: 4:0:0

Course Objective

- The aim of this course is to understand the principles of telemetry, multiplexing, modem protocols, and antenna theory for practical applications.

Course Outcome

- Analyse signals,its transmission principles with discussion on modulations and associated circuits.
- Understand the use of fibre optics in communication.
- Understand the key characteristics of frequency and time division multiplexing together with their relative benefits and drawbacks

Unit I - Telemetry Principles

The basic system - classification - non - electrical and electrical telemetry - local transmitters and converters - frequency telemetering- power line carrier communication, signals -theorems - exponential Fourier series - amplitude and frequency modulations - phase modulation, Bits and symbols- time function pulse - modulation codes - Inter symbol Interference - error rate and probability of error.

Unit II - Frequency and Time Division Multiplexed System

Frequency division multiplexed system: IRIG standards-FM and PM circuits, PLL, Time Division multiplexed system: TDM - PAM ,TDM - PCM system, Digital multiplexer - PCM Reception - differential PCM.

Unit III - Modems and Transmission Lines

Modems- Quadrature amplitude modulation - Modem protocol - Transmitters and Receivers technicques -RF transmission lines- Microwave lines - wave guide components - Micro strip lines – Digital transmission system in Satellite Telemetry.

Unit IV – Fibre Optical Telemetry

Optical Fibre Cable-Dispersion-Losses-Connectors and Splices-Sources and Detectors-Transmitter and Receiver Circuits-Coherent Optical Fibre Communication Systems-Wavelength Division Multiplexing.

Unit V – Internet Based Telemetering

Data Acquisition System-Microprocessor-based DAS-Remote Control-Networking-BLANs-Internet based Telemetering-Wireless LANs-Random Access System-Principles of Telephony.

Reference Books

1. D.Patranabis, “Telemetry Principles”, Tata McGraw Hill, New Delhi, 2007.
2. Taub and Schilling, “Principles of Communication”, Third Edition, Tata McGraw Hill, New Delhi 2008.
3. E.D. Doeblin, Measurement Systems-Applications and Design, McGraw Hill, New York, 2003.

10EI314 ANATOMY AND PHYSIOLOGY

Credit: 4:0:0

Course Objective

- To define the different anatomical terms
- To explain the overall structure-function relationship of all systems

- To apply this basic knowledge to changes in bodily functions as a result of disease and determine the reason for functional changes

Course Outcome

- Be able to identify the major body systems and understand what each body system does
- Be able to relate how each body system works
- Be able to identify and explain major cells, tissues, and organs
- Be able to identify the explain functions of central muscles and bones

Unit I: Introduction to cell structure
Cell structure and organelles, function of each component of the cell-membrane potential-Blood, blood cells-composition-origin of RBC-estimation of RBC- WBC- and platelet

Unit II: Circulatory and Respiratory Systems
Structure and functioning of heart, structure and functioning of lungs, trachea and its branches, general circulation. Capillary circulation, venous return, neural control of cardio vascular system. Pulmonary Ventilation, Regulation of breathing, hypoxia

Unit III: Nervous And Sensory Systems
Structure and function of nervous tissues, reflex action, afferent nervous system, regulation of posture-physiology of emotion, regulation of temperature, cerebrospinal fluid, sensory end organs, tongue, mechanism of sight, hearing and smelling

Unit IV: Digestive and Excretory System
Structure of alimentary canal, related digestive glands, liver, mechanism of alimentary canal, secretion of digestive fluids, function of liver. Structure of kidney, bladder and colon, physiology of perspiration, physiology of urine formation, physiology of micturation, physiology of defaecation.

Unit V: Endocrine System
Pituitary gland, thyroid and parathyroid glands, pancreas, ovary and testis.

Reference Books

1. Arthur.C.Guyton, "Textbook of Medical Physiology" Prism Book (P) Ltd, USA, 2008.
2. Ranganathan, T.S. "Text Book of Human Anatomy", S.Chand&Co. Ltd., New Delhi, 2007.

10EI315 DISCRETE TIME CONTROL SYSTEMS

Credit: 3: 1: 0

Course Objective

- To Understand the application of Z Transforms in process control
- To study various control algorithms

Course Outcome

- At the end of the course students will be able apply Z transform concepts process control
- Students will be equipped with different control algorithm

Unit I: Introduction

Computer control – Introduction – Review of Z Transform, Modified Z Transform and Delta Transform. Relation between Discrete and Continuous Transfer function-Poles and Zeros of Sampled Data System (SDS) – Stability Analysis in Z domain

Unit II: Pulse Transfer Function

Introduction - Open loop and closed loop response of SDS Design and implementation of different digital control algorithm: Dead beat, Dahlin, Smith predictor and Internal Model Control algorithm with examples.

Unit III: Different Models of Discrete System

LTI System:- Family of Discrete Transfer function Models- State Space models- Distributed Parameter Model. Models for Time varying and Non-linear System: Linear Time varying models- Non-linear State space models- Non-linear Black Box Models- Fuzzy Models

Unit IV: Parameter Estimation Methods

General Principles- Minimizing Prediction errors- Linear Regression and the Least Square method- Statistical Frame work for Parameter Estimation and the Maximum Likely hood method- Instrument Variable method – Recursive and Weighted Least square method

Unit V: Adaptive Control

Introduction -Deterministic Self Tuning Regulator: Indirect and Direct self tuning regulator-Model reference Adaptive system: Design of MRAS using Lyapnov and MIT Rule- Auto tuning and Gain scheduling adaptive control design with examples

Reference Books

1. Lennart Ljung, “System Identification Theory for the user”, PTR Prentice Hall Information and system sciences Series, New Jersey, 2005.
2. Gopal M, Digital Control and State variable Methods, Second Edition, Tata McGrawHill, New Delhi, 2003.
3. Gene F. Franklin,J. David Powell, “Digital control of dynamic systems”, Pearson Education Limited-2002.
4. Dale E. Seborg, Thomas F. Edgar, Duncan A. Mellichamp, “Process Dynamics and Control”, Willey India, 2006.
5. Astrom .K. J, Bjorn Wittenmark, “Adaptive Control”, Second Edition, Prentice Hall of India, New Delhi, 2008.
6. Ogata, “Discrete- Time Control Systems”, Pearson Education, Sigapore,2002

10EI316 MEDICAL SENSORS

Credit: 4:0:0

Course Objective

- An introduction to the field of medical sensors and an in-depth and quantitative view of device design and performance analysis. An overview of the current state of the art to enable continuation into advanced biosensor work and design.

Course Outcome

- Define the fundamental components of any biosensor,
- Define the major performance characteristics of any biosensor and design an experiment to measure that characteristic ,
- Evaluate a sensor based on standard performance criteria and appropriateness for an application,
- Given a specific biosensor application, identify the key design criteria and suggest and an appropriate biosensor approach which is most likely to meet those design criteria,
- Compare the relative advantages and disadvantages of the major approaches to biosensor design,
- Communicate the most relevant challenges facing the biosensor research field and given a particular challenge suggest a reasonable approach to finding a solution to the challenge,

Unit I: Introduction
Methods for biosensors fabrication: self-assembled monolayers, screen printing, photolithography, microcontact printing, MEMS. Physiological Pressure Measurement:Units of pressure, Physiological pressure ranges and measurement sites-Direct measurement-Dynamic response of catheter transducer systems-Catheter tip pressure transducers-Implantable pressure transducers, Telemetering capsules, Pressure measurements in small vessels, collapsible vessels, Interstitial spaces-Differential pressure measurement. Indirect pressure measurement-Cuff design-Detection of korotkoff sounds-Oscillometric method-Doppler Ultrasound-Instantaneous arterial pressure-Internal pressure measurement by reaction forces.

Unit II: Motion And Force Measurement
Units of quantities-Displacement and Rotation measurements by contact and noncontact methods-Linear and angular velocity measurements-Translational and angular acceleration-force measurement, Muscle contraction measurements-Design of elastic beam-Force in isolated muscle-Invivo-Measurements-Stresses in the bone-Force plate-Stabilometer

Unit III: Flow Measurement
Units-Blood flow measurement in single vessels-Electromagnetic, Ultrasonic Flowmeters-Indicator dilution method-Impedence cardiography-Laser Doppler flowmetry-RBC velocity measurement-Miscallaneous mechanical flowmeters. Tissue blood flow measurement-Venous occlusion plethysmography-Clearance technique-Measurement by heat transport-Laser Doppler flowmeter-NMR flowmete. Respiratory gas flow measurement-Rotometer,Pnemotachograph, Hot-Wire anemometer-Time of flight, Ultrasonic vortex flowmeter, Spirometer, Lung plethysmography.

Unit IV: Temperature, Heat Flow and Evaporation Measurement
Units, Thermistors, Thermocouples, Termosensitive elements, Diodes, Transistors, Crystal resonators, Non contact temperature measurement techniques-Infrared

measurements, Thermography, Microwave imaging clinical thermometers-Rectal, Esophageal, Bladder temperature measurement, Tympanic thermometers, Zero heat flow thermometers. Heat flow measurements-Transducers-Direct calorimetry. Evaporation measurement, Humidity transducers-Electrolytic water vapor analyzer, Dewpoint-Hygrometer-Impedence, Capacitive sensors, Thermoelectric Psycrometer, Evaporative water loss from skin and mucosa.

Unit V: Chemical Measurement

Electrode theory-surface potential electrodes-ECG,EMG,EEG electrodes-micro & suction electrodes. Chemical transducer-Electrochemical transducers-Transducer with optical, Acoustic and thermal principles-Mass spectrometer-Chromatography-Electrophoresis-Magnetic resonance-Other optical methods-Other analytical methods-Continous measurement-Intravascular, tissue-Ex vivo measurements. Transcutaneous measurements-Respiratory gas analysis.

Reference Books

1. Tatsuo Togawa, Toshiyo Tamura, p. Ake Oberg, “Bio-Medical Transducers and Instruments”-CRC Press, USA, 2010.
2. Gábor Harsányi, ”Sensors in biomedical applications: fundamentals, technology & applications”, CRC Press, USA, 2000.
3. Joseph D. Bronzino,” The biomedical engineering handbook”, Volume 2, CRC Press, USA, 2000.

10EI317 ADVANCED INSTRUMENTATION AND PROCESS CONTROL

Credit: 4:0:0

Course objective

- To introduce the concept of process instruments for various physical variables, system, automation and optimal control.

Course outcome

- To introduce the fundamental of measurement and the techniques for measurement of various physical variables.
- To review the concept of system and learn the basic concept of process automation.

Unit I: Introduction

Principle of measurement and classification of process control instruments; temperature, pressure fluid flow- liquid level- velocity- fluid density etc., instrument scaling- sensors-transmitters and control valves- instrumentation symbols and labels.

Unit II: Measurements

Principle of measurements of weight flow rate-viscosity-consistency- pH concentration-electrical and thermal conductivity-humidity of gases-composition by physical and chemical properties and spectroscopy.

Unit III: Review of Systems
Review of first and higher order system, closed and open loop response-response to step, impulse and sinusoidal disturbance-control valve type-linear-equal percentage and quick opening valve. Design of valves.-transient response-block diagram.

Unit IV: Process Automation
Basic concept: terminology and techniques for process control; control modes; tuning process controllers

Unit V: Advanced Control System
Cascade control- ratio control-feed forward control- multi variable process control.
Case studies: Distillation column, chemical reactor, heat exchanger, condenser, evaporator

Reference books

1. D.E.Seborg, T.F.Edger, and D.A.Millichamp, "Process Dynamics and Control", John Wiley and Sons, Newyork,2004.
2. B.Roffle, B.H.L.Betlem, "Advanced Practical Control", Springer, Newyork,2004.
3. Jean Pierre Corriou, "Process Conrol: Theory and Application",Springer,London,2004.
4. Stephanopoulos, "Chemical Process Control", 2^{nd} Edition, Prentice Hall, New Delhi, 2003.

10EI318 EMBEDDED LINUX

Credit: 4:0:0

Course objective
- To expose the students to the fundamentals of embedded Linux programming.

Course outcome
- Students will be able to work on basic Linux Programming.
- Students will be capable to develop embedded Linux program.
- Students will be able to program in real-time systems with memory management.

Unit I: - Fundamentals of Operating Systems
Overview of operating systems – Process and threads – Processes and Programs – Programmer view of processes – OS View of processes – Threads - Scheduling – Non preemptive and preemptive scheduling – Real Time Scheduling – Process Synchronization – Semaphores – Message Passing – Mailboxes – Deadlocks – Synchronization and scheduling in multiprocessor Operating Systems

Unit II: Linux Fundamentals
Introduction to Linux – Basic Linux commands and concepts – Logging in - Shells - Basic text editing - Advanced shells and shell scripting – Linux File System –Linux programming - Processes and threads in Linux - Inter process communication – Devices – Linux System calls

Unit III: Introduction to Embedded Linux

Embedded Linux – Introduction – Advantages- Embedded Linux Distributions - Architecture - Linux kernel architecture - User space – linux startup sequence - GNU cross platform Tool chain

Unit IV: Board Support Package and Embedded Storage
Inclusion of BSP in kernel build procedure - The bootloader Interface – Memory Map – Interrupt Management – PCI Subsystem – Timers – UART – Power Management – Embedded Storage – Flash Map – Memory Technology Device (MTD) –MTD Architecture - MTD Driver for NOR Flash – The Flash Mapping drivers – MTD Block and character devices – mtdutils package – Embedded File Systems – Optimizing storage space – Turning kernel memory

Unit V: Embedded Drivers and Application Porting
Linux serial driver – Ethernet driver – I2C subsystem – USB gadgets – Watchdog timer – Kernel Modules – Application porting roadmap - Programming with pthreads – Operting System Porting Layer – Kernel API Driver - Case studies - RT Linux – uClinux

Reference Books

1. Dhananjay M. Dhamdhere, “Operating Systems A concept based Approach”, Tata Mcgraw-Hill, New Delhi, 2002.
2. Matthias Kalle Dalheimer, Matt Welsh, “Running Linux”, O’Reilly, U.K, 2005.
3. Mark Mitchell, Jeffrey Oldham and Alex Samuel “Advanced Linux Programming” New Riders, USA, 2001.
4. P. Raghavan ,Amol Lad , Sriram Neelakandan, “Embedded Linux System Design and Development”, Auerbach Publications. London, 2006.
5. Karim Yaghmour, “Building Embedded Linux Systems”, O'Reilly, UK, 2003.

10EI319 ADVANCED EMBEDDED SYSTEMS LAB

Credit: 0:0:2

Course Objective

- To illustrate concepts discussed in the syllabus and to give the students the opportunity to build and test the digital systems. The lab exercises will make use of the Xilinx 9.2 ISE tool for designing and implementing digital systems on FGPA. The system consists of an integrated set of tools that allows one to capture designs (with schematic entry or a Hardware Description Language), simulate, implement and test them.

Course Outcome

- Students will have knowledge about the concepts and methods of digital system design techniques.
- Students able to design combinational and sequential digital systems.
- Students able to analyze the results of logic and timing simulations and to use these simulation results to debug digital systems.

- Students will have the knowledge through hands-on experimentation the Xilinx tools for FPGA design as well as the basics of VHDL to design, simulate and implement the digital systems.

List of Experiments

1. Implementation of logic gates & i/o module.
2. Realization of half/full adder, half/full subtractor
3. Realization of encoder/decoder
4. Realization of flipflops/ counter
5. Implementation of multiplexer/ demultiplexer
6. Realization of SRAM
7. Implementation of ALU ARM7 processor
8. Graphic LCD interface
9. TFT display interface
10. GPS interface RTOS
11. Multi-tasking.

10EI320 MEDICAL DIAGNOSTICS AND THERAPEUTIC LAB

Credit: 0:0:2

Course Objective

- To provide basic knowledge of physiological signals
- To make the students to know about various physiological measuring instruments and to diagnose the various disease
- To make the students to know about various measurement techniques

Course Outcome

- Students are equipped with knowledge of physiological signals
- Students can apply the various measurement techniques.

LIST OF EXPERIMENTS

1. Blood pressure measurement
2. Determination of auditory capacity using audio meter
3. Determination of blood flow velocity using ultrasonic Doppler blood flow meter
4. Surgical diathermy
5. Recording of EOG signals
6. Recording of ECG waveforms using bio-kit physio-graph
7. Recording of EMG waveforms using bio-kit physio-graph
8. Recording of PCG waveforms using bio-kit physio-graph
9. Recording of peripheral pulse waveforms using bio-kit physio-graph
10. Recording of EEG waveforms using bio-kit physio-graph
11. Determination of percentage of oxygen saturation in blood using pulse oximeter
12. TENS-physiotherapy

10EI321 OPTIMAL CONTROL THEORY

Credit : 4:0:0

Course Objective

- To provide an introductory account of the theory of optimal control and its applications
- The purpose of this course is to give students background in dynamic optimization: the Calculus of Variations, Pontryagin's Minimum Principle, and Bellman's Dynamic Programming.

Course Outcome

- Students will have the basic knowledge of optimal control and its applications
- Students will be equipped with dynamic optimization: the Calculus of Variations, Pontryagin's Minimum Principle, and Bellman's Dynamic Programming.

Unit: I Introduction

Problem formulation – Mathematical model – Physical constraints – Performance measure Optimal control problem. Form of optimal control. Performance measures for optimal control problem. Selection a performance measure

Unit: II Dynamic Programming

Optimal control law – Principle of optimality. An optimal control system. A recurrence relation of dynamic programming – computational procedure. Characteristics of dynamic programming solution. Hamilton – Jacobi – Bellman equation. Continuous linear regulator problems

Unit:III Calculus of Variations

Functions and Functional- Maxima and minima of function- Variation of functional- Extremal of functional- Euler Lagrange equation

Unit: IV - Variational Approach to Optimal Control Problems

Necessary conditions for optimal control – Linear regulator problems. Linear tracking problems. Pontryagin's minimum principle and state inequality constraints

Unit: V Minimum Time Problems

Minimum control – effort problems. Singular intervals in optimal control problems. Numerical determination of optimal trajectories – Two point boundary – value problems. Methods of steepest decent, variation of extremals.Quasilinearization. Gradient projection algorithm

Reference Books

1. Donald E. Kirk, Optimal Control Theory: An Introduction, Prentice-Hall networks series, New Jersey, 2004.
2. Singiresu S. Rao "Engineering Optimization: Theory and Practice" New Age International (P) Ltd., Publishers New Delhi-2004.
3. M. Gopal, "Digital Control and State Variable Methods", Tata McGraw-Hill Companies New Delhi, 2009.
4. Dimitri P. Bertsekas.'Dynamic Programming and Optimal Control' Vol -1 Athena Scientific, Bell mount MA, 2000.

10EI322 NETWORKS AND PROTOCOLS FOR MEDICAL SYSTEM

Credit: 4:0:0

Course Objective

- To understand the System Interconnection and protocols.
- To introduce the concept of communication protocols and give an overview of Data Communication Standards.
- To discuss the types of cables used for transmission.
- To discuss the operation and applications of the Wireless Protocols.

Course Outcome

- The student will be able to identify the protocol.
- The student will have the ability to chose the require protocol and the communication modes for the given system.
- The student will be able to select a suitable cable for the transmission.

Unit I : Overview & Basic Principles

Open systems interconnection (OSI) model - Protocols - Physical standard – Smart Instrumentation systems- Bits, bytes and characters- Communication principles- Communication modes- Asynchronous systems- Synchronous systems- Error detection- Transmission characteristics- Data coding- The universal asynchronous receiver/transmitter (UART)- The high speed UART (16550)

Unit II: Data Communication Standards

Standards organizations- Serial data communications interface standards- Balanced and unbalanced transmission lines- EIA-232 interface standard - Troubleshooting serial data communication circuits- Test equipment- Ethernet - Ethernet Protocol operation - Ethernet hardware requirements. The RS-485 interface standard- Troubleshooting and testing with RS-485- The 20 mA current loop- Serial interface converters- Interface to serial printers- Parallel data communications interface standards- General purpose interface bus (GPIB) or IEEE-488 or I EC-625- The universal serial bus (USB**)**

Unit III: Cabling, Electrical Noise and Error Detection

Origin of errors- Factors affecting signal propagation- Types of error detection, control and correction- Copper-based cables -Twisted pair cables- Coaxial cables- Fiber-optic cables- Definition of noise- Frequency analysis of noise- Sources of electrical noise- Electrical coupling of noise –Shielding- Good shielding performance ratios- Cable ducting or raceways- Cable spacing- Earthing and grounding requirements- Suppression technique- Filtering

Unit IV: Modem and Multiplexer

Modes of operation- Synchronous or asynchronous- Interchange circuits- Flow control- Distortion- Modulation techniques- Components of a modem- Types of modem- Radio modems- Error detection/correction- Data compression techniques- Modem standards- Troubleshooting a system using modems- Multiplexing concepts- Terminal multiplexers- Statistical multiplexers

Unit V:Wireless Protocol

Bluethooth: Definition - Bluetooth protocol stack – Network Establishment in Bluetooth – Wireless Local Area Network – WLAN Standard – Home RF – Network topologies – Physical Layer – Zigbee Networks.

Reference Books

1. Steve Mackay, John Park and Edwin Wright, "Practical Data Communication for Instrumentation and Control", Newnes Elsevier, USA, 2002.
2. A.S. Tanenbaum, "Computer Networks", Fourth Edition, Prentice-Hall of India, Hyderabad, 2002.
3. William A Shay, "Understanding Data Communications and networks", Pacific Grove, USA, 2003.
4. P Nicopolitidis, M S Odaidat, G I Papadimitriou, A S Pomportsis "Wireless Networks", Wiley India Edition – New Delhi.
5. Vijay K Garg , "Wireless Network Evolution" Pearson Education, Delhi.

10EI323 REAL TIME AND EMBEDDED SYSTEMS

Credit : 4:0:0

Course Objective:

- To introduce the basic concepts of Embedded Systems and the various techniques used for Embedded Systems with real time examples.

Course Outcome:

- To discuss the basics o embedded systems and the interface issues related to it.
- To learn the different techniques on embedded systems
- To discuss the real time models, languages and operating systems
- To analyze real time examples

Unit I: System Design

Definitions - Classifications and brief overview of micro-controllers microprocessors and DSPs - Embedded processor architectural definitions - Typical application scenario of embedded systems

Unit II: Interface Issues Related To Embedded Systems

A/D, D/A converters - Interfacing to External Devices – Switches – LED/LCD Displays – Relays – Dc Motor – Stepper Motor

Unit III: Techniques For Embedded Systems

State Machine and state Tables in embedded design – Event based, Process based and Graph based models – Petrinet Models - Simulation and Emulation of embedded systems - High level language descriptions of S/W for embedded system - Java based embedded system design.

Unit IV: Real Time Models, Language And Operating Systems

Real time languages - Real time kernel, OS tasks, task states, task scheduling, interrupt processing, clocking communication and synchronization, control blocks, memory requirements and control, kernel services

Unit V: Micro C/OS-II Real Time Operating System

Study of Micro C/OS-II RTOS – RTOS System Level Functions – Task Service Functions – Time Delay Functions – Memory Allocation Related Functions – Semaphore Related Functions – Mailbox Related Functions – Queue Related Functions

Reference Books

1. RajKamal, “Embedded Systems Architecture, Programming and Design”, Tata McGrawHill , Second Edition, 2008
2. Tim Wilhurst, “An Introduction to the Design of Small Scale Embedded Systems, Palgrave, 2004.
3. Tammy Noergaard, “Embedded Systems Architecture”, Elsevier, 2005.
4. Frank Vahid, Tony Givargis, “Embedded Systems Design”, Wiley India, 2006

ADDITIONAL SUBJECTS

S.N.	Code	Name of the Subject	Credits
1	11EI201	Electrical And Electronic Instrumentation	4:0:0
2	11EI202	Digital Signal Processing	3:1:0
3	11EI203	Power Plant Instrumentation	4:0:0
4	11EI204	Automotive Instrumentation	4:0:0
5	11EI205	Electron Devices Laboratory	0:0:2
6	11EI206	Electrical Machines Laboratory	0:0:2
7	11EI207	Sensors and Transducers Laboratory	0:0:2
8	11EI208	Measurements Laboratory	0:0:2
9	11EI209	Control Systems Laboratory	0:0:2
10	11EI210	Signal Conditioning Circuits Laboratory	0:0:2
11	11EI211	Microprocessors and Microcontrollers Laboratory	0:0:2
12	11EI212	Computer Based Process Control Laboratory	0:0:2
13	11EI213	Digital Signal Processing Laboratory	0:0:2
14	11EI214	Digital Control Laboratory	0:0:2
15	11EI215	Instrumentation and Process Control for Food Engineers	4:0:0
16	11EI216	Instrumentation and Process Control Lab for Food Engineers	0:0:2
17	11EI217	C++ and Data Structures	3:0:0
18	11EI218	Power Electronics	4:0:0
19	11EI301	Discrete Control System	3:1:0
20	11EI302	Robust Control	4:0:0
21	11EI303	System Identification	4:0:0
22	11EI304	Process Modelling And Simulation	4:0:0
23	11EI305	Adaptive Control	4:0:0
24	11EI306	Advanced Medical Instrumentation	4:0:0
25	11EI307	Medical Image Processing	4:0:0
26	11EI308	Rehabilitation Engineering	4:0:0
27	11EI309	BioMEMS	4:0:0
28	11EI310	Biomedical Signal Processing	4:0:0
29	11EI311	VLSI Signal Processing	4:0:0
30	11EI312	Radiological Equipments	4:0:0

11EI201 ELECTRICAL AND ELECTRONIC INSTRUMENTATION

Credits: 4:0:0

Course Objective

- To introduce the basic concepts related to the operation of Electrical and Electronic Measuring Instruments.

Course Outcome

The students will

- Apply the knowledge about the instruments to use them more effectively
- Suggest the kind of instrument suitable for typical measurements

Unit I Introduction – Measurement of Current, Voltage, Power and Energy
Review of AC circuit analysis. Faraday's law of electromagnetic induction, Lenz's law, Statically and Dynamically induced emf-Galvanometers – Moving Coil and Moving Iron Instruments - Principle of operation, construction- sources of errors and compensation– dynamometer and rectifier typeammeter and voltmeter – Wattmeter – Energy meter - Calibration of meters.

Unit II Measurement of Resistance, Inductance and Capacitance
Measurement of low, medium and high resistance – Wheatstone bridge – Kelvin double bridge – Meggar – Direct deflection methods – A.C Bridges – Measurements of inductance, capacitance – Maxwell bridge – Wien bridge – Hay bridge – Schering bridge – Anderson bridge – Desauty's bridge – Errors in A.C bridges and their compensations – detectors.

Unit III Analog Meters
Amplified DC Meter – AC Voltmeter Using Rectifiers – True RMS-Responding Voltmeter– Electronic Multimeter – Vector impedance meter – Wave analyzer– Harmonic distortion analyzer – Spectrum analyzer.

Unit IV Cathode Ray Oscilloscope
General purpose oscilloscope – Cathode Ray Tube – CRT screen characteristics – Vertical Deflection system – Delay Line – Horizontal Deflection system – Sampling Oscilloscope – Measurement of frequency and Phase by Lissajous method

Unit V Digital Measurement and Displays
Digital Displacement transducer: Incremental and Absolute – Digital method of measuring Displacement, Frequency and Phase difference. Digital Alpha Numeric Displays – 7 Segment displays – Dot matrix displays – XY Plotter – UV recorder – Magnetic tape recorder – Digital recording and Data Loggers.

Text Books

1. A.k. Sawhney, "Electrical Measurements and Instrumentation", DhanpathRai& Co., (P) Ltd., 2005, NewDelhi.

Reference Books

1. R.K. Rajput, "Electronic Measurement and Instrumentation", S.Chand Publisher, 2008, NewDelhi.
2. David A Bell, " Electronic Instrumentation and Measurements, Prentice Hall of India, 2006, NewDelhi.

3. Kalsi H S, " Electronic Instrumentation", 2nd Edition, Tata McGraw Hill Company, 2004, NewDelhi.

11EI202 DIGITAL SIGNAL PROCESSING

Credits: 3:1:0

Course Objectives

- To introduce the basic concepts involved in discrete time signal processing
- To give an in depth knowledge of the concepts of digital filter design
- To learn the intricacies involved in designing a DSP chip in hardware

Course Outcome

The student will be able to

- Use DFT and FFT to analyse the spectrum of signals
- Design Digital FIR and IIR filters for DSP applications
- Write simple programs in DSP chip.

Unit I Introduction

Concepts of signal processing - typical applications -advantages of digital signal processing compared with analog processing.
Review of Discrete Time LTI Systems – Linear, circular and sectioned convolutions - DFS, DTFT, DFT – FFT computations using DIT and DIF algorithms - Time response and frequency response analysis of discrete time systems to standard input signals.

Unit II Finite Impulse Response Digital Filters

Symmetric and Antisymmetric FIR filters - FIR filter design using window method – frequency sampling method – realization of structures of FIR filters – transversal and linear phase structures.

Unit III Infinite Impulse Response Digital Filters

Review of classical analog filters-Butterworth, Chebyshev and Elliptic filters–Transformation of analog filters into equivalent digital filters using impulse invariant method and Bilinear transform method-Realization of stuctures of IIR filters-Direct, cascade, parallel forms

Unit IV Introduction to programmable DSPs

Multiplier and Multiplier Accumulator Unit – Modified Bus Structure and memory Access in P-DSPs – Multiple Access Memory – Multiported memory – VLIW Architecture – Pipelining - Special addressing modes – P-DSPs with RISC and CISC processors

Unit V Architecture of TMS 320C5X

Introduction – Architecture of TMS320C5X – On-chip peripherals – Instruction set of TMS320C5X – Simple Programs

Text Books

1. John G. Proakis and DimitrisG.Manolakis, 'Digital Signal Processing, Algorithms and Applications', PHI of India Ltd., New Delhi, 3rd Edition, 2000.

Reference Books

1. B. Venkatramani, M. Bhaskar, 'Digital Signal Processors Architecture, Programming and Applications', Tata McGraw-Hill Publishing Company Limited, New Delhi, 2002
2. Emmanuel C. Ifeacher and Barrie W. Jervis, 'Digital Signal Processing – A

Practical Approach', Addition – Wesley Longman Ltd., UK, 2nd 2004 Low Price Edition

3. Texas Instruments Manuel for TMS320C5XProcessor.

11EI203 POWER PLANT INSTRUMENTATION

Credits 4:0:0

Course Objective

- To provide an overview of different methods of power generation with a particular stress on thermal power generation.
- To bring out the various measurements involved in power generation plants.
- To provide knowledge about the different types of devices used for analysis
- To impart knowledge about the different types of controls and control loops.
- To familiarize the students with the methods of monitoring different parameters like speed, vibration of turbines and their control.

Course Outcome

- The students will apply the knowledge of power plant instrumentation to control the boiler parameters

Unit I Overview of Power Generation

Brief survey of methods of power generation – hydro, thermal, nuclear, solar and wind power– importance of instrumentation in power generation – thermal power plants – building blocks – details of boiler process - P&I diagram of boiler – cogeneration.

Unit II Measurements in Power Plants

Electrical measurements – current, voltage, power, frequency, power factor etc. – nonelectrical parameters – flow of feed water, fuel, air and steam with correction factor for temperature – steam pressure and steam temperature – drum level measurement – radiation detector – smoke density measurement – dust monitor.

Unit III Analyzers in Power Plants

Flue gas oxygen analyser – analysis of impurities in feed water and steam – dissolved oxygen analyser – chromatography – PH meter – fuel analyser – pollution monitoring instruments.

Unit IV Control Loops in Boiler

Steam pressure control -Combustion control – air/fuel ratio control – furnace draft control – drum level control –main steam and reheat steam temperature control – superheater control – attemperator –deaerator control – distributed control system in power plants – interlocks in boiler operation.

Unit V Turbine Monitoring and Control

Speed, vibration, shell temperature monitoring and control -lubricant oil temperature control

Text Books

1.P.K Nag, Power plant Engineering, Tata McGraw Hill, 2001.

Reference Books

1. Elonka,S. M. and Kohal. A.L. Standard Boiler Operations, McGraw-Hill, New Delhi, 1994.
2. R.K.Jain, Mechanical and industrial Measurements, Khanna Publishers, New Delhi, 1995.

11EI204 AUTOMOTIVE INSTRUMENTATION

Credits: 4:0:0

Course Objective

- To learn the fundamental principles of electronics and to introduce the application of electronics in the modern automobile
- To develop ability to understand various latest Communication protocols used in automobiles industries.
- To provide a thorough understanding of automotive systems and various electronic accessories used in automobile.

Course Outcome

The student will

- Design instruments for automotive applications
- Use Communication protocols to perform advanced monitoring and control

Unit I Automotive Electricals and Electronics

Basic Electronics components and their operation in an automobile – Starting Systems – Charging Systems – Ignition Systems – Electronic Fuel Control .

Unit II Advanced Vehicle Control Systems

Environmental legislation for pollution – Overview of vehicle electronics systems – Power train system – Chassis subsystem – Comfort and Safety subsystems.

Unit III Embedded System Communication Protocols

Introduction to control networking – Communication protocols in embedded systems – SPI, I^2C, USB – Vehicle Communication Protocols – Introduction to CAN, LIN, FLEXRAY, MOST, KWP2000 – Details of CAN.

Unit IV Embedded System in Control of Automotive Systems

Engine management systems – Gasoline/Diesel Systems – Various Sensors used in System – Vehicle Safety System – Electronic Control of braking and traction – Introduction to control elements and control methodology – Electronic transmission control.

Unit V Embedded System in Automotive Applications

Body Electronics – Infotainment systems – Navigation Systems –System level tests – Software Calibration using engine and vehicle dynamometers – Environmental tests for electronic control units.

Text Books

1 Robert BoschGmbh ,“BOSCH- Automotive Handbook”, 7th Edition,John Wiley & Sons, ISBN: 0470519363, 2008.

Reference Books

1 Knowles.D, “Automotive Electronic and Computer control Ignition Systems”, Prentice Hall,1988
2 William.T.M, “Automotive Electronic System”,Elsevier Science,6th Edition,2003.
3 Denton.T, “Automobile Electrical and Electronic System”,Elsevier Butterworth-Heinemann Publications,3rd Edition,2004.

11EI205 ELECTRON DEVICES LABORATORY

Credits: 0:0:2

Course Objective

- To impart practical knowledge on the working of electron devices and their applications

Course Outcome

The student will

- Analyze the characteristics of basic electronic devices
- Design small projects using the devices

List of Experiments

1. a.Characteristics of PN diode
   b. Characteristics of Zener diode
2. a.Characteristics of Photo diode
   b. Characteristics of Light Dependant resistor (LDR)
3. Study of Half-wave and Full Wave rectifier with and without filter
4. Characteristics of BJT (common base configuration)
5. Characteristics of BJT (common emitter configuration)
6. Transistor as a switch
7. Characteristics of Junction Field Effect Transistor (JFET)
8. Characteristics with MOSFET characteristics.
9. Characteristics of Silicon Controlled Rectifier (SCR)
10. Comparison of Characteristics of Thyristors.
11. Characteristics ofUni-Junction Transistor (UJT)
12. PSPICE simulation

11EI206 ELECTRICAL MACHINES LABORATORY

Credits: 0:0:2

Course Objective

- To expose the students to the operation of DC machines, Transformers, synchronous machines and induction motors and give them experimental skills.

Course Outcome

The student will

- Analyse the characteristics of DC and AC machines

List of Experiments

1. Open circuit characteristics of self excited dc shunt generator
2. Open circuit characteristics of separately excited dc shunt generator
3. Load characteristics of self excited dc shunt generator
4. Load characteristics of separately excited dc shunt generator
5. Load test on dc shunt motor
6. Load test on dc series motor
7. Speed control of dc shunt motor
8. Open circuit and short circuit tests on 1-ϕ (single phase) transformer
9. Load test on single phase Transformer
10. Load test on 3-ϕ (three phase) squirrel cage induction motor
11. Load test on alternator
12. V-curve and inverted-V-curve for synchronous motor

11EI207 SENSORS AND TRANSDUCERS LABORATORY

Credits: 0:0:2

Course Objective

- The student is introduced to the practical aspects of various transducers and their characteristics.

Course Outcome

The student will
- Analyse the performance characteristics of various transducers and infer the reasons for the behavior.
- Critically anlayse any measurement application and suggest suitable measurement methods.

List of Experiments

Resistive Transducers

1. Characteristics of Resistive Potentiometer
2. Characteristics of Strain Gauge and Load Cell
3. Characteristics of RTD
4. Measurement of Force Using Pressure Cell
5. Study of Torque Transducer

Inductive and Capacitive Transducers

6. Characteristics of LVDT
7.Characteristics of Capacitive Transducer
8. Characteristics of Humidity Sensor
9.Characteristics of Loud Speaker and Microphone

Thermo Electric and Optical Transducers

10. Study of Thermocouple Characteristics
11. Speed Measurement Using an Optical Sensor
12.Typical applications of Transducers

11EI208 MEASUREMENTS LABORATORY

Credits: 0:0:2

Course Objective

- To impart knowledge in measurement of Resistance, Inductance and Capacitance using bridges.
- To learn the usage of Cathode Ray Oscilloscope.
- To improve the skills in calibrating analog meters.

Course Outcome

The student will
- Calibrate basic instruments
- Apply the knowledge of bridges for measurement of resistance, inductance and capacitance.

List of Experiments

1. Measurement of Inductance using Maxwell's Bridge.
2. Calibration of Ammeter and Voltmeter.
3. Measurement of Inductance using Hay's Bridge.
4. Measurement of Resistance using Wheatstone's Bridge
5. Measurement of Resistance using Kelvin's Double Bridge.
6. Measurement of Capacitance using Schering's Bridge.
7. Measurement of Capacitance using Desauty's Bridge.
8. Calibration of Wattmeter
9. Calibration of Energy meter.
10. Measurement of voltage, frequency and phase difference using CRO.
11. Measurement of B-H Curve using CRO.

12.Typical applications of measurement using bridges.

11EI209 CONTROL SYSTEMS LABORATORY

Credits: 0:0:2

Course Objective

- To strengthen the knowledge of Feedback control
- To inculcate the controller design concepts
- To introduce the concept of Mathematical Modeling

Course Outcome

- Students will have knowledge of Feedback control
- Students will have the knowledge of controller Design
- Students will be able to model simple first order systems

List of Experiments

1. Study of On-Off Temperature Control System
2. Study of Digital PID Controllers in Temperature Process
3. Mathematical Modeling of Mercury Thermometer
4. Study of D.C Position Control System
5. Response of P and PI Controller for the given error signal using MATLAB
6. Controller Tuning using Ziegler-Nichols (Z-N) method
7. Controller Tuning using Cohen Coon(C-C) method
8. Design of Lead Compensator
9. Design of Lag Compensator
10. Design of Lead-lag Compensator
11. Study of Non-Linear Characteristics of Relay
12. Speed Torque Characteristics of AC Servomotor

11EI210 SIGNAL CONDITIONING CIRCUITS LABORATORY

Credits: 0:0:2

Course Objective

- To gain experience in the use of op-amps and Logic gates

Course Outcome

- The outcome of the course is the ability to design,analyze and implement thesignal conditioning circuits. This laboratory imparts the knowledge about characteristics of op-amplifier, filter, logic gates and Flip flops

List of Experiments

1. Measurement of Op-Amp Parameter.
2. Design and testing of precision rectifier
3. Operational amplifier application: Integrator and Differentiator.
4. Design and testing of Instrumentation Amplifier.
5. Design of second order Active filter.
6. Study of 555 Timer
7. Design of Oscillators
8. Testing of Half Adder, Full Adder, Half Subtractor and Full Subtractor.
9. Verification of Truth Tables of RS, clocked RS, D and JK Flip Flops.
10. Multiplexers andDemultiplexers.

11. Design of Digital to Analog Converters
12. Design of Digital to Analog converters using PSPICEsoftware.

11EI211 MICROPROCESSORS AND MICROCONTROLLERS LABORATORY

Credits: 0:0:2

Course Objective

- To impart Programming knowledge based on the 8085 microprocessors and its interfacing.
- To impart knowledge about embedded C programming in89C51RD2.

Course outcome

- Students will have knowledge to program using 8085.
- Students know how to interface 8085 with ADC,DAC, stepper motor etc.
- Will have knowledge about embedded C implementation in 89C51RD2.

List of Programs

Programs using 8085 Microprocessors

1. Basic arithmetic operations (addition, subtraction, multiplication and division)
2. Sorting (ascending & descending order)
3. Code conversion (BCD to hexadecimal, hexadecimal to BCD, ASCII to decimal)
4. Generation of square wave using 8085.

Programs using 8051 Microcontrollers

5. Basic arithmetic operations (addition, subtraction, multiplication and division)
6.Serial communication
7. Square wave generation
8. Digital to analog conversion
9. DC motor control
10. Interfacing stepper motor
11. Interfacing ADC

Implementation of Embedded C program in 89C51RD2

12 .a.Activating a buzzer
b.Switch&LED indication

11EI212 COMPUTER BASED PROCESS CONTROL LABORATORY

Credits: 0:0:2

Course Objective

- To strengthen the knowledge of Mathematical Modeling
- To strengthen the practical knowledge of process control
- To inculcate the operation of Process Components
- To introduce Ladder programming for Various PLCs

Course Outcome

- Students will be able to Model simple Physical Processes
- Students will have the practical knowledge of Process control
- Students will have the knowledge of Process Components
- Students will be able to program PLCs

List of Experiments

1. Modeling of RC Circuit
2. Calibration of Pressure Process Station using LabVIEW
3. Study of Level Control System
4. Study of Flow control System
5. Study of Temperature Control
6. Study of Pneumatic Actuator, P/I and I/P Converter
7. Measurement of Viscosity, Conductivity and pH
8. Calibration of Pressure Gauges
9. PLC Simulation of Keyence/Picosoft
10. PLC Simulation of Typical Industrial applications
11. Ladder Programming and implementation using Omron PLC
12. Ladder Programming and implementation using SIMATIC S7-200 PLC

11EI213 DIGITAL SIGNAL PROCESSING LABORATORY

Credits: 0:0:2

Course objective

- To verify the concepts in Digital Signal Processing practically using software tools like Matlab and LabVIEW

Course Outcome

The student will

- Visualize the operations done on signals
- Appreciate the concept of convolution and verify the convolution theorem.
- Compute the DFT and IDFT of sequences
- Determine the response of DT system
- Design and implement Digital filters for real time applications

List of experiments

1.Generation of discrete time signals
2.Operations on discrete time signals
3.Verification of properties of DT systems
4.Convolution
5. Computation of DFT and IDFT
6. Fast Fourier Transform
7.Design of FIRfilter
8.Design of IIR filter
9. Simulation of Noise cancellation
10.Sampling and Reconstruction
11.Real time implementation of Signal Processing using LabVIEW
12.Simple programs in TMS320c5X kit

11EI 214 DIGITAL CONTROL LABORATORY

Credits: 0:0:2

Course objective

- To inculcate the basic concepts of digital controllers
- To introduce Digital Controller Design
- To introduce Data Acquisition LabVIEW
- To inculcate the controller design, simulation and implementation using MATLAB and LabVIEW.

Course outcome

- Students will have the basic concepts of digital controllers
- Students will be able to design Digital Controller
- Students will be able to acquire data through DAC cards using LabVIEW
- Students will have the knowledge of controller design, simulation and implementation sing MATLAB andLabVIEW

List of Experiments

1. Discrete –Time Simulations
2. Data Acquisition Using LabVIEW
3. Response of First order system with and without dead time in Z Domain
4. Response of Second order system with and without dead time in Z Domain
5. Simulation of First and Second order systems using Runge-Kutta method
6. Design of discrete PID Controller
7. Design of Pole Placement Controller
8. Design of Dead Beat Algorithm
9. Design of Dahlin's Algorithm
10. Design of Kalman Algorithm
11. Design of Internal Model Controller
12. Design of Smith Predictor Algorithm

11EI215 INSTRUMENTATION AND PROCESS CONTROL FOR FOOD ENGINEERS

Credits 4:0:0

Course Objective

- To provide sound knowledge in the basic concepts of control theory and Instrumentation.

Course Outcome

The student will

- Analyse the transient and frequency response of systems
- Test the stability of a given system
- Apply controller principles to typical applications

Unit I Introduction to Process control

System – steady state design – process control – process control block diagram –definition of a process, measurement, controller, and control element, loop – damped and cyclic response-feedback control – transient responses – laplace transform – transforms of simple functions – step function, exponential function, ramp function and sine function.

Unit II Control systems

Open and closed loop systems, servo- mechanisms, hydraulic and pneumatic control systems, two-way control, proportional control, differential control and integral control. Control valve – Construction and working of pneumatically operated valve and spring – diaphragm actuator

Unit III Stability Analysis

Signal flow graph – Mason's Gain formula, Block diagram algebra.
Stability – concept of stability, definition of stability in a linear system, stability criterion, characteristic equation, Routh test for stability

Unit IV Pressure and Temperature sensors

Pressure measurement – Construction and working of capacitive pressure sensor, Inductive pressure sensor, strain gauge, pressure sensor, diaphragm, bourdon tube, differential pressure cell Temperature sensors –Construction and working of RTD, Thermistors, Thermocouples, bimetallic strips

Unit V Level sensor
Simple float systems, capacitive sensing element, radioactive methods(nucleonic level sensing) – ultrasonic level sensor**.**Measurement of density – U-type densitometer, Buoyancy meter Measurement of composition – Electrical conductivity cell, non-dispersive photometers, pH meter, Gas chromatograph, Massspectrometer.

Text Books
1. J.F Richardson A D.G.Peacock, Coulson &Richardson's " Chemical Engineering", Volume 3,(Chemical and Biochemical reactors and process control) Butherworth – Heinemann, an imprint of Elsevier ,2006.

Reference Books
1. Donald R. Coughanowr., "Process System analysis and control" Mc- Graw Hill International Edition , Second Edition,.
2. Nagoorkani.A "Control Systems", RBA publications, first edition ninth reprint 2002
3. S.Baskar,"Instrumentation control system measurements and controls"Anuradha Agencies Publishers,2004
4. Nagrath, M and Gopal, I.J, "Control Systems Engineering", Wiley Eastern Limited, Third Edition Reprint 2003

11EI216 INSTRUMENTATION AND CONTROL LABORATORY FOR FOOD ENGINEERS

Credits: 0: 0:2
Course Objective
- This lab imparts the practical methods for the measurement of temperature, pressure, torque speed,sound, displacement, weight.

Course Outcome
The student will
- Analyse the characteristics of sensors and transducers.
- Apply the transducers for various applications

List of Experiments
1. Study of characteristics of Strain Gauge
2. Study of characteristics of Load cell
3. Study of characteristics of LVDT
4. Study of characteristics of RTD
5. Study of characteristics ofThermocouple
6. Study of characteristics of Resistive potentiometer
7. Study of characteristics of Loudspeaker
8. Study of characteristics of Microphone
9. Study of characteristics of Pressure transducer
10. Study of Tachogenerator characteristics
11. Study of characteristics of Humidity sensor
12. Study of characteristics of Viscometer

11EI217C++ AND DATA STRUCTURES

Credits: 3: 0:0
Course Objective
- To provide basic knowledge of C++
- To generate skills in basic OOPs concept

- To introduce Data Structure concept.
- To improve the programming skills.

Course Outcome

- Students can develop programs in C++.

Unit I Basics of C++

Building Blocks of C++ Progamming: Basic Program Construction-Functions-Declaration and Definition-Character Variables-Input with Cin and Output with Cout-Using Data Types-Header Files and Library- Decisions: If-else, nested If-Else- Switch-Case- Conditional operator-Logical Operator- Loop: While, do-While, For.

Unit II Function and Structures

Functions: passing arguments to functions, returning values from functions, reference arguments, overloaded functions, Structures-Enumeration- Arrays-Strings-Pointers: Address and Pointers - Pointers and Arrays-Pointer and C-type Strings-New and Delete Operator-Pointers to Pointer

Unit III Classes and Object

A Simple Class- C++ Objects as Physical Objects- Objects as Function Argument-Constructors-Destructors-Inheritance-Types of Inheritance-Virtual Function- Friend Function-this Pointer-Templates: Class and Function-Exception Handling.

Unit IV Data Structure

Introduction to Data Structure-Linked List: Single, Double, Circular- Stack: Infix, Postfix- Queue-Trees.

Unit V Searching, Sorting and File Handling

Sorting: Bubble SortInsertion Sort, Selection Sort, Quick Sort, Heap Sort, Merge Sort
Searching: Binary Tree Search, Linear Search, Binary Search.
File Handling: Stream Class, Disk File I/O with Streams, File Pointers, Error Handling in file I/O.

Text Books

1. Robert Lafore, "Object Oriented Programming in C++," Sams Publishing, 3rd Ed, 2002.

Reference Books

1. Herbert Schmidt, "C++, The Complete Reference," McGraw-Hill Publishing Company Limited, 4th Ed, New Delhi, 2003.
2. SartajSahni, "Data Structures, Algorithms and Applications in C++," McGraw-Hill Publishing Company Limited, 2nd Ed, New York, 2004.
3. Peter Smith, "Applied Data Structure with C++," Jones and Bartlett Publishers, California, 2004.
4. Jean-Paul Tremblay and Paul G Sorenson, "An Introduction to Data Structures with Applications," McGraw-Hill Publishing Company Limited, New Delhi, 1994.

11EI218 POWER ELECTRONICS

Credits: 4:0:0

Course Objective

To introduce the basic concepts of power semiconductor devices and their applications.

Course Outcome

The student will

- Design power semiconductor circuits for switching applications.

- Apply the knowledge of thyristors in practical applications.

Unit I Power semiconductor switches
SCRs - series and parallel connections, driver circuits, turn-on characteristics, turn off characteristics.

Unit II AC to DC converters
Natural commutation, single phase and three phase bridge rectifiers, semi controlled and fully controlled rectifiers, dual converters, inverter operation.

Unit III DC to DC converters
Voltage, Current, load commutation, thyristor choppers, design of commutation elements, MOSFET/IGBT choppers, AC choppers.

Unit IV DC to AC converters
Thyristor inverters, McMurray-Mc Murray Bedford inverter, current source inverter, voltage control, inverters using devices other than thyristors, vector control of induction motors.

Unit V AC to AC converters
Single phase and three phase AC voltage controllers, integral cycle control, single phase cyclo-converters - effect of harmonics and Electro Magnetic Interference (EMI). Applications in power electronics: UPS, SMPS and Drives.

Text Books
1. Rashid M. H, "Power Electronics - Circuits, Devices and Applications", 2nd Edition, Prentice Hall, New Delhi, 2003.

Reference Books
1. VedamSubramanyam K, "Power Electronics", 2nd Edition, New Age International Publishers, New Delhi, 2003.
2. Mohan, Undeland and Robbins, "Power Electronics", John Wiley and Sons, New York, 2003.
3. Joseph Vithyathil, "Power Electronics", McGraw Hill, New York, 1995.

11EI301 DISCRETE CONTROL SYSTEM

Credits: 3:1:0

Course Objective

- To inculcate the concepts of discrete time Control systems.
- To introduce polynomial equations approach to control system design.
- To inculcate the different types of digital control algorithm.

Course Outcome

- Students will have the knowledge of discrete time Control systems.
- Students will be able to design control system using polynomial equations approach.
- Students will have an exposure in different types of digital control algorithm

Unit I Introduction

Review of Z Transform, Impulse Sampling and data Hold- Z-Transform by Convolution Integral Method- Reconstructing original signal from sampled signal- Pulse Transfer function-Mapping between the S plane and Z plane-Poles and Zeros of Sampled Data System (SDS) – Stability Analysis in Z domain, modified Z transform

Unit II State Space Analysis

State Space representation of discrete time Signals-Solving discrete time State Space Equations-Pulse Transfer Function Matrix-Discretization of continuous time State Space Equations

Unit III Pole Placement and Observer Design

Controllability-Observability-Useful Transformations in State Space Analysis and Design, design Via Pole placement-State observer-Servo Systems.

Unit IV Polynomial Equations Approach to Control System Design

Diophantine Equations-Polynomial Equations Approach to Regulator system- Polynomial Equations Approach to Control system Design- Design of Model Matching Control Systems.

Unit V Digital Control Algorithm

Implementation of different digital control algorithm: Digital PID, Deadbeat, Dahlin, Smith predictor and Internal Model Control algorithm with examples.

Text Books

1. Gopal M, Digital Control and State variable Methods, Second Edition, Tata McGrawHill, New Delhi, 2003.
2.Gene F. Franklin,J. David Powell, "Digital control of dynamic systems", Pearson Education Limited-2002.

Reference Books

1.Dale E. Seborg, Thomas F. Edgar, Duncan A. Mellichamp, "Process Dynamics and Control", Willey India, 2006.
2.Ogata, "Discrete- Time Control Systems", Pearson Education, Sigapore,2002

11EI302 ROBUST CONTROL

Credits: 4: 0: 0

Course Objective

- To inculcate the concepts of Robust Control.
- To introduce Modeling of Unstructured Systems
- To train the students in H-infinity design and H- infinity Loop shaping procedure

Course Outcome

- Students will have an exposure about Robust Control.
- Students can able to model Unstructured Systems
- Students will have exposure in H-infinity design and H- infinity Loop shaping procedure

Unit I Introduction

Uncertainty and control an overview-uncertain and approximate model-categories of uncertainty-Control System Representation- System Stabilities- Co prime Factorization and stabilizing controllers- Signals and system norms: Vector norms and signal norms- system norms

Unit II Modeling of Unstructured Systems

Unstructured Uncertainties- Parametric Uncertainty- Linear fractional transformations-Structured Uncertainties- Robust Design Specifications: Small gain theorem and Robust Stabilization, Performance Consideration, Structured Singular Values.

Unit III H – Infinity Design

Mixed Sensitivity H-infinity Optimization- 2 degree of freedom H- infinity design- H-infinity suboptimal solutions- Discrete time cases

Unit IV H-Infinity Loop Shaping Design Procedure

Robust Stabilization against normalised Co-prime Factor Perturbations- Loop Shaping Design Procedure- Discrete time case- Mixed Optimization Design Method with LSDP- μ- Analysis and Synthesis: Consideration of Robust performance, μ-synthesis- D-K Iteration method, μ-K Iteration method.

Unit V Lower Order Controllers

Absolute-error-Approximation Methods- Reduction via Fractional Factors-Relative-error Approximation Methods-Frequency Weighted Approximation Methods

Text Books

1. Gu D W, Petkov, Konstantinov M M, "Robust Control with MATLAB", Springer, 2005.
2. Skogestad and Postlethwaite, "Multivariable Feedback Control**:** Analysis and Design", John-Wiley & Sons Inc., 2005.

Reference Books

1. Ian R Petersen, Valery A Ugrinovskii, and Andrey V Savkin, "Robust control design using H-infinity methodUncertain Models and Robust Control", Springer Verlag-London Ltd-2000.
2. Feng lin, "Robust control design an Optimal approach", John Wiley & sons England, 2007.

11EI303 SYSTEM IDENTIFICATION

Credits: 4: 0: 0

Course Objective

- To inculcate the concepts of Probability Theory and Random Process.
- To inculcate system identification concepts.
- To introduce estimation problems in Instrumentation and control

Course Outcome

- Students will have an exposure Probability Theory and Random Process.
- Students will have the knowledge of system identification concepts.
- Students will be able to do estimation problems in Instrumentation and control

Unit I

Probability Theory - Random Variables -Function of Random Variable - Joint Density- Mean and Variance-Random Vectors Random Processes -Random Processes and Linear Systems

Unit II

Linear Signal Models- Linear Mean Square .Error Estimation- Auto Correlation and Power Spectrum Estimation- Z-Transform Revisited Eigen Vectors/Values

Unit III

The Concept of Innovation- Least Squares Estimation Optimal IIR Filters- Introduction to Adaptive Filters-State Estimation- Kalman Filter-Model and Derivation

Unit IV

Kalman Filter-Derivation - Estimator Properties- The time-Invariant Kalman Filter - Kalman Filter-Case Study- System identification Introductory Concepts- Linear Regression-Recursive Least Squares.

Unit V

Variants of LSE-Least Square Estimation- Model Order Selection Residual Tests-Practical Issues in Identification- Estimation Problems in Instrumentation and Control.

Text Books

1. Geoffrey Grimmett, David Stirzaker "Probability and random processes" Oxfor University Press, Third Edition- 2001.
2. Monson H Hayes, Petkov, Konstantinov M, "Statistical Digital Signal Processing and Modeling", Wiley India Private Ltd., 2002

Reference Books

1. Rik Pintelon, Gainluca Zito, Gu D W, Petkov, Konstantinov M M, "System Identification A Frequency Domain Approach", IEEE press New York, 2001.
2. Karl J. Astrom, Biorn Wittenmark, "Adaptive Control" Pearson Education Asia, Second Edition, 2001.
3. Tohru Katayama, "Subspace Methods for System Identification" , Springer, Verlag London Ltd., 2005.
4. Loan D Landau, Gainluca Zito, Gu D W, Petkov, Konstantinov M M, "Digital Control Systems Design, Identification and implementation", Springer, Verlag London Ltd., 2006.

11EI304 PROCESS MODELLING AND SIMULATION

Credits: 4: 0: 0

Course Objective

- To inculcate the concepts of Process Modelling.
- To inculcate lumped and distributed parameter models
- To introduce grey box models. Empirical model building.

Course Outcome

- Students will have the exposure of Process Modelling.
- Students will have the exposure of lumped and distributed parameter models
- Students will be able to use grey box models and Empirical Model building

Unit I

Introduction to Modelling - a systematic approach to model building- classification of models-Conservation principles- thermodynamic principles of process systems.

Unit II

Development of steady state models: lumped parameter systems- Dynamic models: lumped parameter systems- distributed parameter systems

Unit III

Development of grey box models- Empirical model building- Statistical model calibration and validation- Population balance models.

Unit IV

Solution strategies for lumped parameter models- Stiff differential equations- Solution methods for initial value and boundary value problems- Euler's method- R-K method- finite difference methods-Solving the problems using MATLAB.

Unit V

Solution strategies for distributed parameter models- Solving parabolic, elliptic and hyperbolic partial differential equations-Finite element and finite volume methods.

Text Books

1. K. M. Hangos and I. T. Cameron, "Process Modelling and Model Analysis", Academic Press, 2001.
2. B. Wayne Bequette, "Process control: modeling, design, and simulation", Pearson Education Inc., 2003.

Reference Book

1. Singiresu S. Rao, "Applied Numerical Methods for Engineers and Scientists" Prentice Hall, Upper Saddle River, NJ, 2001

11EI305 ADAPTIVE CONTROL

Credits: 4: 0: 0

Course Objective

- To inculcate the need of Adaptive Control.
- To train the students in Model Reference Adaptive System Design.
- To introduce Auto tuning and Gain Scheduling.
- To inculcate the practical issues in Adaptive control Implementation.

Course Outcome

- Students will understand the need of Adaptive Control.
- Students will be able to design Model Reference Adaptive System.
- Students can able to do Gain Scheduling.
- Students will have an exposure about the practical issues in Adaptive control Implementation.

Unit I Introduction

Linear Feedback- Effect of Process variations: Non-linear Actuators-Flow and speed variation – Variations in Disturbance Characteristics - Adaptive schemes- The Adaptive control Problem-applications

Unit II Model Reference Adaptive Systems

Introduction-MIT Rule- Determination of the Adaptation Gain-Lyapunov Theory-design of MRAC using Lyapunov Theory-Bounded input, bounded output Stability- Applications to Adaptive control-Output feedback-Relations between MRAC and STR- Nonlinear Systems

Unit III Auto Tuning

Introduction- PID Control Auto tuning techniques-Transient Response methods: Ziegler-Nichols Step response method-Characterization of step response- Method based on relay feedback: Ziegler-Nichols closed loop method-Method of Describing function- relay oscillations

Unit IV Gain Scheduling

Introduction-The principle- Design of gain scheduling Controllers- nonlinear Transformations-Applications of Gain scheduling: Ship steering-pH Control-Combustion control-Fuel Air control in car Engine-Flight control systems

Unit V Practical Issues and Implementation

Introduction-Controller Implementation-Controller Design-Solving the Diophantine equation-Estimator Implementation-Square Root Algorithms-Interaction of Estimation and control-prototype algorithms- Operational issues

Text Books

1. Karl J. Astrom, Biorn Wittenmark, "Adaptive Control" Pearson Education Asia, Second Edition, 2001.
2. Gang Tao, "Adaptive Control design and Analysis", John Wiley & Sons, New Jersey,2003

Reference Book

1. Gang Tao, Adaptive Control Design And Analysis, John Wiley & Sons,2003

11EI306 ADVANCED MEDICAL INSTRUMENTATION

Credits: 4:0:0

Course Objective

- With widespread use and requirements of medical instruments, this course gives knowledge of the principle of operation and design of biomedical instruments.
- It attempts to render a broad and modern account of biomedical instruments.

Course Outcome

- They will have knowledge of the principle operation and design and the background knowledge of biomedical instruments and specific applications of biomedical engineering

Unit I Biopotentials and their Measurements

Cell and its structure – resting potentials – action potentials – bioelectric potentials – measurement of potentials and their recording – basic principles of ECG, EEG, EMG– Electrode theory – bipolar and Unipolar electrode-surface electrode – electrode impedance – equivalent circuit for extra cellular electrodes- micro electrodes,

Unit II Computer based medical instrumentation

Computerised versions of ECG, EEG, EMG, Tread Mill Test ECG– Foetal monitor, cardiac arrthymias and its monitoring through Holter monitor, Event monitors, Bispectral Index EEG for depth of anesthesia monitoring

Unit III Operation theatre equipment and Critical Care instrumentation

Patient monitors, pulse oximetry, ICU ventilators, suction apparatus, anesthesia equipment, electro surgery, operating microscopes, motorized operation table, infusion pumps and syringe pumps, nerve stimulator, defibrillators, Electrical Safety and other safety aspects of medical equipment.

Unit IV Medical Imaging Techniques

X-rays – scanning techniques-ultrasound scanner- color Doppler system, CT, MRI scanning techniques – coronary angiogram, nuclear imaging

Unit V Specialized Therapeutic and diagnostic equipment

Cardiac pacemakers, heart lung machines, Haemodialysis, clinical laboratory instrumentation, Audiometer, Phonocardiogram,

Text Books

1. Leslie Cromwell, "Biomedical Instrumentation and measurement", Prentice hall of India, New Delhi, 2007.
2. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw-Hill, New Delhi, 2003.

Reference Books

1 John G. Webster, "Medical Instrumentation Application and Design", John Wiley and sons, New York, 2009.
2 Standard Handbook of Biomedical Engineering & Design – Myer Kutz, McGraw-Hill Publisher, UK,2003.

11EI307 MEDICAL IMAGE PROCESSING

Credits: 4:0:0

Course Objective

- To learn the fundamentals of medical image processing techniques.

Course Outcome

- Students will be able to apply image processing concepts for medical images.
- Will be able to analyze Morphology, Segmentation and enhancement and reconstruction techniques and implement these in images.

Unit I Image Fundamentals

Image perception, MTF of the visual system, Image fidelity criteria, Image model, Image sampling and quantization – two dimensional sampling theory, Image quantization, Optimum mean square quantizer, Image transforms – 2D-DFT and other transforms.

Unit II Image Preprocessing

Image enhancement – point operation, Histogram modeling, spatial operations, Transform operations, Image restoration – Image degradation model, Inverse and Weiner filtering. Image Compression – Spatial and Transform methods

Unit III Medical Image Reconstruction

Mathematical preliminaries and basic reconstruction methods, Image reconstruction in CT scanners, MRI, fMRI, Ultra sound imaging., 3D Ultra sound imaging Nuclear Medicine Imaging Modalities-SPECT,PET, Molecular Imaging

Unit IV Image Analysis And Classification

Image segmentation- pixel based, edge based, region based segmentation. Image representation and analysis, Feature extraction and representation, Statistical, Shape, Texture, feature and image classification – Statistical, Rule based, Neural Network approaches

Unit V Image Registrations And Visualization

Rigid body visualization, Principal axis registration, Interactive principal axis registration, Feature based registration, Elastic deformation based registration, Image visualization – 2D display methods, 3D display methods, virtual reality based interactive visualization.

Text Books

1. R.C.Gonzalez and R.E.Woods, 'Digital Image Processing', Second Edition, Pearson Education, 2002.
2. Kavyan Najarian and Robert Splerstor," Biomedical signals and Image processing",CRC – Taylor and Francis,New York,2006

Reference Books

1 Atam P.Dhawan, 'Medical Image Analysis', Wiley Interscience Publication, NJ, USA 2003.
2 Anil. K. Jain, 'Fundamentals of Digital Image Processing', Pearson education, Indian Reprint 2003.
3 Jerry L.Prince and Jnathan M.Links," Medical Imaging Signals and Systems"- Pearson Education Inc. 2006

11EI308 REHABILITATION ENGINEERING

Credits: 4:0:0

Course objective

- To provide knowledge about various types of assist devices and its applications.

Course outcome

- Students will have knowledge about various types of assist devices
- Students will have the ability to choose which type of assist device is suitable for various disorders and legal aspects related to rehabilitation.

Unit I Prosthetic And Orthotic Devices

Hand and arm replacement, different types of models for externally powered limb prosthetics, feedback in orthotic system, material for prosthetic and orthotic devices, mobility aids.

Unit II Auditory And Speech Assist Devices

Types of deafness, hearing aids, application of DSP in hearing aids, vestibular implants, Voice synthesizer, speech trainer.

Unit III Visual Aids

Ultra sonic and laser canes, Intra ocular lens, Braille Reader, Tactile devices for visually challenged, Text voice converter, screen readers.

Unit IV Medical Stimulator

Muscle and nerve stimulator, Location for Stimulation, Functional Electrical Stimulation, Sensory Assist Devices

Unit V Rehabilitation Medicine And Advocacy

Physiological aspects of Function recovery, Psychological aspects of Rehabilitation therapy, Legal aspect available in choosing the device and provision available in education, job and in day-to-day life.

Text Books

1. Rehabilitation Engineering by Raymond V. Smith, John H. Leslie Jr. ISBN 13: 9780849369513 Crc Press (Jul 1990).
2. An Introduction to Rehabilitation Engineering, Rory A Cooper, Hisaichi Ohnabe, Douglas A. Hobson, ISBN: 9780849372223 ,CRC Press ,2006

Reference Books

1. Rehabilitation Engineering by Tan Yen Kheng, ISBN: 978-953-307-023-0, Publisher: InTech, Publishing date: December 2009.
2. Medical Devices and Systems, Joseph D. Bronzino, Trinity College, Hartford, Connecticut, Crc Press , 2006.

11EI309 BIO-MEMS

Credits: 4:0:0

Course objective

- To understand a wide knowledge about MEMS and its role in medical Instrumentation area.

Course outcome

- Students will have basic knowledge about MEMS and Microsystems.

- Will have the exposure to micro opto electro mechanical systems.

Unit I Mems And Microsystems
Working principle of Microsystems, materials for MEMS and Microsystems, micromachining, System modeling and properties of materials

Unit II Microsensors And Acuators
Mechanical sensors and actuators – beam and cantilever, piezoelectric materials, thermal sensors and actuators- micro machined thermocouple probe, Peltier effect heat pumps, thermal flow sensors, Magnetic sensors and actuators- Magnetic Materials for MEMS Devices

Unit III Micro Opto Electro Mechanical Systems
Fundamental principle of MOEMS technology, light modulators, beam splitter, micro lens, digital micro mirror devices, light detectors, optical switch

Unit IV Microfluidic Systems
Microscale fluid, expression for liquid flow in a channel, fluid actuation methods, dielectrophoresis, micro fluid dispenser, micro needle, micro pumps-continuous flow system

Unit V Drug Delivery Systems
Drug delivery, micro total analysis systems (MicroTAS) detection and measurement methods, microsystem approaches to polymerase chain reaction (PCR), DNA hybridization, Electronic nose, Bio chip

Text Books

1. Wanjun Wang, Steven A.Soper " BioMEMS- Technologies and applications", CRC Press, Boca Raton,2007
2. Abraham P. Lee and James L. Lee, BioMEMS and Biomedical Nano Technology, Volume I, Springer 2006.

Reference Books

1. Tai Ran Hsu , " MEMS and Microsystems design and manufacture", Tata McGraw Hill Publishing Company, New Delhi, 2002
2. Nitaigour Premchand Mahalik, " MEMS", Tata McGraw Hill Publishing Company, New Delhi, 2007

11EI 310 BIOMEDICAL SIGNAL PROCESSING

Credits: 4:0:0

Course Objective
- To learn the techniques of signal processing that are fundamental to medical signal processing applications**.**

Course outcome
- Students will know various techniques in processing medical signals.
- Students will have the ability to apply signal processing techniques in practical
- cardiac EEG,EMG and other bio signals.

Unit I Introduction To Random Signal Processing

Discrete Random Processes– Variance - Co-Variance - Scalar Product -Energy of Discrete Signals - Parseval's Theorem - Wiener Khintchine Relation- - Sample Autocorrelation - Sum

Decomposition Theorem Spectral Factorization Theorem-Characteristics of some dynamic biomedical signals, Noises- random, structured and physiological noises.

Unit II Time Series Analysis And Spectral Estimation
Time series analysis – linear prediction models, process order estimation, lattice representation, non stationary process, fixed segmentation, adaptive segmentation, application in EEG, PCG signals, Time varying analysis of Heart-rate variability, model based ECG simulator. Spectral estimation – Blackman Tukey method, periodogram, and model based estimation. Application in Heart rate variability, PCG signals.

Unit III Adaptive Filtering And Wavelet Detection
Filtering – LMS adaptive filter, adaptive noise cancelling in ECG, improved adaptive filtering in FECG, Wavelet detection in ECG – structural features, matched filtering, adaptive wavelet detection, detection of overlapping wavelets.

Unit IV Biosignal Classification And Recognition
Signal classification and recognition – Statistical signal classification, linear discriminate function, direct feature selection and ordering, Back propagation neural network based classification. Application in Normal versus Ectopic ECG beats.

Unit V Time Frequency And Multivariate Analysis
Time frequency representation, spectrogram, Wigner distribution, Time-scale representation, scalogram, wavelet analysis – Data reduction techniques, ECG data compression, ECG characterization, Feature extraction- Wavelet packets, Multivariate component analysis-PCA, ICA

Text Books

1. Kavyan Najarian and Robert Splerstor," Biomedical signals and Image processing", CRC – Taylor and Francis,New York,2006.
2. Willis J. Tompkins, Biomedical Digital Signal Processing, Prentice Hall of India, New Delhi, 2003.

Reference Books

1. Rangaraj M. Rangayyan, 'Biomedical Signal Analysis-A case study approach', Wiley-Interscience/IEEE Press, 2002
2. K.P.Soman,K.I Ramachandran,"Insight into wavelet from theory to practice", PHI, New Delhi,2004
3. D.C.Reddy,"Biomedical Signal Processing – Principles and Techniques",TMH,New Delhi,2005

11EI311 VLSI SIGNAL PROCESSING

Credits: 4:0:0
Course objective

- To introduce the basic approaches and methodologies implementation of signal processing systems in FPGA.

Course outcome

- The students will design various algorithms for DSP applications in FPGA

Unit I Introduction To DSP Systems
Introduction To DSP Systems -Typical DSP algorithms, data flow graph representations, loop bound and iteration bound- Longest path Matrix algorithm; Pipelining and parallel processing–

Pipelining of FIR digital filters, parallel processing, pipelining and parallel processing for low power.

Unit II Retiming, Folding And Unfolding
Retiming - definitions and properties, Retiming techniques; Unfolding– an algorithm for Unfolding, properties of unfolding, sample period reduction and parallel processing application; Folding– Folding transformation– Register minimizing techniques– Register minimization in folded architectures

Unit III Convolution
Fast convolution– Cook-Toom algorithm, modified Cook-Took algorithm– Winograd Algorithm, Iterated Convolution– Cyclic Convolution;

Unit IV Filters
Parallel FIR filters, Pipelined and parallel recursive filters– inefficient/efficient single channel interleaving, Look- Ahead pipelining in first- order IIR filters, Look-Ahead pipelining with power-of-two decomposition parallel processing of IIR filters, combined pipelining and parallel processing of IIR filters, pipelined adaptive digital filters, relaxed look-ahead, pipelined LMS adaptive filter.

Unit V Bit-Level Arithmetic Architectures
Bit-Level Arithmetic Architectures- parallel multipliers with sign extension, parallel carry-ripple array multipliers, parallel carry-save multiplier, 4x 4 bit Baugh- Wooley carry-save multiplication tabular form and implementation, design of Lyon‘s bit-serial multipliers using Horner‘s rule, bit-serial FIR filter, CSD representation, CSD multiplication using Horner‘s rule for precision Improvement.

Text Book
1. Keshab K.Parhi, ―VLSI Digital Signal Processing systems, Design and implementation, Wiley, Inter Science, reprint 2008.

Reference Books
1. Gary Yeap, ―Practical Low Power Digital VLSI Design, Kluwer Academic Publishers, reprint 2009.
2. Wayne Wolf, "Modern VLSI Design – system on chip", Pearson education Pvt Ltd, New Delhi, 2004

11EI312 RADIOLOGICAL EQUIPMENTS

Credits: 4:0:0

Course objective
- This course gives knowledge of the principle of operation and design of Radiological equipments.

Course Outcome
- Students will have indepth knowledge about Radiological equipments and its imaging techniques.

Unit I X-Rays
Principles and production of soft and hard X-rays, selection of anodes, Heel Pattern. Scattered radiation, Porter Bucky system, Cooling system.

Unit II Radio Diagnosis

Radiography, Angiography, Fluoroscopy, Image Intensifier, Multi section radiography.

Unit III Special Radiological Equipments

Principle, Plane of Movement, Multi section Radiography, CAT. Principle of NMR, MRI

Unit IV Application Of Radioisotopes

Alpha, Beta and Gamma emission, Principle of radiation detectors, dot scanners, nuclear angiogram, Principles of Radiation therapy.

Unit V Radiation Safety

Hazardous effect of Radiation, Radiation protection Techniques, Safety Limits, Radiation Monitoring.

Text Books

1. Isaac Bankman, I. N. Bankman , Handbook of Medical Imaging: Processing and Analysis (Biomedical Engineering),Academic Press,2000

2. Jacob Beutel (Editor), M. Sonka (Editor), Handbook of Medical Imaging, Volume 2. Medical Image Processing and Analysis , SPIE Press 2000

Reference Book

1. Khandpur R.S, “Handbook of Biomedical Instrumentation”, Tata McGraw-Hill, New Delhi, 2003.

LIST OF SUBJECTS

Sub. Code	Name of the Subject	Credits:
12EI201	Circuit Analysis and Networks	3:1:0
12EI202	Electrical Machines	4:0:0
12EI203	Electronic Circuits	4:0:0
12EI204	Thermodynamics and Fluid Machinery	3:1:0
12EI205	Sensors and Transducers	4:0:0
12EI206	Electron Devices and Circuits Laboratory	0:0:2
12EI207	Sensors and Transducers Laboratory	0:0:2
12EI208	Electrical Measurements	4:0:0
12EI209	Signals and Systems	3:1:0
12EI210	Control System	3:1:0
12EI211	Digital Electronics	3:1:0
12EI212	C++ and Data Structures	3:1:0
12EI213	Electrical Measurements and Machines Laboratory	0:0:2
12EI214	Control Systems Laboratory	0:0:2
12EI215	Communication Engineering	4:0:0
12EI216	Signal Conditioning Circuits	3:1:0
12EI217	Microprocessors and Microcontrollers	4:0:0
12EI218	Industrial Instrumentation	4:0:0
12EI219	Process Dynamics and Control	3:1:0
12EI220	Industrial Instrumentation Laboratory	0:0:2
12EI221	Signal Conditioning Circuits Laboratory	0:0:2
12EI222	Microprocessors and Microcontrollers Laboratory	0:0:2
12EI223	Electronic Instrumentation	4:0:0
12EI224	Digital Signal Processing	3:1:0
12EI225	Logic and Distributed Control Systems	4:0:0
12EI226	Industrial Data Communication and Networks	4:0:0
12EI227	Process Control Laboratory	0:0:2
12EI228	Digital Signal Processing Laboratory	0:0:2
12EI229	Advanced Processors	4:0:0
12EI230	Embedded Systems Laboratory	0:0:2
12EI231	Logic and Distributed Control Systems Laboratory	0:0:2
12EI232	Biomedical Instrumentation	4:0:0
12EI233	Embedded Systems	4:0:0
12EI234	Neural Networks and Fuzzy Logic Control	4:0:0
12EI235	Digital Control Systems	3:1:0
12EI236	Instrumentation and Control in Petrochemical Industries	4:0:0
12EI237	Instrumentation and Control in Paper Industries	4:0:0
12EI238	Instrumentation and Control in Iron and Steel Industries	4:0:0
12EI239	Ultrasonic Instrumentation	4:0:0
12EI240	Instrumentation and Control for Aircraft	4:0:0
12EI241	Opto Electronics and Laser Based Instrumentation	4:0:0
12EI242	Power Plant Instrumentation	4:0:0
12EI243	Automotive Control Systems	4:0:0
12EI244	Power Electronics	4:0:0

12EI245	Analytical Instrumentation	3:0:0
12EI246	Medical Instrumentation	3:0:0
12EI247	Fiber Optics and Laser Instrumentation	3:0:0
12EI248	Ultrasonic Instrumentation	3:0:0
12EI249	Aircraft Instrumentation	3:0:0
12EI250	Automotive Instrumentation	3:0:0
12EI251	Robotics and Automation	3:0:0
12EI252	Instrumentation and Process Control for Food Engineers	4:0:0
12EI253	Instrumentation and Control Laboratory for Food Engineers	0:0:2
12EI254	Instrumentation and Control Systems	3:0:0
12EI255	Instrumentation and Control Systems Laboratory	0:0:1
12EI301	Advanced Digital Signal Processing	3:1:0
12EI302	Industrial Instrumentation	4:0:0
12EI303	Instrumentation	4:0:0
12EI304	Advanced Process Control	3:1:0
12EI305	Discrete Control System	3:1:0
12EI306	Virtual Instrumentation Laboratory	0:0:2
12EI307	Advanced Control Systems	3:1:0
12EI308	Soft Computing	4:0:0
12EI309	Real Time and Embedded Systems	4:0:0
12EI310	Optimal Control Theory	4:0:0
12EI311	Industrial Communication Systems	4:0:0
12EI312	Industrial Instrumentation and Process Control Laboratory	0:0:2
12EI313	Embedded Systems Laboratory	0:0:2
12EI314	Robust Control	4:0:0
12EI315	System Identification	4:0:0
12EI316	Process Modelling And Simulation	4:0:0
12EI317	Adaptive Control	4:0:0
12EI318	Embedded System Software Design	4:0:0
12EI319	Advanced Microcontrollers	4:0:0
12EI320	Digital Image Processing Techniques	4:0:0
12EI321	Advanced Programmable Signal Processor	4:0:0
12EI322	Digital System Design	4:0:0
12EI323	Advanced Embedded system Laboratory	0:0:2
12EI324	Computer Architecture	4:0:0
12EI325	Mobile Communication	4:0:0
12EI326	Mobile Computing	4:0:0
12EI327	Telemetry	4:0:0
12EI328	VLSI Signal Processing	4:0:0
12EI329	Embedded LINUX	4:0:0
12EI330	Medical Instrumentation	4:0:0
12EI331	Medical Sensors	4:0:0
12EI332	Medical Image Processing	4:0:0
12EI333	Anatomy and Physiology	4:0:0
12EI334	Soft Computing Techniques	4:0:0
12EI335	Modeling of Physiological systems	4:0:0
12EI336	Special Purpose Instrumentation	4:0:0

12EI337	Medical Diagnostics and Therapeutic Laboratory	0:0:2
12EI338	Medical Imaging Techniques	4:0:0
12EI339	Rehabilitation Engineering	4:0:0
12EI340	Hospital Management Systems	4:0:0
12EI341	Biomedical Signal Processing	4:0:0
12EI342	Bio MEMS	4:0:0
12EI343	Medical Informatics	4:0:0
12EI344	Biomaterials	4:0:0
12EI345	Medical Devices Safety	4:0:0
12EI346	Bio Virtual Instrumentation laboratory	0:0:2
12EI347	Embedded Virtual Instrumentation Laboratory	0:0:2
12EI348	Advanced Instrumentation and Process Control for Food Engineers	4:0:0

12EI201 CIRCUIT ANALYSIS AND NETWORKS

Credits: 3:1:0

Course Objective:

- To introduce the concept of circuit elements, lumped circuits, circuit laws and reduction.
- To understand the transient response of series and parallel A.C. circuits.
- To analyze the concept of coupled circuits and two port networks.

Course Outcome:

At the end of the course, the student will

- Design simple DC circuits.
- Determine AC steady– state response and transient response.
- Analyze two port networks

Unit I

BASIC CIRCUIT CONCEPTS: Classification of Circuit Elements – Lumped Circuits – V– I Relationships of R, L and C - Energy Sources – Independent Sources – Dependent Sources – Kirchhoff's Voltage Law – Voltage Division – Kirchhoff's Current Law – Current Division –

Network Reduction – Matrix Representation and Solution of DC Networks – Node and Loop basics

Unit II

NETWORK THEOREMS AND TRANSFORMATIONS: Voltage and Current source transformations – Star and Delta Transformations – Network Theorems: Superposition, Thevenin, Norton, Millman's and Maximum Power Transfer Theorems – Statement and Applications

Unit III

RESPONSE OF ELECTRIC CIRCUITS: Concept of Complex Frequency – Pole– Zero Plots – Frequency Response of RL, RC and RLC Circuits – Transient Response of RL, RC and RLC Series and Parallel Circuits – Free Response – Step and Sinusoidal Responses – Natural Frequency – Damped Frequency – Damping Factor – Logarithmic Decrement – Response of Circuits for Non–sinusoidal Periodic Inputs

Unit IV

COUPLED CIRCUITS : Self and Mutual Inductances – Coefficient of Coupling – Analysis of Coupled Circuits – Natural Current – Dot Rule for Coupled Circuits – Equivalent Circuit of Coupled Circuits – Coupled Circuits in Series And Parallel – Tuned Coupled Circuits – Double Tuned Circuits

Unit V

TWO PORT NETWORKS AND FILTERS: Driving Point and Transfer Impedances–Admittances – Voltage and Current Ratios of Two Port Networks – Parameters of Two Port Networks: Admittance, Impedance, Hybrid, Transmission and Image Parameters – ImpedanceMatching – Equivalent Pi and T Networks – Passive Filter as a Two Port Network – Characteristics of Ideal Filter – Low pass and High Pass Filter

Text Books

1. Joseph Edminister, MahmoodNahvi, "Electric circuits", Mcgraw Hill, New York 2004.
2. Sudhakar.A. and Shyam Mohan S.P., "Circuits and Network Analysis and Synthesis", TataMcGraw Hill Publishing Co. Ltd., New Delhi, 2008.

Reference Books

1. Arumugam. M. and N.Premkumar, "Electric circuit Theory", KhannaPublishers , New Delhi,2006.
2. Hytt, W.H. Jr. and Kemmerly, J.E., "Engineering Circuit Analysis", McGraw Hill International Editions, New York, 2002.
3. Charles. K.Alexander,Mathew. N.O.Sadiku, "Fundamentals of Electric Circuit", McGraw– Hill, New York, 2003.

12EI202 ELECTRICAL MACHINES

Credits: 4:0:0

Course Objective:

- To impart knowledge on Constructional details, principle of operation, performance, speed control of DC Machines.

- To understand the principle of operation of AC machines.
- To introduce the concept of Special Machines and Utilization of Electrical Energy.

Course Outcome:
At the end of the course, the student will

- Analyze the performance of various DC and AC machines.
- Suggest suitable machines for various applications.

Unit I
DC MACHINES : Principle and theory of operation of D.C. generator – Constructional features of D.C. Machines– Characteristics of shunt, series and compound generators – Principle of operation of D.C. motor – Back E.M.F – Torque equation – Characteristics of shunt, series and compound motors – Losses and Efficiency Calculations – Applications of D.C. Motors – Motor starters – Speed control of D.C. motors

Unit II
TRANSFORMERS: Principle and Constructional details of Shell and Core type transformer – EMF equation – No load and on load operation – Equivalent circuit – Voltage Regulation – Test on Transformers: Load test, Open Circuit and Short Circuit Test

Unit III
INDUCTION AND SYNCHRONOUS MACHINES: Induction Motor**:** Construction and Principle of operation, Classification, Torque Equation, Torque Slip characteristics, Starting and Speed control – Synchronous Motor**:**Construction and Principle of operation, EMF equation, V curves, Synchronization

Unit IV
SPECIAL MACHINES : Tachogenerator – AC and DC servomotor – Linear induction motor – Single phase motor – Double field revolving theory – Capacitor start Capacitor run motors – Shaded pole motor – Repulsion type motor – Universal motor – Stepper motor

Unit V
UTILIZATION OF ELECTRICAL ENERGY: Electric heating– Methods of heating – Welding Generator – Electric traction– Traction motors and control – Recent trends in Electric traction

Text Books

1. Albert.E.Clayton, N.N. Hancock, "The Performance and Design of Direct Current Machines", Oxford Publishing Co. Pvt. Ltd, New Delhi, 2001.
2. Rajput, R.K., "Utilisation of Electrical Power", Laxmi publications, New Delhi,2006.

Reference Books

1. Theraja. B.L. and Theraja. A.K., "Electrical Technology", Nirja Construction and Development Company Pvt. LTD, New Delhi, Vol. II, 22nd Edition, 2005.
2. Nagrath. I.J., "Electric Machines", Tata McGraw Hill, 2002.

12EI203 ELECTRONIC CIRCUITS

Credits: 4:0:0

Course Objective:

- To familiarize the student with the design of basic transistor amplifier circuits.
- To introduce the principles ofpower and feedback amplifiers.
- To cover the basics of Oscillator circuits and Multivibrators.

Course Outcome:

At the end of the course, the student will

- Analyze the characteristics of diodes and transistor circuits.
- Design DC bias circuitry of BJT and FET.
- Build simple circuits using semiconductor devices.

Unit I

DIODE CIRCUITS: Diode as a Circuit Element – Load line – Piecewise Linear Diode model – Clipping circuits– Introduction to D.C. Regulated Power Supply – Rectifiers – Half Wave and Full Wave Rectifiers – Filters: L, C, LC filters–Zener diode as Voltage Regulator

Unit II

ANALYSIS OF TRANSISTOR CIRCUITS: Load line analysis –Biasing Methods – Transistor hybrid model – Analysis of transistor amplifier using h parameters – Analysis of transistors at Low, Medium Frequencies – High Frequency Model – RC coupled Amplifier – DC Amplifiers

Unit III

POWER AMPLIFIERS AND FEEDBACK AMPLIFIERS: Power Amplifiers: Class A, Class B, Class C Amplifiers – Single ended and Push PullOperation – Class AB Amplifier – Feedback amplifiers. Basic Concepts, Effects of Negative Feedback, Voltage and Current Feedback Circuits

Unit IV

OSCILLATORS AND MULTIVIBRATORS: Oscillators**:** Barkhausen criteria, RC Phase Shift, Wien Bridge, Hartley, Colpitts, Crystal Oscillators – Multivibrators: Bistable, Monostable, Astable

Unit V

FET CIRCUITS: FET small signal model – Low frequency Common source and Common drain amplifiers – Biasing FET amplifiers

Text Books

1. Jacob Millman and Halkias. C., “Integrated Electronics”, McGraw hill, New York, 2004.
2. Jacob Millman and ArvindGrabel, “Microelectronics”, McGraw hill, New York, 2008.

Reference Books

1. David A Bell, “Electronic Devices and Circuits”, Prentice hall of India, New Delhi, 2008.

2. Thomas Floyd, “Electronic Devices”, Prentice Hall of India, New Delhi 2003.
3. Boylestad L. Robert and Nashelsky Louis, “Electronic Devices and Circuits”, Prentice Hall of India, New Delhi, 2008.

12EI204 THERMODYNAMICS AND FLUID MACHINERY
(Use of Steam tables, Heat and Mass Transfer Data Book is permitted)

Credits 3:1:0

Course Objective:
- To enable the students to understand the fundamentals and basics of Heat Engines and Machinery.
- To give exposure to students about various types of engines and fluid machinery.

Course Outcome:
At the end of the course, the student will
- Apply the concepts of the fluid properties to systems.
- Derive models of systems using the Thermodynamic laws.

Only theoretical concepts and simple problems to be taught.

Unit I
THERMODYNAMICS: Basic concepts – Thermodynamic system – Properties – Processes – Cycle – Equilibrium – First law of thermodynamics – Application of first law to non flow and flow process – Second law of thermodynamics – Kelvin Planck's statement – Clausius statement – Reversibility – Carnot theorem – Heat engine

Unit II
HEAT TRANSFER: Modes of heat transfer – One dimensional steady state heat conduction equation – Plain wall – Convection – Empirical relations – Radiation – Laws of radiation

Unit III
STEAM GENERATORS AND HEAT EXCHANGERS: Classification of boilers – Boiler terms – Performance of steam generator – Boiler efficiency – Heat losses in a boiler plant and heat balance calculations – Types of heat exchangers – Overall heat transfer coefficients – LMTD and NTU method – Fouling factor – Problems in heat exchangers, Effectiveness

UnitIV
FLUID PROPERTIES: Properties of fluids: Density, Specific weight, Specific volume, Specific gravity – Viscosity: Units, Kinematic Viscosity, Newtons law of viscosity, Variation of viscosity with temperature, Types of fluids – Surface tension and capillarity: Surface tension on liquid droplet, Hollow bubble – Manometers:Piezometer, U– tube manometer, Single column manometer tube differential manometer – PUMPS: Reciprocating pumps, Centrifugal pumps – operating principles

Unit V
TYPES OF FLOW AND TURBINES: Types of flow:Steady and unsteady, Uniform and non uniform, Laminar and turbulent, Compressible and incompressible, Rotational and irrotational,

One, two and three dimensional flows – Turbines: Classification, Working Principle – Pelton wheel, Francis, Kaplan turbines, Simple problems

Text Books

1. Dr.Bansal R.K, "A Text Book of Fluid Mechanics and Hydraulic Machines", Ninth Edition, 2009.
2. Kothandaraman.C.P.etal,"A course in Heat Engines and Thermodynamics", DhanpatRaiand Sons, 3rd Edition, 1993.

Reference Books

1. Som.S.R, and Biswas, "Introduction to Fluid Mechanics and Fluid Machines", Tata McGraw Hill, 1998.
2. Holman, "Heat Transfer", McGraw Hill International, 7thEdition, 1992.
3. Cengel. A., "Introduction to Thermodynamics and Heat Transfer", Tata McGraw Hill, New Delhi, 1997.

12EI205 SENSORS AND TRANSDUCERS

Credits: 4:0:0

Course Objective:

- To provide knowledge on the principle and operation of different transducers.
- To introduce the application of sensors and transducers in the measuring system.

Course Outcome:

At the end of the course the student will

- Apply the source of information about the transducers for their project applications.
- Analyze the characteristics of transducers.

Unit I

INTRODUCTION: Main Terms and Definitions of measurements: Accuracy and Precision, Significant figures, Types of Error – Units of Measurement: Fundamental and Derived units, Systems of units, Electric, Magnetic and International system of units, Conversion and other system of units – Standards of Measurement:Classification, Standards for Mass, Length, Volume, Time, Frequency, Electrical, Temperature and Luminous intensity – IEEE standards – Transducers: Definition, Classification of transducer, Selecting a transducer

Unit II

RESISTIVE TRANSDUCERS: Resistive Potentiometer: Basic principle, Loading effects, Resolution, Linearity, Application: Motion measurement – Resistance Strain Gauge, Application: Load cell, Force, Torque and Shaft Power Measurement – Resistance Thermometer – Thermistors: Characteristics, Compensation circuits – Junction and Lead compensation, Merits and demerits – Hot– wire Anemometer – Humidity sensor

Unit II

INDUCTIVE AND CAPACITANCE TRANSDUCERS: Inductance Transducer: Basic principle, Linear Variable Differential Transformer (LVDT), Rotary Variable Differential

Transformer (RVDT), Application:Acceleration measurement using Variable Reluctance Accelerometer, Synchro, Induction Potentiometer, Microsyn– Capacitance Transducer: Basic principle, Capacitance Displacement Transducers, Desirable features of Capacitive Transducers, Circuitry for Capacitance Transducer, Application: Capacitance pickups, Capacitor Microphone

Unit IV

PIEZOELECTRIC AND MAGNETIC TRANSDUCERS: Piezoelectric transducer: Basic principle, Mode of operation, Properties of piezoelectric crystals, Loading effect – Magnetostrictive Transducer – Hall effect transducer

Unit V

MISCELLANEOUS SENSORS: Elastic transducers – Digital Transducer: Shaft encoder, Optical encoder – Digital speed transducer: Stroboscope – Chemical sensor: pH sensor – Ultra sonic sensors – Fiber optic sensors – MEMS: Introduction to Microscale sensors

Text Books

1. Doebelin. E.O., "Measurement Systems Application and Design", McGraw Hill International, New York, 2007.
2. Renganathan. S., "Transducer Engineering", Allied publishers Limited, Chennai, 2003.

Reference Books

1. Cooper W.D., "Electronic Instrumentation and Measurement Techniques", Prentice Hall of India, New Delhi, 2003.
2. Sawhney A.K., "A Course in Electrical and Electronics Measurements and Instrumentation", Eighteenth Edition, DhanpatRai and Sons, New Delhi, 2007.
3. Ian R Sinclair, "Sensors and Transducers", Third Edition, Newnes, New Delhi, 2001.

12EI206 ELECTRON DEVICES AND CIRCUITS LABORATORY

Credits: 0:0:2

Course Objective:

- To impart practical knowledge on the working of Electron devices and their applications.

Course Outcome:

At the end of the course, the student will

- Analyze the characteristics of basic Electronic devices.
- Design small projects using the Semiconductor devices.

List of Experiments

1. a.Characteristics of PN diode
   b.Characteristics of Zener diode
2. a.Characteristics of Photo diode
   b.Characteristics of Light Dependant Resistor (LDR)
3. Study of Half– wave and Full Wave Rectifier with and without filter
4. Characteristics of BJT (Common Base Configuration)
5. Characteristics of BJT (Common Emitter Configuration)
6. Transistor as a Switch

7. Characteristics of Junction Field Effect Transistor (JFET)
8. Characteristics with Metal Oxide Semiconductor FET (MOSFET)
9. Characteristics of Silicon Controlled Rectifier (SCR)
10. Characteristics of Uni– Junction Transistor (UJT)
11. Design of Transistor Amplifier
12. Design of Oscillator
13. PSPICE Simulations

12EI207 SENSORS AND TRANSDUCERS LABORATORY

Credits: 0:0:2

Course Objective:

- To introduce the practical aspects of various transducers and their characteristics.
- To impart knowledge in measurement of Resistance, Inductance and Capacitance using bridges.
- To improve the skills in calibrating analog meters.

Course Outcome:

At the end of the course the student will

- Analyze the performance characteristics of various transducers and infer the reasons for the behavior.
- Critically analyze any measurement application and suggest suitable measurement methods.
- Calibrate basic instruments.

List of Experiments

1. Measurement of Strain using Strain Gauge
2. Characteristics of Load cell
3. Measurement of Displacement using LVDT
4. Characteristics of RTD
5. Characteristics of Thermocouple
6. Characteristics of Resistive Potentiometer
7. Characteristics of Torque Measurement System
8. Measurement using Capacitive Sensors
9. Characteristics of Microphone and Loud Speaker
10. Characteristics of Pressure Measurement System
11. Measurement of Humidity
12. Characteristics of Speed Measurement System

12EI208 ELECTRICAL MEASUREMENTS

Credits: 4:0:0

Course Objective:

- To introduce the principle of measurement of D.C. and A.C. voltages.

- To understand the use of instruments and techniques for practical measurements required in electrical measurements.

Course Outcome:
At the end of the course, the student will
- Solve problems through instrument illustrations.
- Apply the knowledge of electrical measurement techniques to design circuits.

Unit I
FUNDAMENTALS OF ELECTRICAL MEASUREMENTS: Need for measurement systems – Types of Measurement Applications – Functional Elements of an Instrument – Null and Deflection methods – Input– Output Configuration of Measurement Systems – Performance Characteristics of Instruments: Static and Dynamic characteristics

Unit II
ELECTROMECHANICAL DC INSTRUMENTS: Galvanometers – PMMC Instrument – DC Ammeter and Voltmeter – Voltmeter Sensitivity – Ohmmeter : Series and Shunt type – Multimeter – Calibration of DC instruments

Unit III
ELECTROMECHANICAL AC INSTRUMENTS: Moving Iron Instrument – Thermoinstruments – Electrodynamometers in Power Measurements – Watt– hour meter – Power– factor meters – Instrument Transformers: Current Transformer and Voltage Transformer

Unit IV
BRIDGE CIRCUITS: D.C. Bridges: Wheatstone bridge, Kelvin bridge, Guarded Wheatstone bridge – A.C. Bridges : Maxwell bridge, Wien bridge, Hay's bridge, Schering bridge, Anderson bridge, Desaughty's bridge, Wein bridge – Wagner ground connection

Unit V
RECORDING INSTRUMENTS: Introduction – Strip chart recorder – Galvanometer Type recorder – Potentiometric Recorder: Basic Potentiometer circuit – XY recorder – Magnetic tape recorder.

Text Books
1. Cooper W.D., "Electronic Instrumentation and measurement techniques", Prentice Hall of India, New Delhi, 2003.
2. Tumanski. S., "Principles Of Electrical Measurement", Taylor and Francis Group, Ny, 2006.
3. Kalsi.H.S, "Electronics Instrumentation", Tata McGraw Hill, New Delhi, 2009.

Reference Books
1. Golding E.W. and Widdis F.E., "Electrical measurements and measuring instruments", Sir Issac Pitman and Sons Pvt., Ltd., 2001.
2. Laughton. M. A. and Warne. D. J., "Electrical Engineer's Reference Book" Sixteenth Edition, Newnes, 2003.

12EI209 SIGNALS AND SYSTEMS

Credits: 3:1:0

Course Objective:

- Coverage of continuous and discrete– time signals and systems, their properties and representations.
- Knowledge of time– domain representation and analysis concepts as they relate to difference equations, impulse response and convolution, etc.
- Knowledge of frequency– domain representation and analysis concepts using Fourier Analysis tools, Z– transform.
- Concepts of the sampling process.

Course Outcome:

At the end of the course, the student will

- Characterize and analyze the properties of CT and DT signals and systems.
- Represent CT and DT systems in the Frequency domain using Fourier analysis tools like CTFS, CTFT, DTFS and DTFT.
- Conceptualize the effects of sampling a CT signal.
- Analyze CT and DT systems using Laplace transforms and Z Transforms.

Unit I

INTRODUCTION: Signals and their origin – Characterization and classification of Signals – Signal Operations – Classification of Systems

Unit II

TIME DOMAIN REPRESENTATION OF CONTINUOUS AND DISCRETE TIME SYSTEMS: CT system representations by differential equations – DT System representations by difference equations – Continuous and Discrete Convolutions

Unit III

FREQUENCY DOMAIN REPRESENTATION OF PERIODIC SIGNALS: Continuous Time Fourier Series **– Properties** – Convergence of Fourier series – Discrete Time Fourier series (DTFS) – Properties –Power Spectral Density – Parseval's Relation

Unit IV

FREQUENCY DOMAIN REPRESENTATION OF APERIODIC SIGNALS: Continuous Time Fourier Transform (CTFT) – Properties – Discrete Time Fourier Transform(DTFT) – Properties – Frequency response of systems characterized by Differential and Difference Equations – Energy Spectral Density – Parseval's Relation – Sampling Theorem

Unit V

TRANSFORM OPERATIONS ON CT AND DT SIGNALS AND SYSTEMS: Laplace Transforms and its properties – Inverse Laplace Transform – Z transform and its properties – Inverse Z transform – Solution of Difference equations – Analysis of LTI systems using Z transform

Text Books

1. Alan V Oppenheim, Alan S Wilsky and Hamid Nawab S, “Signals and Systems”, Prentice Hall, New Delhi, 2005.
2. Simon Haykin and Barry Van Veen, “Signals and Systems”, John Wiley and Sons Inc., New Delhi, 2008.

Reference Books

1. Ashok Ambardar, “Introduction to Analog and Digital Signal Processing”, PWS Publishing Company, Newyork, 2002.

12EI210 CONTROL SYSTEM

Credits: 3:1:0

Course Objective:

- To introduce the fundamentals of Feedback Control systems and mathematical modeling of the system.
- To cover the concepts of time response and frequency response of the system.
- To understand the basics of stability analysis of the system.

Course Outcome:

At the end of the course, the student will

- Represent the mathematical model of a system.
- Determine the response of different order systems for various test inputs.
- Analyze the stability of the system.

Unit I

MODELING OF SYSTEMS: Introduction to Control Systems – Types of Control Systems – Effect of Feedback Systems – Differential equation of Physical Systems – Mechanical systems: Friction, Translational systems, Rotational systems, Gear trains – Electrical systems – Analogous Systems – Transfer functions, Block diagram algebra, Signal Flow graphs

Unit II

TIME RESPONSE OF FEED BACK CONTROL SYSTEMS: Standard Test signals – Unit Step response of First and Second order systems – Time response specifications of Second Order Systems, Steady State Errors and Error constants – Introduction to PID Controllers

Unit III

STABILITY ANALYSIS: Concepts of Stability – Necessary conditions for Stability– Routh stability criterion – Relative stability analysis – More on the Routh stability criterion – Root Locus Techniques: Introduction, The root locus concepts, Construction of Root Loci

Unit IV

FREQUENCY DOMAIN ANALYSIS: Correlation between time and frequency response – Bode plots – Experimental determination of transfer functions – Assessment of relative stability using Bode Plots – Introduction to lead, lag and lead–lag compensating networks – Stability in the Frequency Domain: Introduction to Polar Plots, Mathematical preliminaries, Nyquist Stability criterion, Assessment of relative stability using Nyquist criterion

Unit V

INTRODUCTION TO STATE VARIABLE ANALYSIS: Concepts of State, State variable and State models for electrical systems – Solution of State Equations

Text Book

1. Nagarath .J and Gopal M., "Control Systems Engineering", New Age International (P) Limited, Publishers, Fourth edition – 2005

Reference books

1. Ogata .K "Modern Control Engineering ", , Pearson Education Asia/ PHI, 4th Edition, 2002.
2. Benjamin C. Kuo and Farid Golnaagi, Wiley "Automatic Control Systems", 8th Edition, 2009.
3. Joseph J Distefano "Feedback and Control System", III et al., Schaum's Outlines, TMH, 2nd Edition 2007.

12EI211 DIGITAL ELECTRONICS

Credits: 3:1:0

Course Objective:

- To introduce the concepts of Digital Electronics.
- To make the students familiar with the implementation of combinational logic functions.
- To learn the working of counters and flip flops.

Course Outcome:

At the end of the course the student will

- Apply Boolean algebra and K –map to digital circuits.
- Design combinational and Sequential circuits.
- Select suitable Digital Devices from the various logic families.

Unit I

DIGITAL LOGIC AND LOGIC FAMILIES: Introductory Digital Concepts – Digital and Analog Quantities – Electronic Concepts of Digital Design – Logic Families: RTL, DTL, TTL families, Emitter Coupled Logic(ECL), MOS inverters, CMOS inverters – Comparison of performance of various logic families

Unit II

NUMBER SYSTEMS AND BOOLEAN ALGEBRA: Binary Digits – Logic Levels – Buffer – Tri– state buffer – Review of Binary, Octal and Hexa-decimal Number Systems – Signed Numbers and Floating Point Numbers Representation – BCD –ASCII – EBCDIC – Excess 3 codes – Gray Code – Error detecting and correcting codes – Logic gates –Boolean algebra: Postulates and theorems of Boolean algebra –canonical forms – Simplification of Logic Functions using Karnaugh map

Unit III

COMBINATIONAL LOGIC DESIGN : Implementation of Combinational Logic Functions – Encoders and Decoders – Multiplexers and Demultiplexers – Code converters – Comparator –

Half adder, Full adder – Parallel adder – Binary adder – Parity Generator/Checker – Implementation of logical functions using multiplexers.

Unit IV

SEQUENTIAL LOGIC CIRCUITS AND DESIGN: RS, Gated RS, Gated D, Edge Triggering, JK, Master – Slave, T Flip Flops – Level triggering and Edge triggering – Shift Register – Concept of State table – State diagram – Asynchronous and Synchronous counters – Modulus counters—Johnson counter – Ring counter – Timing waveforms – Basic models of Sequential Machines

Unit V

PROGRAMMABLE LOGIC DEVICES: Introduction to PLD's – PAL – PLA – FPGA – Implementation of digital functions – Basics 0f Semiconductor Memory – RAM and ROM

Text Books

1. Morris Mano, "Digital Logic and Computer Design", Prentice Hall India, New Delhi, 2007.
2. Thomas L. Floyd, "Digital Fundamentals", Prentice Hall Higher Education Series, 2008.

Reference Books

1. Tocci.R.J, "Digital Systems – Principles and Applications", Prentice Hall India, New Delhi,10th Edition , 2008.
2. Donald. P. Leach, Albert. Paul Malvino, Gowtham Saha, " Digital Principles and Applications", Tata McGrawHill, NewDelhi, 2008

12EI212 C++ AND DATA STRUCTURES

Credits: 3:1:0

Course Objective:

- To expose the different data structures and the various operations performed.
- To give the basics of object oriented approach.
- To demonstrate different applications using object oriented programming.

Course Outcome:

At the end of the course, the student will

- Use the data structures concepts for various applications.
- Develop different applications using object oriented approach.

Unit I

INTRODUCTION TO DATA STRUCTURES: Stack – Queue – Linked list: Single linked list, Doubly linked list, Circular Linked list – Trees: Binary Search Tree

Unit II

SORTING AND SEARCHING TECHNIQUES: Sorting: Bubble sort, Insertion Sort, Selection Sort, Quick Sort, Heap Sort, Merge Sort – Searching: Linear Search, Binary Search

Unit III

OBJECTS AND CLASSES: A Simple class – C++ objects as physical objects – C++ Objects as Data types – Constructors – Object as function argument – Overloaded Constructors – Copy Constructors – Returning objects from functions – Structures and classes – Static class data – Const and classes – Arrays and Strings

Unit IV

OPERATOR OVERLOADING, INHERITANCE AND POINTERS: Overloading Unary and Binary Operator – Data conversion – Pitfalls of Operator Overloading and Conversion – Inheritance: Derived class and Base class, Derived class constructors, Overriding member functions, Class hierarchies, Public and Private inheritance, Levels of inheritance, Multiple inheritance – Pointers: Address and Pointers, Pointers and Arrays, Pointer and C– type strings, New and Delete operator, Pointers to pointer

Unit V

VIRTUAL FUNCTIONS, STREAMS, FILES, TEMPLATES AND EXCEPTIONS: Virtual functions – Friend functions – Static functions – This pointer – Streams and files: Stream classes, Stream errors, Disk file I/O with streams, File pointers, Error handling in file I/O – Templates and Exception: Function Templates, Class templates, Exceptions

Text Books

1. Robert Lafore, “Object Oriented Programming in C++”, Sams Publishing, USA, Fourth Edition, 2002.
2. Nell Dale, “C++ plus Data Structure, An Introduction to Data Structures with Applications”, Jones and Bartlett Publishers, London, 3rdEdition, 2003.

Reference Books

1. Herbert Schildt, “ C++, The Complete Reference” , McGraw– Hill Publishing Company Limited, New York, 4thEdition, 2003.
2. Adam Drozed, “Data Structures and Algorithms in C++”, Brooks/Cole Thomson Learning, U.K. 2ndEdition, 2001.

12EI213 ELECTRICAL MEASUREMENTS AND MACHINES LABORATORY

Credits: 0:0:2

Course Objective:

- To expose the students to the operation of DC machines, Transformers, Synchronous machines and Induction motors and give them experimental skills.

Course Outcome:

At the end of the course, the student will

- Analyze the characteristics of DC and AC Machines.
- Determine the efficiency of a given DC or AC Machine.

List of Experiments:

1. Calibration of Ammeter and Voltmeter
2. Calibration of Energy meter and Wattmeter

3. Measurements using Resistive Bridges
4. Measurements using Inductive Bridges
5. Measurement using Capacitive Bridges
6. Measurements using CRO
7. Open circuit characteristics of DC shunt generator
8. Load characteristics of DC shunt generator
9. Load test on DC shunt motor and DC Series Motor
10. Speed control of DC shunt motor
11. Load test on Single Phase Transformer
12. Load test on 3–ϕ (three phase) squirrel cage induction motor

12EI214 CONTROL SYSTEMS LABORATORY

Credits: 0:0:2

Course Objective:

- To strengthen the knowledge of Feedback control
- To inculcate the controller design concepts
- To introduce the concept of Mathematical Modeling

Course Outcome:

At the end of the course the student will

- Design a controller for a practical system
- Derive the mathematical model of a system
- Analyze the characteristics of systems

List of Experiments:

1. RC network modelling
2. Open loop and closed loop response of DC motor using VI
3. Frequency Response of second order system
4. Time response of second order system
5. Lead– Lag compensator
6. ON/OFF controller in temperature process
7. PID controller in temperature process
8. Stepper Motor control
9. Study of Synchro
10. DC servo motor position controller using VI
11. Non– linear characteristics of relay
12. Study of Analog PID Controllers

12EI215 COMMUNICATION ENGINEERING

Credits: 4:0:0

Course Objective:

- To introduce basic concepts of Analog and Digital communication.
- To understand the modulation and demodulation circuits.

Course Outcome:

At the end of the course the student will

- Detect and correct the errors that occur due to noise during transmission.
- Appreciate the significance of communication systems in various applications.

Unit I

ANALOG MODULATION : Need for Modulation – Principle of Amplitude Modulation (AM) – Frequency Modulation (FM) and Phase Modulation (PM) – Modulation index– Signal power – DSBSC – SSBSC– Independent sideband– Vestigial sideband

Unit II

TRANSMITTERS AND RECEIVERS: AM and FM transmitters and receivers – AM and FM modulators and demodulators – Comparison of AM, FM and PM – Noise –Sources and Types of noise – Effects of noise in AM and FM systems

Unit III

DIGITAL COMMUNICATION SYSTEMS:PAM, PPM, PDM, PCM – Delta modulation – Differential PCM – Merits and demerits – Comparison of pulse modulation schemes– Digital modulation and demodulation systems: FSK – ASK – PSK – Modem functions

Unit IV

DATA TRANSMISSION: Twisted pair and coaxial cables – Fiber optics – Sources and detectors – Fiber optic complete system – Error detection and correction –Multiplexing – TDM and FDM

Unit V

APPLICATIONS: Television Signals – TV receivers – Color TV– Radar concepts– Basic concepts of Satellite communication and Cellular communication

Text Books

1. Roody and Coolen , “Electronic Communication”, Prentice Hall of India LTD., New Delhi, 2007.
2. Wayne Tomasi, “Electronic communication systems”, Prentice Hall of India LTD, New Delhi, 2004

Reference Books

1. Kennedy G, “Electronic Communication Systems”, McGraw– Hill, New York,2008.
2. Simon Haykins, “Communication Systems”, John Wiley,Inc., USA, 2006.
3. Taub and Schilling “Principles of Communication Systems”, McGraw– Hill, New York, 2008.
4. Anokh Singh, “Principles of Communication Engineering”, S.Chand and Company Ltd., Delhi, 2001.

12EI216 SIGNAL CONDITIONING CIRCUITS

Credits: 3:1:0

Course Objective:

- To impart knowledge on the basic concepts of linear integrated circuits and their applications in the processing of analog signals.
- To understand the working of PLL and 555 timer.

Course Outcome:

At the end of the course the student will

- Design Amplifier circuits of various gains
- Design Integrator, Differentiator and other circuits
- Build simple applications using 555 timer

Unit I

OPERATIONAL AMPLIFIER: Operational amplifier– Ideal Opamp– Op amp internal circuit – DC characteristics –Bias– Offset –Frequency– Slew rate – AC characteristics– frequency compensation techniques– Non inverting and inverting amplifier – Differential amplifier with active loads– Current sources

Unit II

OPERATIONAL AMPLIFIER AND APPLICATIONS : Inverter – Adder – Subtractor – Integrator – Differentiator – Multiplier – Divider – Comparator –Applications – Logarithmic Amplifier – Current To Voltage Converter – Voltage To Current Converter – Precision Rectifier – Clipper – Clamper – Sample And Hold Circuit

Unit III

AMPLIFIERS AND FILTERS : Instrumentation amplifier – Isolation amplifier – Buffer amplifier – Use of opamp with capacitive displacement transducer – Charge amplifier – Filters – Low pass – High pass – Band Pass – Band reject filter – First order and second order transformations – State variable filter –Switched capacitor filter – Design of Signal Conditioning Circuits for Strain Gage and Thermistor – Interface with ADC – Design Aspects

Unit IV

IC VOLTAGE REGULATORS AND MULTIPLIERS: Series op amp regulator– IC voltage regulator – 723 general– purpose regulators – Precision Reference Regulator – Multipliers – Frequency doubling – Phase angle detection

Unit V

555 TIMER AND PHASE LOCKED LOOP (PLL): 555 Timers – Astable – Monostable Operation – Phase Locked Loop (PLL):Basic principle – Phase Detector and Comparator – Analog and digital – Voltage Controlled Oscillator – Monolithic PLL – Application of PLL for Frequency Multiplication and Division – Frequency Translation – AM – FM – FSK modulation and demodulation

Text Books

1. Roy Choudhury and Shail Jain, “Linear integrated circuits” ,Wiley Eastern Ltd,2002.
2. RamkantGaykwad, “Op amps & Linear Integrated Circuits” , 2008,

Reference Books

1. Denton J. Dailey, "Operational Amplifier and Liner integrated Circuits", McGraw Hill, New York, 2000.
2. Coughlin and Driscoll, "Operational Amplifier and Liner integrated Circuits," Prentice Hall of India Pvt., New Jersey,Ltd 2003.
3. Sawhney A.K, "Course in Electrical and Electronic Measurement & Instrumentation" ,DhanpatRai& sons, Delhi, 2005.

12EI217 MICROPROCESSORS AND MICRO CONTROLLERS

Credits: 4:0:0

Course Objective:

- To impart an in depth understanding of the Basics of Microprocessors and microcontrollers.
- To introduce the basics of Assembly Language Programming and Interfacing.

Course Outcome:

At the end of the course the student will

- Write simple programs in 8085 Microprocessor and 8051 Microcontroller.
- Interface different peripheral devices with the processor.

Unit I

INTRODUCTION TO 8085 : Functional Block Diagram – Registers – ALU– Bus systems – Timing and control signals – Machine cycles– Instruction cycle and timing states – Instruction timing diagrams – Memory interfacing

Unit II

PROGRAMMING, INTERRUPTS AND DMA : Addressing modes– Instruction set – Simple programs in 8085– Interrupt feature – Need for Interrupts Interrupt structure– Multiple Interrupt requests and their handling – Typical programmable interrupt controller– Need for direct memory access – Devices for Handling DMA – Typical DMA Controller features

Unit III

INTERFACING PERIPHERALS WITH 8085 : Programmable peripheral interface (8255)— Interfacing ADC0801 A/D Converter –DAC 0800 D/As Converters – Multiplexed seven segments LED display systems – Waveform generators– Stepper motor control

Unit IV

INTRODUCTION TO 8051 MICROCONTROLLER: Architecture of 8051 – Memory Organization– interrupt structures – Timer and counters –Serial Data I/O–Addressing modes – Instruction set.

Unit V

APPLICATION OF 8051: Simple programs in 8051–Typical applications – Keyboard and Display interfacing- pulse measurement, D/A and A/D conversions

Text Books

1. Ramesh S.Gaonkar, “Microprocessor – Architecture, Programming and Applications with the 8085”, Penram International publishing private limited, 2002.
2. Kenneth J Ayala, “The 8051 Microcontroller Architecture, Programming and Applications”,2005.

Reference Books

1. A.P.Godse,G.P.Godse, “Microprocessor and Applications”,Technical Publication, Pune, 2004.
2. Douglas V.Hall, “Microprocessors and Interfacing: Programming and Hardware”, Tata Mcgraw Hill, New Delhi, 2003.
3. Microcontroller Hand Book, INTEL, 2008.

12EI218 INDUSTRIAL INSTRUMENTATION

Credits: 4:0:0

Course Objective:

- To equip the students with the basic knowledge of Pressure, Temperature, flow, level, density and viscosity measurements.

Course Outcome:

At the end of the course the student will

- Apply the knowledge of various Measuring Instruments to design a simple Instrumentation system.
- Calibrate the various instruments and use them in various fields.

Unit I

PRESSURE MEASUREMENT: Standards – Deadweight Gauges and Manometers – Elastic elements – Dynamic testing of pressure measuring system – High pressure measurement – Low Pressure measurement: Diaphragm gauge, Mcleod gauge, Knudsen gauge, Thermal conductivity gauges, Ionization gauge – Capacitance type Pressure measurement – Piezoelectric Pressure measurement – Application Considerations: Selection, Range, Installation, Calibration and Protection

Unit II

FLOW MEASUREMENT: Introduction – Definitions and units – Flow visualization – Velocity magnitude from Pitot static tube –Velocity direction from Yaw tube, Pivoted vane, Servoed sphere – Hot wire/hot film anemometer –Laser Doppler anemometer (LDA) – Gross volume flow rate: Calibration, standards, Obstruction meters, Rotameters, Turbine meters, Positive Displacement meters, Electromagnetic flow meter, Drag force flow meter , Ultrasonic flow meters, Vortex – Shedding flow meters – Application Considerations: Selection, Range, Installation, Calibration and Protection

Unit III

TEMPERATURE MEASUREMENT: Standards – Thermal Expansion Methods– Thermoelectric sensors – Electrical Resistance Sensors – Junction Semiconductor Sensors– Radiation methods: Radiation fundamentals – Automatic Null Balance Radiation Thermometers

– Optical Pyrometers– Two Color Radiation Thermometers– Fiber Optic Radiation Thermometers– Application Considerations: Selection, Range, Installation, Calibration and Protection

Unit IV

LEVEL MEASUREMENT: Introduction– Direct methods: Hook type level indicator, Sight glass, Float type and displacer lever detectors– Indirect methods: Pressure gauge method, Air bellows, Air purge system, Capacitance level indicator and radiation level detector– Laser level sensors– Microwave level switches– Optical level detectors– Ultrasonic level detectors– Eddy current level measurement sensors– Application Considerations: Selection, Range, Installation, Calibration and Protection

Unit V

DENSITY AND VISCOSITY MEASUREMENT: Introduction to density measurement – Magnetic type density measurements – Weight methods of density measurement– Radiation densitometers – Introduction to viscosity measurement– Capillary viscometers– Efflux cup viscometers– Rotational viscometers– Industrial viscometers – Application Considerations: Selection, Range, Installation, Calibration and Protection

Text Books

1. Doebelin E.O, "Measurement Systems: Application and Design", McGraw Hill, New York, 2003.
2. Singh S K, "Industrial Instrumentation and Control", Tata McGraw– Hill, New Delhi, 2004.
3. William C. Dunn, "Fundamentals of Industrial Instrumentationand Process Control", McGraw– Hill, New Delhi, 2005.

Reference Books

1. Liptak B.G, "Process Measurement and Analysis," Chilton Book Company, Radnor, Pennsylvania, 2003.
2. Walt Boyes, "Instrumentation Reference Book," Butterworth Heinemann, United States, 2003.

12EI219 PROCESS DYNAMICS AND CONTROL

Credits: 3:1:0

Course Objective:

- To equip the students with the knowledge of modelling a physical process.
- To understand the design of various control schemes.
- To apply the control system in various processes.

Course Outcome:

At the end of the course the student will

- Derive the Mathematical Model of a physical system.
- Tune controllers for Optimum gain using various techniques.
- Analyze and decide suitable control schemes for a particular system.

Unit I

PROCESS DYNAMICS: Process Control System: Terms and objectives – Piping and Instrumentation diagram – Instrument terms and symbols – Process characteristics: Process equation – Degrees of freedom– Modeling of simple systems – Thermal – Gas – Liquid systems – Self– regulating processes – Interacting and non– interacting processes

Unit II

BASIC CONTROL ACTIONS: Two position – Multi position – Floating control modes – Continuous Controller Modes: Proportional, Integral, Derivative, PI, PD , PID – Integral wind–up and Prevention – Auto/Manual transfer – Response of controllers for different test inputs – Selection of control modes for processes like Level, Pressure, Temperature and Flow

Unit III

OPTIMUM CONTROLLER SETTINGS: Controller tuning Methods: Evaluation criteria, Integral Absolute Error (IAE), Integral Squared Error (ISE), Integral Time Absolute Error (ITAE), Process reaction curve method, Ziegler Nichol's tuning, Damped Oscillation Method – Closed loop response of First and Second order systems with and without valve and measuring element dynamics

Unit IV

FINAL CONTROL ELEMENTS: Pneumatic control valves – Construction details –Types – Plug characteristics – Valve sizing – Selection of control valves – Inherent and installed valve characteristics – Cavitation and flashing in control valves – Valve actuators and positioners

Unit V

ADVANCED CONTROL SCHEMES: Cascade control – Ratio control – Feed forward control – Split range and selective control – Multivariable process control – Interaction of control loops – Case Studies: Distillation column, Boiler drum level control, Heat Exchanger and chemical reactor control

Text Books

1. Stephanopoulos, "Chemical Process Control", Prentice Hall, New Delhi, 2003.
2. Coughanowr D.R., "Process Systems Analysis and Control", McGraw Hill, Singapore, 2008.
3. Curtis D .Johnson, "Process Control Instrumentation Technology, "Prentice Hall , New Jersey2006.

Reference Books

1. Dale E. Seborg, Thomas F. Edgar, Duncan A. Mellichamp, "Process Dynamics and Control," John Willey and Sons, Singapore, 2006.
2. Wayne Bequette B., "Process control: modeling, design, and simulation" Prentice Hall , New Jersey– 2003
3. Peter Harriott, "Process Control", Tata McGraw Hill, New Delhi, 2008.

12EI220 INDUSTRIAL INSTRUMENTATION LABORATORY

Credits: 0:0:2

Course Objective:

- To strengthen the knowledge of Industrial Instruments.
- To strengthen the knowledge of Calibration for Instruments.
- To inculcate the operation of Instrumentation Circuits.

Course Outcome:

At the end of the course the student will

- Handle simple Industrial Instruments.
- Perform Calibration of Instruments.
- Design Instrumentation Circuits.

List of Experiments:

1. Calculation of discharge coefficient of orifice plate.
2. Design of Alarm circuit
3. Design of Temperature Transmitter
4. Calculation of Percentage Error in Pressure Gauge using Dead Weight Tester
5. Linearization of Thermistor
6. Instrument control
7. Measurement of Level using Capacitive Transducer
8. Measurement of Conductivity and pH of a solution
9. Measurement of Viscosity of a solution
10. Design of Cold Junction Compensation circuit.
11. Study of Pressure Transmitter.
12. Characteristics of I/P and P/I Converters

12EI221 SIGNAL CONDITIONING CIRCUITS LABORATORY

Credits: 0:0:2

Course Objective:

- To gain experience in the use of op– amps.
- To learn the usage of digital devices for various applications.

Course Outcome:

At the end of the course the student will

- Design, analyze and implement Amplifiers, Filters and Digital circuits.
- Analyze the characteristics of Op– amplifier, Filter, Logic Gates and Flip flops.

List of Experiments:

1. Design and Implementation of Adder and Subtractor
2. Design and Implementation of Code Convertor
3. Parity Bit Generator and Checker.
4. Construction and Verification of Counters
5. Design and Implementation of Encoder and Decoder

6. Design and Implementation of Multiplexer and Demultiplexer.
7. Linear Op– Amp Circuits
8. Comparator Circuits
9. Design and Testing of Instrumentation Amplifier
10. Multivibrator Using IC555
11. Frequency Response of 2^{nd} Order Filters.
12. Implementation of Precision Rectifiers
13. Simulation using PSPICE and NI – ELVIS

12EI222 MICROPROCESSORS AND MICROCONTROLLERS LABORATORY

Credits: 0:0:2

Course Objective:

- To impart Programming knowledge based on the 8085 microprocessors and its interfacing.
- To impart knowledge about embedded C programming in 89C51RD2.

Course Outcome:

At the end of the course the student will

- Write simple Assembly Language programs using 8085 and 8051.
- Interface 8085 and 8051 with ADC,DAC, stepper motor etc.

List of Programs:

Programs using 8085 Microprocessors

1. Basic arithmetic operations (Addition, Subtraction, Multiplication and Division)
2. Sorting (Ascending and Descending order)
3. Code conversion (BCD to Hexadecimal, Hexadecimal to BCD, ASCIIto Decimal)
4. Generation of square wave using 8085.
5. KeyBoard Display Interface

Programs using 8051 Microcontrollers

6. Basic arithmetic operations (addition, subtraction, multiplication and division)
7. Serial communication
8. Square wave generation
9. Digital to Analog conversion
10. DC motor control
11. Interfacing stepper motor
12. Interfacing ADC

12EI223 ELECTRONIC INSTRUMENTATION

Credits: 4:0:0

Course Objective:

- To provide descriptive information Electronics Measurements.
- To include specialized information needed for Digital Instrumentation.
- To exploit an instrument's potential, to be aware of its limitations.

Course Outcome:
At the end of the course the student will
- Discover applications and solve problems that arise in Various Felds
- Correctly interpret the measurement results

Unit I
ELECTRONIC ANALOG METERS: Introduction – Amplified DC meter – AC voltmeters using rectifiers – True RMS voltmeter – Electronic Multimeter – Component measuring instruments – Q meter – Vector impedance meter– Vector voltmeter – Power meter

Unit II
OSCILLOSCOPE AND DISPLAY DEVICES: Oscilloscope: Introduction, Block diagram, Cathode Ray Tube (CRT), CRT circuits, Vertical deflection system, Horizontal Deflection system – Special Oscilloscopes: Storage, Sampling, Digital Storage Oscilloscopes – Display Devices: LED, LCD, 7 Segment displays, Dot matrix displays, Bar graph displays, FM recorder, Digital recording

Unit III
SIGNAL GENERATORS AND ANALYSERS: Signal generator: Sine wave generator, Frequency synthesized signal generator, Frequency divider generator, Sweep frequency generator, Pulse and Square Wave Generator, Function Generator – Signal Analyzers: Wave Analyzer, Harmonic Distortion Analyzer, Spectrum analyzer

Unit IV
DIGITAL INSTRUMENTS : Digital Voltmeters and Multimeters – Simple frequency counter – Digital methods of measuring frequency, period, phase difference, pulse width, time interval, total count – Measurement error – Digital Displacement transducer: Incremental and Absolute – Digital tachometer – Digital Capacitance meter

Unit V
VIRTUAL INSTRUMENTATION: Evolution of Virtual Instrumentation – Architecture – Presentation and Control – Functional Integration – Programming Requirements – Conventional and Distributed Virtual Instrumentation – Virtual Instruments and Traditional Instruments – Advantages – Evolution of LabVIEW – Creating Virtual Instruments using LabVIEW – Virtual Instrumentation in the Engineering Process

Text Books
1. Cooper W.D., “Electronic Instrumentation and measurement techniques”, Prentice Hall of India, New Delhi, 1998.
2. Kalsi.H.S, “Electronics Instrumentation”, Tata McGraw Hill, 1995.
3. Bouwens A.J., Digital Instrumentation, McGraw Hill Ltd., USA, 2002.

Reference Books
1. Sumathi S and P. Surekha , “LabVIEW based Advanced Instrumentation Systems” Springer, 2007.
2. Oliver B.H., and Cage J.M., “Electronics Measurements and Instrumentation”, McGraw Hill, 1999.

3. David A Bell, "Electronic Instrumentation and measurements", Prentice Hall of India, New Delhi, 2006.

12EI224 DIGITAL SIGNAL PROCESSING

Credits: 3:1:0

Course Objective:

- To introduce the basic concepts involved in discrete time signal processing.
- To give an in depth knowledge of the concepts of digital filter design.
- To learn the intricacies involved in designing a DSP chip in hardware.

Course Outcome:

At the end of the course the student will

- Use DFT and FFT to analyze the spectrum of signals.
- Design Digital FIR and IIR filters for DSP applications.
- Use DSP Processor for practical applications.

Unit I

INTRODUCTION: Concepts of signal processing – Typical applications – Advantages of Digital Signal Processing compared with Analog Processing – Review of Discrete Time LTI Systems – Linear, Circular and Sectioned convolutions

Unit II

DISCRETE FOURIER TRANSFORM:DFT – FFT computations using DIT and DIF Algorithms – Time and frequency response analysis of discrete time systems

Unit III

INFINITE IMPULSE RESPONSE DIGITAL FILTERS: Review of Classical Analog Filters – Butterworth, Chebyshev and Elliptic filters – Design of IIR filters – Impulse invariant method – Bilinear Transform method – Realization of structures of IIR filters

Unit IV

FINITE IMPULSE RESPONSE DIGITAL FILTERS: Symmetric and Antisymmetric FIR filters – FIR filter design using window method – frequency sampling method – Realization of structures of FIR filters – Transversal and linear phase structures

Unit V

INTRODUCTION TO PROGRAMMABLE DSPs: Multiplier and Multiplier Accumulator Unit – Modified Bus Structure and Memory Access in PDSPs – Multiple Access Memory – Multiported memory – VLIW Architecture – Pipelining – Special addressing modes – PDSPs with RISC and CISC Processors – Architecture of TMS320C5X – On–chip peripherals

Text Books

1. John G. Proakis and Dimitris. G.Manolakis, 'Digital Signal Processing, Algorithms and Applications', PHI of India Ltd., New Delhi, 2000.
2. Sanjit. K.Mitra, 'Digital Signal Processing – A Computer Based Approach', Tata McGraw– Hill, New Delhi, 2001.
3. Venkatramani B, M. Bhaskar, 'Digital Signal Processors Architecture,Programming and Applications', Tata McGraw– Hill Publishing CompanyLimited, New Delhi, 2002.

Reference Books

1. Oppenheim and Schafer, 'Digital Time Signal Processing', Prentice Hall of India, Reprint, 2002.
2. Emmanuel C. Ifeacher and Barrie W. Jervis, 'Digital Signal Processing – APractical Approach', Addition – Wesley Longman Ltd., UK,2004.
3. Texas Instruments Manual for TMS320C5XProcessor.

12EI225 LOGIC AND DISTRIBUTED CONTROL SYSTEMS

Credit: 4:0:0

Course Objective:

- To provide the fundamentals of Data Acquisition system.
- To introduce the concept of PLC and its Programming using Ladder Diagram.
- To cover the basics of Distributed Control Systems

Course Outcome:

At the end of the course the student will

- Acquire knowledge of data acquisition System
- Write simple Programs using ladder diagrams
- Use the knowledge of DCS and communication standards in their Projects

Unit I

REVIEW OF COMPUTERS IN PROCESS CONTROL : Data loggers – Data Acquisition Systems (DAS) – Direct Digital Control (DDC) – Supervisory Control and Data Acquisition Systems (SCADA) – sampling considerations – Functional block diagram of computer control systems

Unit II

PROGRAMMABLE LOGIC CONTROLLER(PLC) BASICS: Definition – Overview of PLC systems - Input/output modules - Power supplies and isolators - General PLC programming procedures - Programming on-off inputs/ outputs - Auxiliary commands and functions - PLC Basic Functions - Register basics - Timer functions - Counter functions.

Unit III

PLC INTERMEDIATE FUNCTIONS : PLC intermediate functions: Arithmetic functions, Comparison functions, Skip and MCR functions, Data move systems - PLC Advanced intermediate functions: Utilizing digital bits, Sequencer functions, Matrix functions - PLC Advanced functions: Alternate programming languages, Analog PLC operation, Networking of PLC - PID functions - PLC installation - Troubleshooting and maintenance - Design of interlocks and alarms using PLC.

Unit IV

DISTRIBUTED CONTROL SYSTEMS (DCS): Introduction : DCS Evolution, DCS Architecture, Comparison – Local Control unit – Process Interfacing Issues – Redundancy concept - Communication facilities.

Unit V

INTERFACES IN DCS: Operator interfaces: low level, high level – Operator Displays – Engineering Interfaces : Low level, high level – General purpose computers in DCS

Text Books

1. John.W. Webb, Ronald A Reis, “Programmable Logic Controllers - Principles and Applications”, Prentice Hall Inc., New Jersey, 2003.
2. Michael P Lukas, “Distributed Control System”, Van Nostrand Reinhold Co., Canada, 1986.
3. B.G. Liptak, “Instrument Engineers Hand, Process control and Optimization”, CRC press- Radnor, Pennsylvania, 2006.
4. M.Chidambaram, “Computer Control of Process,” Narosa Publishing, New Delhi, 2003

Reference Books

1. B.G. Liptak, “Process software and digital networks,” CRC press,Florida-2003.
2. Curtis D. “Johnson Process control instrumentation technology,” Prentice Hall , New Jersey 2006.
3. Krishna Kant, “Computer-Based Industrial Control,“ PHI, New Delhi, 2004
4. Frank D. Petruzella, “Programmable Logic Controllers”, McGraw Hill, New York, 2004.

12EI226 INDUSTRIAL DATA COMMUNICATION AND NETWORKS

Credits: 4:0:0

Course Objective:

- To equip the students with relevant knowledge about network that allows computers to communicate with each other and share resources and information.

Course Outcome:

At the end of the course the student will

- Appreciate the need for network protocols during data transmission and reception.
- Compare the different protocols used as Universal standards.

Unit I

INTRODUCTION AND BASIC PRINCIPLES: Protocols – Physical standards – Modern instrumentation – Bits, Bytes and characters – Communication principles – Communication modes – Synchronous and Asynchronous systems – Transmission Characteristics – Data Coding – UART

Unit II

SERIAL COMMUNICATION STANDARDS: Standards organizations – Serial data communications interface standards – Balanced and unbalanced transmission lines – RS232,422,,423,449,485 interface standard – Troubleshooting – The 20mA current loop – Serial interface converters – Interface to printers – IEEE 488 – USB

Unit III

INTRODUCTION TO PROTOCOLS: Flow control Protocols – BSC Protocols – HDLC – SDLC – Data communication for Instrumentation and Control – Individual OSI layers – OSI Analogy –Example

Unit IV

INDUSTRIAL PROTOCOLS: Introduction – ASCII based protocols – Modbus Protocols – Allen Bradley Protocol – HART – Field bus

Unit V

LOCAL AREA NETWORKS: Circuit and packet switching – Network Topologies – LAN Standards – Ethernet – MAC – Token bus – Internetwork connections – NOS Network Architecture and Protocols

Text Book

1. John Park,SteveMackay,Edwin Wright,"Practical Data Communications for Instrumentation and Control", Elsevier Publications, 2003.

Reference Books

1. Stallings W. "High speed Networks TCP/IP and ATM Design Principles " PHI , 2002.
2. Behrouz A. Forouzan" Data Communication and Networking" , TMH,2006.

12EI227 PROCESS CONTROL LABORATORY

Credits: 0:0:2

Course Objective:

- To introduce the practical concepts of digital controllers .
- To demonstrate Data Acquisition in VI
- To provide knowledge about controller design, simulation and implementation using

Course Outcome:

At the end of the course the student will

- Design and compare Digital Control Algorithms.
- Analyze the performance of a Process

List of Experiments:

1. Study of Pressure Process Station
2. Study of Level Process Station
3. Study of Flow Process Station
4. Study of Temperature Process Station
5. Transfer function of DC servo motor
6. Characteristics of Pneumatic control valve
7. Obtain mathematical model of a Process Plant
8. Tuning of PID controller
9. Response of P and PI Controller for the given error signal
10. Study of interacting system
11. Cascade control of process
12. Study of field bus protocol

12EI228 DIGITAL SIGNAL PROCESSING LABORATORY

Credits: 0:0:2

Course Objective:
- To verify the concepts in Digital Signal Processing practically using software tools

Course Outcome:
At the end of the course the student will
- Visualize the operations done on signals.
- Appreciate the concept of convolution and verify the convolution theorem.
- Compute the DFT and IDFT of sequences.
- Design and implement Digital filters for real time applications,

List of Experiments:
1. Generation and Operation of Discrete Time signals
2. Verification of properties of Discrete Time systems
3. Determination of Response of a system using convolution
4. Computation of Correlation
5. Computation of Discrete Fourier Transform(DFT) and Inverse DFT
6. Signal Spectrum Analysis using Fast Fourier Transform
7. Design and testing of FIR filter
8. Design and testing of IIR filter
9. Sampling and Reconstruction
10. Acquisition and Processing of Bio signals using VI
11. Audio Signal Processing in VI
12. Simple programs in TMS320c5X kit

12EI229 ADVANCED PROCESSORS

Credits: 4:0:0

Course Objective:
- To impart the basic knowledge about the Processors.
- To inculcate the understanding about the RISC and CISC Architectures.
- To understand the concepts of various processors programming.

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Course Outcome:
At the end of the course, the student will
- Use the knowledge of processors in practical applications.

Unit I
INTRODUCTION TO PROCESSOR: Instruction set – Data formats – Instruction formats – Addressing modes – Memory hierarchy – Register file – Cache – Virtual memory – Segmentation – Pipelining – The instruction pipeline – Pipeline hazards – Instruction level parallelism – Reduced instruction set – Computer principles – RISC versus CISC

Unit II

HIGH PERFORMANCE CISC ARCHITECTUREPENTIUM: The software model – functional description – CPU pin description – RISC operation – Bus operation – Superscalar architecture – Pipelining – The instruction and caches – Floating point unit – Protected mode operation – Segmentation – Exception and interrupts – Virtual 8086 model – Interrupts processing instruction types – Addressing modes

Unit III
HIGH PERFORMANCE RISC ARCHITECTURE:ARM: Introduction to processor design – Abstraction in hardware design – Instruction set design – Processor design trade offs – Reduced instruction set computer – Design for low power consumption – The ARM architecture – The Acorn RISC machine – Architectural inheritance – ARM programmer model – ARM development tools

Unit IV
ARM ORGANISATION AND IMPLEMENTATION:ARM organization – 3stage pipeline ARM organization – 5stage pipeline ARM organization – ARM instruction execution – ARM implementation – ARM coprocessor interface – Instruction set – The thump instruction set – ARM Processor cores

Unit V
EMBEDDED ARM APPLICATIONS: The VLSI Ruby II Advanced Communication Processor– The VLSI ISDN Subscriber Processor – The OneC™ VWS22100 GSM chip – The Ericsson – VLSI Bluetooth Baseband Controller

Text Books
1. Daniel Tabak "Advanced Microprocessors", McGraw Hill.Inc .,1995
2. Steve Furber, "ARM system on chip architecture", Addison Wesley,2000.

Reference Books
1. Barry B.Breg., "The Intel Microprocessors Architecture, Programming and interfacing", PHI,2002
2. James L.Antonakos, "The Pentium microprocessors",Pearson Education,1997.

12EI230 EMBEDDED SYSTEMS LABORATORY

Credits:0:0:2

Course Objective:
- To learn about the Embedded Processors with Real World applications:

Course Outcome:
At the end of the course the student will
- Write programs in an IDE and download it to the Processor.
- Design and program Embedded circuits.

List of Experiments:
The Following Experiments are conducted on 89C51 Processor
1. Activation of Buzzer
2. Generating delay using timer for buzzer
3. Activation of LED

4. Activation of LED using Switch
5. Seven segment Display
6. Real Time Clock
7. Digital to Analog Converter
8. Generation of Sawtooth and Triangular waveforms
9. Sine waveform generation
10. Digital Voltmeter
11. Keypad Scanning
12. Stepper motor interfacing

12EI231 LOGIC AND DISTRIBUTED CONTROL SYSTEMS LABORATORY

Credits : 0:0:2

Course Objective:
- To strengthen the knowledge of PLC
- To introduce the concepts of SCADA
- To gain hands on experience on DCS

Course Outcome:
At the end of the course the student will
- Write simple programs in PLC
- Integrate SCADA and PLC and implement projects
- Work on a DCS

List of Experiments:
1. Study of Siemens PLC
2. Study of Omron PLC
3. Study of Keyence PLC
4. Simulation of Ladder Diagram Using PICSOFT
5. SCADA for Bottle filling Plant
6. SCADA For Mixing Plant
7. PLC SCADA Integration
8. Open Loop and Closed Loop Configuration for DCS
9. Trends and Alarms
10. Fault Diagnosis
11. Process Station Control Using DCS
12. Cascade Control Using DCS

12EI232BIOMEDICAL INSTRUMENTATION

Credits: 4: 0:0

Course Objective:
- To give knowledge of the principle of operation and design of Biomedical Instruments.

- To render a broad and modern account of biomedical instruments.
- To give an introductory idea about human physiology system which is very important with respect to design consideration.

Course Outcome:

At the end of the course the student will

- Design Instrumentation circuits for BiomedicalApplications.
- Use the knowledge of Biomedical Instruments to Practical Problems.

Unit I

ANATOMY AND PHYSIOLOGY OF HUMAN BODY: The cell and its electrical activity– Principle physiological system: Cardiovascular System, Nervous system, Respiratory system, Muscular system – Origin of bioelectric signal – Bioelectric signals: ECG, EMG, EEG, EOG and their characteristics

Unit II

MEASUREMENT OF PHYSIOLOGICAL PARAMETERS: Physiological transducers – Measurement of Blood pressure – Blood flow – Cardiac output measurement – Heart rate – Respiration rate – Measurement of lung volume – Oximeters – Audiometer

Unit III

THERAPEUTIC EQUIPMENTS AND PATIENT SAFETY: Electro Surgical unit: Short wave and microwave diathermy – Laser surgical unit – Defibrillators – Pacemaker – Heart Lung machine – Dialyser – Anesthesia machine – Ventilators – Nerve stimulators – Total artificial heart (TAH) – Patient Safety: Electric Shock Hazards, Leakage Current

Unit IV

CLINICAL LABORATORY INSTRUMENTS: Clinical Flame photometer – Spectrophotometer – Colorimeter – Chromatography– Automated Biochemical analysis system – Blood Gas Analyzer – Blood pH Measurement– Measurement of Blood pCO_2– Blood pO_2 Measurement– Blood Cell Counters: Types and Methods of cell counting

Unit V

IMAGING TECHNIQUE ANDTELEMETRY: X– ray – C.T. scan – MRI instrumentation – Ultrasound scanner – Vector cardiograph – Echo cardiograph – Angiography – Telemetry: Wireless telemetry, Single channel and multichannel telemetry system– Multi patient Telemetry – Implantable Telemetry systems

Text Books

1. Khandpur. R. S., “Handbook of Biomedical Instrumentation”, Prentice Hall of India, New Delhi, 2003.
2. Cromwell, “Biomedical Instrumentation and Measurements”, Prentice Hall of India, New Delhi, 2007.

Reference Books

1. Arumugam.M. “Biomedical Instrumentation", Anuradha Agencies Publishers, Kumbakonam, 2006.

2. Joseph J. Carr and John M. Brown, "Introduction to Biomedical Equipment Technology", Pearson Education India, Delhi, 2004.
3. Webster, "Medical Instrumentation – Application & Design," John Wiley and sons Inc, Netherlands, 2009.

12EI233 EMBEDDED SYSTEMS

Credits: 4:0:0

Course Objective:

- To introduce the basic concepts of Embedded Systems and the various techniques used for Embedded Systems with examples.

Course Outcome:

At the end of the course the student will

- Apply the concepts of Embedded Systems to build Real Time Projects

UNIT I

INTRODUCTION TO EMBEDDED SYSTEMS: Embedded system, Processor embedded into a system, Embedded hardware units – Embedded software in a system – Conversion of assembly language into machine codes – Software tools for designing an embedded systems – Examples of an embedded systems – Complex systems design and processors – Design process in Embedded system – Classification of an embedded systems

UNIT II

PROGRAM MODELING CONCEPTS: Program modeling concepts – Program model – DFG model – State machine programming model – Modelling for multiprocessor systems – UML modeling – High level language descriptions of S/W for embedded system – Software programming – Object oriented programming – Embedded programming advantages and disadvantages

UNIT III

INTERPROCESS COMMUNICATION AND SYNCHRONIZATION: Multiple processes and threads in an application – Tasks – Task states – Task and data – Distinction between function, ISR and Task – Concept of semaphore – Use of semaphore as event signalling – Use of semaphore as resource key – Shared data – Problem of sharing data – Shared data problem solutions – Priority inversion – Inter process communication – Signal function – Semaphore function – Message queue function – Mailbox function

UNIT IV

REAL TIME OPERATING SYSTEMS:OS services – process management – Timer function – Event function – Memory management – Device, File and subsystem management – Interrupt routine in RTOS environment – Task scheduling – Cooperative scheduling – Preemptive scheduling model – Petrinet model – Embedded software development process and tools – Host and target machine – Testing on Host machine – Simulators

UNITV

APPLICATIONS: Automatic chocolate vending machine – Smart card – Digital camera – stepper motor control – Temperature control – Embedded system in Automobile

Text Book

1. Rajkamal Embedded systems: Architecture, programming and design , TMH

12EI234 NEURAL NETWORKS AND FUZZY LOGIC CONTROL

Credits: 4:0:0

Course Objective:

- To provide knowledge of Neural Networks and Fuzzy Logic Control andtheir application to control systems.

Course Outcome:

At the end of the course the student will

- Analyze the various Neural Network Models.
- Create an Artificial Neural Network and train it.
- Design a Fuzzy Logic Controller for a Real World Application.

Unit I

NTRODUCTION: Introduction to biological neuron –Artificial neural networks – Classification of neural networks – Activation functions and their types – Single layer and multilayer neural Networks – Rosenblatt'sPerceptron – Back propagation algorithm

Unit II

SPECIAL NETWORKS: Hopfield's networks – Kohonen self– organizing maps – Adaptive resonance theory – Associative Memory – Bi– directional associative memories – BAM structure

Unit III

NEURAL NETWORKS FOR CONTROL SYSTEMS: Schemes of neuro– control, Identification and control of dynamical systems – Case studies (Inverted Pendulum, Articulation Control)

Unit IV

INTRODUCTION TO FUZZY LOGIC: Fuzzy sets – Fuzzy Operations – Fuzzy relations – Fuzzy conditional statements – Fuzzy Rules – Membership Functions – Defuzzification

Unit V

FUZZY LOGIC CONTROL: Fuzzy logic controllers – Adaptive Fuzzy Systems – Case studies(Inverted Pendulum, Articulation Control)

Text Books

1. Zurada, J.M., "Introduction to Artificial Neural Systems", Jaico Publishing House, 2006.
2. Timothy J. Ross, 'Fuzzy Logic with Engineering Applications', McGraw Hill, 2008.

Reference Books

1. Driankov D, Hellendoorn H. and Reinfrank M., "An Introduction to Fuzzy Control", Narosa Publishing House, New Delhi, 1996.

2. LauranceFausett, ‘Fundamentals of Neural Networks’, Pearson Education, 2004.
3. Klir, G.J. and Folger, T., “Fuzzy Sets, Uncertainty and Information”, Prentice Hall of India, 5th Indian reprint, 2002.

12EI235 DIGITAL CONTROL SYSTEMS

Credits: 3:1:0

Course Objective:

- To equip the students with the basic knowledge of A/D and D/A conversion.
- To study the stability analysis of digital control system.
- To equip the basic knowledge of digital process control design.

Course Outcome:

At the end of the course the student will

- Use Z transforms to analyze Discrete Systems.
- Design controllers for a digital process.
- Test the Stability of Discrete Systems.

Unit I

INTRODUCTION TO DIGITAL CONTROL: Need for digital control – Configuration of the basic digital control scheme - Principles of signal conversion - Basic discrete time signals - Time domain models for discrete time systems - Z transform - Transfer function models

Unit II

ANALYSIS OF DIGITAL CONTROL: Frequency Response - Stability on the z-Plane and the Jury stability criterion - Sample and hold systems - Sampled spectra and aliasing - Reconstruction of analog signals - Practical aspects of the choice of sampling rate - Principles of discretization

Unit III

MODELS OF DIGITAL CONTROL DEVICES AND SYSTEMS: Introduction - Z domain description of sampled continuous time plants - Z domain description of systems with dead time - Implementation of digital controllers - Tunable PID controllers - Digital temperature control systems - Digital position control system

Unit IV

DESIGN OF DIGITAL CONTROL ALGORITHMS: Introduction - Z plane specifications of control system design - Digital compensator design using frequency response plots - Digital compensator design using root locus plots - Z plane synthesis

Unit V

STATE VARIABLE ANALYSIS OF DIGITAL CONTROL SYSTEMS: Introduction - State descriptions of digital processor - State description of sampled continuous time plants - State description of systems with dead time - Solution of state difference equations - Controllability and observability - Multivariable systems

Text Books

1. Gopal M, “Digital Control and State variable Methods”, Tata McGrawHill, New Delhi, 2003.
2. Ogata, “Discrete Time Control Systems”, Prentice– hall Of India, New Delhi 2008.

Reference Books

1. Gene F. Franklin, J. David Powell, “Digital control of dynamic systems”, *Pearson* Education Limited, New Delhi,2002.
2. Richard C. Dorf, Robert H. Bishop, “Modern control systems,” Pearson Educatio inc, New Delhi, 2008.

12EI236 INSTRUMENTATION AND CONTROL IN PETROCHEMICAL INDUSTRIES

Credits: 4:0:0

Course Objective:

- To expose the students to the Instrumentation and control applied in petrochemical industries.

Course outcome:

At the end of the course the student will

- Appreciate the significance of Measurement in Petrochemical Industry.
- Use the Knowledge of Control to design new Control Algorithms.

Unit I

DISTILLATION COLUMNS: Piping and Instrumentation diagrams – Instrumentation and control in distillation columns: Distillation equipment, Variables anddegrees of freedom, Measurement and control of column pressure, Liquid distillate, Vapour distillate and inerts, Feed control – Reboiler control – Reflux control – Variable Column feed – Super distillation – Analyzers – Feedforward control

Unit II

CHEMICAL REACTORS: Instrumentation and control in chemical reactors: Temperature and pressure control in batch reactors – Instrumentation and control in dryers: Batch dryers and Continuous dryers

Unit III

HEAT EXCHANGERS: Instrumentation and control in heat exchangers: Variables and degrees of freedom – Liquid toliquid heat exchangers – Steam heaters – Condensers – Reboilers and Vaporizers – Use of cascadeand feed forward control

Unit IV

EVAPORATORS: Instrumentation and control in evaporators: Types of evaporators, Measurement and controlof absolute pressure, Density, Conductivity, Differential pressure and Flow

Unit V

EFFLUENT AND WATER TREAMENT: Instrumentation and control in Effluent and Water Treatment: Chemical oxidation, Chemical Reduction, Neutralization,Precipitation and Biological control

Text Book

1. Béla G. Lipták. 'Instrumentation in the Processing Industries: Brewing, Food, Fossil Power, Glass, Iron and Steel, Mining and Minerals, Nuclear Power, Paper, Petrochemical, Pharmaceutical', Chilton Book Co., Reprint 2003 Original from the University of California.

Reference Books

1. Considine D.M., 'Process / Industrial Instruments and Control Handbook', Fourthedition, McGraw Hill, Singapore, 1993. ISBN– 0– 07– 012445– 0.
2. Curtis D .Johnson,"Process control instrumentation technology,"Prentice Hall , New Jersey2006.

12EI237 INSTRUMENTATION AND CONTROL IN PAPER INDUSTRIES

Credits: 4:0:0

Course Objective:

- To expose the students to the Instrumentation applied in Paper industries.

Course Outcome:

At the end of the course the student will

- Appreciate the need of instrumentation and control in Paper making.
- Design a Controller for paper industries.

Unit I

DESCRIPTION OF THE PROCESS: Raw materials – Pulping process – Chemical Recovery Process – Paper making process – Converting

Unit II

INSTRUMENTATION: Measurements of Basic Weight – Density – Specific gravity – Flow – Level of liquids and solids– Pressure – Temperature – Consistency – Moisture – PH – Oxidation –Reduction potential – Graphic displays and alarms

Unit III

CONTROL OPERATIONS: Blow tank controls – Digester liquor feed pump controls – Brown stock water level control – Stock chest level control – Basic weight control – Dry temperature control

Unit IV

DENSITY AND FLOW CONTROL: Dissolving tank density control – White liquor classifier density control – White liquor flow control – Condensate conductivity control

Unit V

COMPUTER APPLICATIONS: Computer applications in pulping process control – Liquid level control – Input stock control

Text Book

1. B.G Liptak, 'Instrumentation in Process Industries', Chilton Book Company, 1994.

12EI238 INSTRUMENTATION AND CONTROL IN IRON AND STEEL INDUSTRIES

Credits: 4:0:0

Course Objective:

- To provide the fundamentals Steel Production and introduce the Instrumentation involved in such Industries.

Course Outcome:

At the end of the course the student will

- Use the knowledge of Iron and Steel making Process to suggest better Instrumentation and Control Algorithms.

Unit I

DESCRIPTION OF PROCESS: Flow diagram and description of the processes – Raw materials preparation – Iron making – Blast furnaces – Stoves– Raw steel making – Basic Oxygen Furnace – Electric Furnace

Unit II

CASTING OF STEEL: Casting of steel: Primary rolling, Cold rolling and Finishing

Unit III

INSTRUMENTATION: Measurement of level, Pressure, Density, Temperature, Flow ,Weight, Thickness and shape, Graphic displays and alarms

Unit IV

CONTROL SYSTEMS: Blast furnace – Stove combustion control system – Gas and water controls in BOF furnace – Strand Casting Mould Level control – Mould Level sensors – Ingot weight measuring system– Waste water treatment

Unit V

COMPUTER APPLICATIONS: Model calculation and logging – Rolling Mill Control – Annealing Process Control – Center Utilities Dispatch Computer

Text Books

1. Béla G. Lipták. 'Instrumentation in the Processing Industries: Brewing, Food, Fossil Power, Glass, Iron and Steel, Mining and Minerals, Nuclear Power, Paper, Petrochemical, Pharmaceutical', Chilton Book Co., Reprint 2003 Original from the University of California.

Reference Books

1. Liptak B. G, Instrument Engineers Handbook, volume 2, Process Control,

Third edition, CRC press, London, 1995.
2. Considine D.M, Process / Industrial Instruments and Control Handbook, Fourth edition, McGraw Hill, Singapore, 1993 – ISBN– 0– 07– 012445– 0.
3. Steel Designers Handbook 1)Branko 2)Ron Tinyou 3) ArunSyamGorenc Seventh Edition First Indian Reprint 2006.

12EI239 ULTRASONIC INSTRUMENTATION

Credits: 4:0:0

Course Objective:

- To provide knowledge on the basics of Ultrasonic Instrumentation and its Applications.

Course Outcome:

At the end of the course the student will

- Use the knowledge of Ultrasonic Instrumentation to implement Practical Applications.

Unit I

ULTRASONIC WAVES: Principles and propagation of various waves – Characterization of ultrasonic transmission – Reflection and Transmission coefficients – Intensity and attenuation of sound beam – Power level – Medium parameters

Unit II

GENERATION/DETECTION OF ULTRASONIC WAVES: Magnetostrictive and piezoelectric effects – Construction and characteristics – Detection of Ultrasonic Waves: Mechanical method, Optical Method, Electrical Method – Precise Measurement: Pulse– echo Overlap – Cross correlation – Computer Based Automated methods: Pulse– Echo Overlap– Cross correlation– search unit types

Unit III

CLASSIFICATION OF ULTRASONIC TEST METHODS: Pulse echo – Transit time – Resonance – Direct contact and immersion type – Ultrasonic methods of flaw detection – Flow meters – Density measurement – Viscosity measurement – Level measurement – Sensor for Temperature and Pressure measurements

Unit IV

ULTRASONIC APPLICATION: Measuring thickness – Depth – Rail Inspection using Ultrasonic – SONAR – Inspection of Welds and defect detection in welds of anisotropic materials

Unit V

ULTRASONIC APPLICATIONS IN MEDICAL FIELD: Medical Imaging – Diagnosis and therapy – Acoustical holography

Text Books

1. Baldev Raj, V.Rajendran, P.Palanichamy, “Science and Technology of Ultrasonics”,Alpha Science International, UK, 2004.
2. J.David N.Cheeke,”Fundamentals and Applications of Ultrasonic Waves,” CRC Press, Florida, 2002.

Reference Books

1. LawrenceE.Kinsler, Austin R.Frey, Alan B.Coppens, James V. Sanders, “Fundamentals of Acoustics,” John Wiley and Sons Inc,USA,2000.
2. L.A. Bulavin, YU.F.Zabashta, “Ultrasonic Diagnostics in Medicine,” VSP, Koninklijke Brill,Boston,2007.

12EI240 INSTRUMENTATION AND CONTROL FOR AIRCRAFT

Credits: 4:0:0

Course Objective:

- To introduce the basics of Aircraft and the Instrumentation involved in Aircraft Systems

Course Outcome:

- To give an introduction about the Aircraft and the Display Equipments
- To learn the working of various sensors used in the Flight
- To analyze in detail about the Gyroscopic Instruments and Power Plant Instruments

Unit I

INTRODUCTION: Instrument Elements and Mechanisms – Instrument Displays, Panels and Layouts

Unit II

FLIGHT INSTRUMENTATION: Pitot– Static Instruments and Systems – Altimeter – Airspeed indicator – Machmeter – Maximum Safe Speed indicator– Accelerometer

Unit III

PRIMARY FLIGHT INSTRUMENTS: Gyroscope– Gyroscopic theory – Directional gyro indicator – Artificial horizon – Turn and slip indicator

Unit IV

MEASUREMENTS IN AIRCRAFT: Measurement of Engine Speed – Measurement of Temperature – Measurement of Pressure – Measurement of Fuel Quantity and Fuel Flow

Unit V

ENGINE POWER AND CONTROL INSTRUMENTS: Power Indicators – Pressure Indicators – Turbine Temperature Control – Engine Vibration Monitoring and Indicating Instruments

Text Book

1. Pallett, E.B.J,“ Aircraft Instruments – Principles and applications", Pitman and sons, 1981.

12EI241 OPTOELECTRONICS AND LASER BASED INSTRUMENTATION

Credits: 4:0:0

Course Objective:

- To introduce the basic concepts of Optical Fibers and Lasers and their applications in the field of Instrumentation.

Course Outcome:

At the end of the course, the student will

- Use Optical fibers for measurement
- Apply LASER in Instrumentation and Biomedical applications.

Unit I

INTRODUCTION: Characteristics of optical radiation – Luminescence –Optical Sources: Light emitting diode, Heterojunction diode, Laser Diode – Optical Detectors: Photo diode, PIN diode, APD, Photo – Transistor, Photo – Thyristor, Photo – Thermistor – Charge coupled devices: Opto – couplers and their application in analogue and digital devices.

Unit II

OPTICAL FIBRE FUNDAMENTALS: Modes– Types of Optical Fibres – Fibre coupling – Fibre optic sensors for Temperature, Pressure, Flow and Level measurement

Unit III

CHARACTERISTICS OF LASERS: Laser Rate Equation – Properties – Two, Three and Four level system – Resonator configuration – Q switching and Mode locking – Cavity dumping – Types of Lasers

Unit IV

INDUSTRIAL APPLICATIONS OF LASERS: Lasers for measurement of distance and length, Velocity, Acceleration, Atmospheric effects, Sonic boom, Pollutants, Current and Voltage, Material processing: Laser heating, Melting, Scribing, Splicing, Welding and trimming of materials, Removal and Vapourization

Unit V

HOLOGRAM AND MEDICAL APPLICATION: Holography – Basic principle – Methods– Holographic Interferometry and applications – Holography for non – destructive testing – Medical applications of lasers :Laser interaction with biomolecules – Photothermal applications – Photochemical applications – Endoscopes

Text Books

1. Arumugam.M. “Fiber Optics and Laser Instrumentation", Anuradha Agencies Publishers, Kumbakonam, 2006.

2. Optical Fiber Communications: Principles And Practice, John M. Senior, Pearson Education, 2006.

Reference Books

1. G. Keiser, ‘Optical Fibre Communication’, McGraw Hill, 1995.
2. Ghatak A.K. and Thiagarajan K, Optical Electronics Foundation book , TMH, Cambridge University Press, 1989.
3. Wilson and Hawkes, “Opto Electronics –An Introduction”, 3rd Edition, Prentice Hall, New Delhi, 1998.

12EI242 POWER PLANT INSTRUMENTATION

Credit 4:0:0

Course Objective:

- To provide an overview of different methods of power generation with a particular stress on thermal power generation.
- To bring out the various measurements involved in power generation plants.
- To familiarize the students with the methods of monitoring different parameters like speed, vibration of turbines and their control.

Course Outcome:

At the end of the course the student will

- Apply the knowledge of power plant instrumentation to control the boiler parameters.

Unit I

OVERVIEW OF POWER GENERATION : Brief survey of methods of power generation – Hydro, Thermal, Nuclear, Solar and Wind power– Importance of instrumentation in power generation – Thermal power plants – Buildingblocks – Details of boiler process – Piping and Instrumentation diagram of boiler – Cogeneration

Unit II

MEASUREMENTS IN POWER PLANTS: Electrical measurements: Current, Voltage, Power, Frequency, Power factor – Non– electrical parameters:Flow of feed water, Fuel, Air and steam with correction factor fortemperature – Steam pressure and Steam temperature – Drum level measurement – Radiationdetector – Smoke density measurement – Dust monitor

Unit III

ANALYZERS IN POWER PLANTS: Flue gas oxygen analyzer – Analysis of impurities in feed water and steam – Dissolved oxygen analyzer – Chromatography – PH meter – Fuel analyzer – Pollution monitoring instruments

Unit IV

CONTROL LOOPS IN BOILER: Steam pressure control – Combustion control – Air/Fuel ratio control – Furnace draft control – Drum level control – Main steam and reheat steam temperature control – Superheater control – Attemperator –Deaerator control – Distributed control system in power plants – Interlocks in boiler operation

Unit V

TURBINE MONITORING AND CONTROL: Speed, Vibration, Shell temperature monitoring and control – Lubricant oil temperature control

Text Book

1. K. Krishnaswamy, M. Ponnibala, "Power Plant Instrumentation", PHI Learning Pvt Ltd.,2011.

Reference Book

1. P.K Nag, Power plant Engineering, Tata McGraw Hill, 2001.

12EI243 AUTOMOTIVE CONTROL SYSTEMS

Credits: 4:0:0

Course Objective:

- To learn the fundamental principles of electronics and to introduce the application of electronics in the modern automobile.
- To develop ability to understand various latest Communication protocols used in automobiles industries.
- To provide a thorough understanding of automotive systems and various electronic accessories used in automobile.

Course Outcome:

At the end of the course the student will

- Design instruments for automotive applications.
- Use Communication protocols to perform advanced monitoring and control.

Unit I

AUTOMOTIVE ELECTRICALS AND ELECTRONICS: Basic Electronics components and their operation in an automobile – Starting Systems – Charging Systems – Ignition Systems – Electronic Fuel Control

Unit II

ADVANCED VEHICLE CONTROL SYSTEMS: Environmental legislation for pollution – Overview of vehicle electronics systems – Power train system – Chassis subsystem – Comfort and Safety subsystems

Unit III

EMBEDDED SYSTEM COMMUNICATION PROTOCOLS: Introduction to control networking – Communication protocols in embedded systems – SPI, I^2C, USB – Vehicle Communication Protocols – Introduction to CAN, LIN, FLEXRAY, MOST, KWP2000 – Details of CAN

Unit IV

EMBEDDED SYSTEM IN CONTROL OF AUTOMOTIVE SYSTEMS: Engine management systems – Gasoline/Diesel Systems – Various Sensors used in System – Vehicle Safety System – Electronic Control of braking and traction – Introduction to control elements and control methodology – Electronic transmission control

Unit V

EMBEDDED SYSTEM IN AUTOMOTIVE APPLICATIONS: Body Electronics – Infotainment systems – Navigation Systems –System level tests – Software Calibration using engine and vehicle dynamometers – Environmental tests for electronic control units

Text Books

1. RobertBoschGmbh ,"BOSCH– Automotive Handbook", 7th Edition,John Wiley & Sons, ISBN: 0470519363, 2008.
2. Denton.T, "Automobile Electrical and Electronic System", Elsevier Butterworth–HeinemannPublications,3rd Edition,2004.

Reference Books

1. Knowles.D, "Automotive Electronic and Computer control Ignition Systems", Prentice Hall,1988.
2. William.T.M, "Automotive Electronic System",Elsevier Science,6th Edition,2003.

12EI244 POWER ELECTRONICS

Credits:4:0:0

Course Objective:

- To introduce the basic concepts of power semiconductor devices and their applications.

Course Outcome:

At the end of the course the student will

- Design power semiconductor circuits for switching applications.
- Apply the knowledge of thyristors in practical applications.

Unit I

POWER SEMICONDUCTOR SWITCHES: SCRs – Series and parallel connections – Driver circuits – Turnon characteristics – Turn off characteristics

Unit II

AC TO DC CONVERTERS: Natural commutation – Single phase and three phase bridge rectifiers – Semi controlled and fully controlled rectifiers – Dual converters – Inverter operation

Unit III

DC TO DC CONVERTERS: Voltage – Current – Load commutation – Thyristor choppers – Design of commutation elements– MOSFET/IGBT choppers – AC choppers

Unit IV

DC TO AC CONVERTERS: Thyristor inverters – McMurrayBedford inverter – Current source inverter – Voltage control – Inverters using devices other than thyristors – Vector control of Induction motors

Unit V

AC TO AC CONVERTERS: Single phase and three phase AC voltage controllers – Integral cycle control – Single phase Cyclo– converters – Effect of harmonics and Electro Magnetic Interference (EMI)– Applications in power electronics: UPS, SMPS and Drives

Text Books

1. Rashid M. H, "Power Electronics – Circuits, Devices and Applications", 2nd Edition, Prentice Hall, New Delhi, 2003.

Reference Books

1. VedamSubramanyam K, "Power Electronics", 2nd Edition, New Age International Publishers, New Delhi, 2003.
2. Mohan, Undeland and Robbins, "Power Electronics", John Wiley and Sons, New York, 2003.
3. Joseph Vithayathil, "Power Electronics", McGraw Hill, New York, 1995.

12EI245 ANALYTICAL INSTRUMENTATION

Credits: 3:0:0

Course Objective:

- To equip the students with an adequate knowledge of a number of analytical tools which are useful for clinical analysis, pharmaceutical laboratories, environmental pollution monitoring and control.

Course Outcome:

At the end of the course, the student will

- Develop instruments for clinical analysis.
- Apply the concepts of Analytical Instruments for Environmental Monitoring

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

CHROMATOGRAPHY: 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 DISSOLVED COMPONENT ANALYZERS: Principle of pH measurement – Glass electrodes – Hydrogen electrodes – Reference electrodes – Selective ion electrodes – Ammonia electrodes – Biosensor – Dissolved oxygen analyzer – Sodium analyzer – Silicon analyzer

Unit V

RADIO CHEMICAL AND MAGNETIC RESONANCE TECHNIQUES: Nuclear radiations – Detectors – GM counter – Proportional counter – Solid state detectors – Gamma cameras – X–ray spectroscopy – Detectors – Diffractometers– Absorption meters – Detectors – NMR – Basic principles – NMR spectrometer – Applications – Mass spectrometers – Different types – Applications

Text Books

1. Khandpur. R. S., 'Handbook of Analytical Instruments', Tata McGraw Hill Publishing Co. Ltd., 2006.
2. Willard. H., Merritt, Dean. J. A., Settle. F. A., 'Instrumental Methods of Analysis', CBS publishing & distribution, 1995.

Reference Books

1. Robert D. Braun, 'Introduction to Instrumental Analysis', McGraw Hill, Singapore, 1987.
2. Ewing. G. W., 'Instrumental Methods of Chemical Analysis', McGraw Hill, 1992.
3. Skoog. D. A. and West. D. M., 'Principles of Instrumental Analysis', Holt, Saunders Publishing, 1992.

12EI246 MEDICAL INSTRUMENTATION

Credits: 3:0:0

Course Objective:

- With widespread use and requirements of medical instruments, this course gives knowledge of the principle of operation and design of biomedical instruments.
- It attempts to render a broad and modern account of biomedical instruments.
- It gives the introductory idea about human physiology system which is very important with respect to design consideration

Course Outcome:

At the end of the course, the student will

- Apply the concepts of Medical Instrumentation to physiological measurements

Unit I

PHYSIOLOGY OF HUMAN BODY : Cell and its Electrical ctivity– Principle – Physiological system: Cardiovascular– Nervous system– Respiratory system– Vision– Muscular system

Unit II

ELECTRODES AND BIOELECTRIC SIGNALS: Bioelectrodes– Types of electrodes – Electrodes for ECG, EMG, EEG and EOG – Bioelectric signals: ECG , EMG , EOG and their characteristics and recording

Unit III

MEASUREMENT OF PHYSIOLOGICAL PARAMETERS: Physiological Transducers– Classification of Transducer – Displacement – Position and Motion – Pressure – Photoelectric Transducer –Oximeters – Electromagnetic and Ultrasonic Blood Flowmeter – Blood pressure – Cardiac output

Unit IV

BIO–CHEMICAL MEASUREMENT: Blood pH – Blood pO2 – Blood pCO2 – Electrophoresis – Colorimeter – Spectro photometer – Clinical flame photometer – Automated Biochemical analyzer– Medical Diagnosis with chemical tests

Unit V

THERAPEUTIC EQUIPMENTS AND IMAGING TECHNIQUE: Defibrillators – Pacemaker – Heart– lung machine – Dialyser – Anesthesia machine – Ventilators – Nerve stimulators – X– ray – C.T. scan – MRI instrumentation

Text Books

1. Khandpur. R. S, “Handbook of Biomedical Instrumentation”, Prentice Hall of India, New Delhi, 2003.
2. Cromwell, “Biomedical Instrumentation and Measurements”, Prentice Hall of India, New Delhi, 2007.

Reference Books

1. Joseph J. Carr and John M. Brown, “Introduction to Biomedical Equipment Technology”, Pearson Education India, Delhi, 2004.
2. Myer Kutz, “Standard Handbook of Biomedical Engineering & Design,” McGraw– Hill Publisher, New York, 2003.
3. Webster, “Medical Instrumentation – Application & Design,” John Wiley and sons Inc, Netherlands, 2009.

12EI247 FIBER OPTICS AND LASER INSTRUMENTATION

Credits: 3:0:0

Course Objective:

- To introduce the basic concepts of Optical Fibers and Lasers and their applications in the field of Instrumentation.

Course Outcome:

At the end of the course, the student will

- Use Optical fibers for measurement
- Apply LASER in Instrumentation and Biomedical applications.

Unit I

OPTICAL FIBERS AND THEIR PROPERTIES: Principles of light propagation through a fiber – Different types of fibers and their properties – Optical sources: LED, Laser Diode – Optical detectors :PiN photodiode and Avalanche Photodetectors(APD)

Unit II

INDUSTRIAL APPLICATION OF OPTICAL FIBERS: Fiber optic sensors – Fiber optic Instrumentation system – Application in Instrumentation: Measurement of Pressure, Temperature, Liquid Level and strain – Fiber optic gyroscope

Unit III

LASER FUNDAMENTALS: Fundamental characteristics of Lasers – Three level and four level lasers –Properties of laser– Laser modes – Resonator configuration – Q switching and mode locking – Cavity dumping – Types of lasers: Gas lasers, Solid lasers, Liquid lasers, Semi conductor lasers

Unit IV

INDUSTRIAL APPLICATION OF LASERS: Laser for measurement of distance, Length, Velocity, Acceleration, and atmospheric effect – Material processing: Laser heating, Welding, Melting and Trimming of materials – Removal and vaporization

Unit V

HOLOGRAM AND MEDICAL APPLICATION: Holography – Basic principle – Methods– Holographic Interferometry and applications – Holography for non– destructive testing –Medical applications of lasers :Laser interaction with biomolecules – Photothermal applications – Photochemical applications – Endoscopes

Text Books

1. Arumugam.M. "Fiber Optics and Laser Instrumentation", Anuradha Agencies Publishers, Kumbakonam, 2006.
2. Optical Fiber Communications: Principles And Practice, John M. Senior, Pearson Education, 2006

Reference Books

1. G. Keiser, 'Optical Fibre Communication', McGraw Hill, 1995.
2. Ghatak A.K. and Thiagarajan K, Optical Electronics Foundation book , TMH, Cambridge University Press, 1989 .

12EI248 ULTRASONIC INSTRUMENTATION

Credit 3:0:0

Course Objective:

- To learn the basics of Ultrasonics, its production and applications

Course Outcome:

At the end of the course, the student will

- Apply principle of Ultrasonics to Instrumentation

Unit I

ULTRASONIC WAVES: Principles and propagation of various waves– Characterization of UltrasonicTransmission. Generation of ultrasonic waves: Magnetostrictive and Piezoelectric Effects– Search unit types– Phase array– Construction and Characteristics

Unit II

ULTRASONIC MEASUREMENT TECHNIQUE: Detection of Ultrasonic Waves: Mechanical method– Optical Method– Electrical Method– Precise Measurement: Pulse– Echo Overlap– Cross correlation– Computer Based Automated methods: Pulse– Echo Overlap– Cross correlation– Testing Methods: Pulse Echo– Transit time– Resonance– Direct contact and Immersiontype – Ultrasonic methods of Flaw detection

Unit III
ULTRASONIC SENSOR: Flow meters– Density measurement– Viscosity measurement– Level measurement– Sensor for Temperature and Pressure measurements– Thickness measurement

Unit IV
ULTRASONIC APPLICATION: Non– destructive Testing: Inspection of Weldsand defect detection in welds of anisotropic materials– Forgings Castings – Rail Inspection– Concrete Testing– Evaluation of Mechanical Properties: Tensile and yield Strength– Hardness– Fracture toughness– SONAR

Unit V
ULTRASONIC MEDICAL APPLICATION: MedicalImaging– Diagnosis and therapy– Acoustical holography

Text Books

1. Science and Technology of Ultrasonics– Baldev Raj, V.Rajendran, P.Palanichamy, Narosa Publishing House, New Delhi, 2004.
2. Hill C.R.,J.C. Bamber, G.R. terHarr, “Physical Principles of Medical Ultrasonics,” John Wiley & sons, England, 2004.

Reference Books

1. Lawrence E.Kinsler, Austin R.Frey, Alan B.Coppens, James V. Sanders, “Fundamentals of Acoustics,” John Wiley and Sons Inc,USA,2000.

12EI249 AIRCRAFT INSTRUMENTATION

Credits: 3:0:0

Course Objective:

- To introduce the basics of Aircraft and the Instrumentation involved in Aircraft Systems.

Course Outcome:
At the end of the course, the student will

- Use Aircraft and the Display Equipments.
- Apply the sensors to be used in the Flight.
- Analyze Gyroscopic Instruments and Power Plant Instruments.

Unit I
INTRODUCTION: Classification of Aircraft – Instrumentation– Instrument displays – Panels and Layouts

Unit II

FLIGHT INSTRUMENTATION: Static and Pitot Pressure Source – Altimeter – Airspeed indicator – Machmeter – Maximum Safespeed indicator– Accelerometer

UnitIII
GYROSCOPIC INSTRUMENTS: Gyroscopic theory – Directional gyro indicator artificial horizon – Turn and slip indicator

Unit IV
AIRCRAFT COMPUTER SYSTEMS: Terrestrial magnetism, Aircraft magnetism, Direct reading magnetic components– Compasserrors gyro magnetic compass

Unit V
POWER PLANT INSTRUMENTS: Fuel flow – Fuel quantity measurement, Exhaust gas Temperature Measurement and Pressure Measurement

Text Books
1. Pallett, E.B.J ., : " Aircraft Instruments – Principles and applications", Pitman and sons, 1981.

12EI250 AUTOMOTIVE INSTRUMENTATION

Credits: 3:0:0

Course Objective:
To introduce the various meters and Instrumentation used in Automobiles.

Course Outcome:
- To learn the design and construction of panel meters.
- To understand the design and working of Indicating Instruments, Warning Instruments.
- To learn the various Dashboard Amenities, Switching and Control Devices.

Unit I
AUTOMOBILE PANEL METERS AND SENSOR DESIGN: Ergonomics– Panel Meters– Controllers– Sensor for Fuel Level in Tank – Engine Cooling Water Temperature Sensors Design – Engine Oil Pressure Sensor Design – Speed Sensor – Vehicle Speed Sensor Design – Air Pressure Sensors – Engine Oil Temperature Sensor

Unit II
INDICATING INSTRUMENTATION DESIGN: Moving Coil Instrument Design – Moving Iron Instruments– Balancing Coil Indicator Design – Ammeter and voltmeter– Odometer and Taximeter Design – Design of Alphanumeric Display for Board Instruments

Unit III
WARNING AND ALARM INSTRUMENTS: Brake Actuation Warning System. Trafficators– Flash System – Oil Pressure Warning System – Engine Overheat Warning System – Air

Pressure Warning System – Speed Warning System – Door Lock Indicators – Gear Neutral Indicator – Horn Design – Permanent Magnet Horn – AirHorn – Music Horns

Unit IV
DASH BOARD AMENITIES: Car Radio Stereo – Courtesy Lamp – Timepiece – Cigar Lamp – Car Fan – Windshield Wiper – Window Washer – Instrument Wiring System and Electromagnetic Interference Suppression – Wiring Circuits for Instruments – Dash Board Illumination

Unit V
SWITCHES AND CONTROLS: Horn Switches – Dipper Switches – Pull and Push Switches – Flush Switches– Toggle Switches – Limit Switches– Ignition Key – Ignition Lock – Relay and Solenoid – Non– contact Switches

Text Books

1. Walter E, Billiet and Leslie .F, Goings, 'Automotive Electric Systems', AmericanTechnical Society, Chicago, 1971.
2. Judge.A.W, 'Modern Electric Equipments for Automobiles', Chapman and Hall,London, 1975.

Reference Books

1. Sonde.B.S., 'Transducers and Display System', Tata McGraw Hill Publishing Co.Ltd., New Delhi, 1977.
2. W.F. Walter, 'Electronic Measurements', Macmillan Press Ltd., London.
3. Dushin E, 'Basic Metrology and Electrical Measurements', MIR Publishers, Moscow 1989

12EI251 ROBOTICS AND AUTOMATION

Credits: 3:0:0

Course Objective:

- To introduce the Basic concepts of robots, the instrumentation involved, Robot Dynamics and Kinematics and Applications.

Course Outcome:

- To introduce the basic concept of Robots.
- To learn the principle of operation of sensors used in Robotics.
- To understand the working of End Effectors.
- To study the Robot motion Analysis.
- To discuss the applications of robots.

Unit I
INTRODUCTION: Robots introduction – Basic components– Classification—Characteristics– Drives and Control systems – Actuators

Unit II

TRANSDUCERS AND SENSORS: Transducers and Sensors– Tactile sensors– Proximity & Range sensors– Image Processing and Analysis– Image Data reduction– Feature extraction– Object Recognition

Unit III
END EFFECTORS: End effectors – Types– Mechanical Grippers– Vacuum Cups– Magnetic Grippers– Robot/Endeffector Interface

Unit IV
ROBOT MOTION ANALYSIS: Robot motion analysis–Kinematics– Homogenous Transformations– Robot DynamicsConfiguration of Robot controller

Unit V
APPLICATIONS: Industrial Robots –welding painting– Assembly– Remote Controlled Robots for Nuclear,Thermal, Chemical plants– Industrial Automation

Text Books

1. YoramKoren, "Robotics for Engineers", McGraw Hill, 1980. ISBN– 0– 07– 100534– X.
2. Mikell P. Grooveretal, "Industrial Robots – Technology Programming &Applications" McGraw Hill Ltd., 1986. ISBN– 0– 07– 100442– 4.

12EI252 INSTRUMENTATION AND PROCESS CONTROL FOR FOOD ENGINEERS

Credits 4:0:0

Course Objective:

- To provide sound knowledge in the basic concepts of control theory and Instrumentation.

Course Outcome:

- Analyze the transient and frequency response of systems.
- Test the stability of a given system.
- Apply controller principles to typical applications.

Unit I
INTRODUCTION TO PROCESS CONTROL: System – Steady state design – Process control – Process control block diagram –Definition of a process, Measurement, Controller and control element, Loop – Damped andcyclic response– Feedback control – Transient responses – Laplace transform – Transforms of simple functions – Step function, Exponential function, Ramp function and sine function

Unit II
CONTROL SYSTEMS: Open and closed loop systems – Servo– mechanisms – Hydraulic and pneumatic controlsystems – Two– way control – Proportional control – Differential control and integral control - Control valve – Construction and working of pneumatically operated valve and spring –Diaphragm actuator

Unit III

STABILITY ANALYSIS: Signal flow graph – Mason's Gain formula – Block diagram reduction. Stability – Concept of stability – Definition of stability in a linear system – Stability criterion – Characteristic equation – Routh test for stability

Unit IV

PRESSURE AND TEMPERATURE SENSORS: Pressure measurement – Construction and working of capacitive pressure sensor – Inductive pressure sensor– Strain gauge – Pressure sensor – Diaphragm – Bourdon tube – Differential pressure cell – Temperature sensors – Construction and working of RTD – Thermistors – Thermocouples– Bimetallic strips

Unit V

LEVEL SENSOR: Simple float systems – Capacitive sensing element– Radioactive methods(nucleonic level sensing) – Ultrasonic level sensor - Measurement of density – Utype densitometer – Buoyancy meter - Measurement of composition – Electrical conductivity cell – non– dispersive photometers – pH meter – Gas chromatograph– Massspectrometer

Text Books

1. Richardson. J. F., Peacock. A. D. G., Coulson &Richardson's " Chemical Engineering", Volume 3,(Chemical and Biochemical reactors and process control) Butherworth – Heinemann, an imprint of Elsevier ,2006.
2. Nagrath.I.J. and Gopal. M., "Control Systems Engineering", Wiley EasternLimited, third edition reprint 2003.

References Books

1. Donald R. Coughanowr., "Process System analysis and control" Mc– Graw Hill International Edition , Second Edition,.
2. Nagoorkani.A "Control Systems", RBA publications, first edition ninth reprint 2002
3. Baskar S,"Instrumentation control system measurements and controls"anuradha agencies publishers,2004.
4. CurtisJohnson,Process Control Instrumentation Technology 2003.

12EI253 INSTRUMENTATION AND CONTROL LABORATORY FOR FOOD ENGINEERS

Credits: 0: 0:2

Course Objective:

- This lab imparts the practical methods for the measurement of temperature, pressure, torque speed, sound, displacement, weight.

Course Outcome:

At the end of the course, the student will:

- Analyse the characteristics of sensors and transducers.
- Apply the transducers for various applications

List of Experiments:

1. Study of characteristics of Strain Gauge
2. Study of characteristics of Load cell
3. Study of characteristics of LVDT

4. Study of characteristics of RTD
5. Study of characteristics of Thermocouple
6. Study of characteristics of Resistive potentiometer
7. Study of characteristics of Loudspeaker
8. Study of characteristics of Microphone
9. Study of characteristics of Pressure transducer
10. Study of Tachogenerator characteristics
11. Study of characteristics of Humidity sensor
12. Study of characteristics of Viscometer

12EI254 INSTRUMENTATION AND CONTROL SYSTEMS

Credit 3:0:0

Course Objective:

- To provide sound knowledge in the basic concepts of control theory and Instrumentation.

Course Outcome:

At the end of the course, the student will

- Analyze the transient and frequency response of systems.
- Test the stability of a given system.
- Apply controller principles to typical applications.

Unit 1

GENERALIZED MEASUREMENT SYSTEM: General concepts of Mechanical Instrumentation generalized measurement system - Classification of instruments as indicators, Recorders and integrators their working principles - Precision and accuracy: Measurement error and calibration

Unit II

PRESSURE AND TEMPERATURE MEASUREMENT: Pressure measurement: Gravitational, Bourdon, Elastic transducers, Strain gauge, Pressure cells, Measurement of high and low pressure – Temperature measurement: Bimetallic, Resistance thermometer, Thermocouples, Pyrometer, Thermistors – Measurement of displacement, Speed, Acceleration – vibrometer , Accelerometer

Unit III

STRAIN AND FLOW MEASUREMENT: Strain gauges types, Gauge rosettes.Force measurement: Scales and torque measurement: Mechanical torsion meter, Electrical torsion meter, Piezo Electric Transducer - Hot– Wire anemometer - Magnetic flowmeter- Ultrasonic flow meter

Unit IV

CONTROL SYSTEMS: Open and closed systems - Servo– mechanisms- Transferfunctions, Signal flow graphs - Block diagram algebra - hydraulic and pneumatic control systems - Two – way control - Proportional control - Differential and Integral control

Unit V

STABILITYANALYSIS: Time response of First Order and Second Order Systems, Concept of Stability, Necessary condition for Stability, Routh stability criterion, Polar and Bode plots, Nyquist plots

Text Books

1. Jain R.K., "Mechanical and Industrial Measurements" Khanna Publishers, 2002.
2. Nagoorkani.A "Control Systems", RBA publications, first edition ninth reprint 2002.

Reference Books

1. Sawhny, A.K. "Electrical and Electronics Measurements & Instrumentation", DhanpatRai& Co., 2000.
2. Collet. C. V. and Hope. A.D. 'Engineering Measurements' 2nd Edition ELBS.
3. Nagrath. M. and Gopal.I.J.Control systems Engineering, Wiley eastern Ltd.,.2001.
4. Baskar S,'Instrumentation control system measurements and controls 'anuradha agencies publishers,2004.

12EI255 INSTRUMENTATION AND CONTROL SYSTEMS LABORATORY

Credits: 0: 0: 1

Course Objective:

- This lab imparts the practical methods for the measurement of temperature, pressure, torque speed, sound, displacement, weight.

Course Outcome:

At the end of the course, the student will

- Analyse the characteristics of sensors and transducers.

List of Experiments:

1. Study of characteristics of strain gauge and Load Cell
2. Study of characteristics of LVDT
3. Study of characteristics of RTD
4. Study of characteristics of Thermocouple
5. Study of characteristics of Resistive potentiometer
6. Study of characteristics of Loudspeaker
7. Study of characteristics of Microphone
8. Study of characteristics of Pressure transducer
9. Study of Tacho – generator characteristics
10. Study of ON– OFF Temperature Controller

12EI301 ADVANCED DIGITAL SIGNAL PROCESSING

Credits: 3:1:0

Course Objective:

- This course covers the techniques of modern signal processing that are fundamental to a wide variety of application areas.

Course Outcome:

At the end of the course, Students will have

- A good knowledge about the advanced areas in DSP.
- The ability to solve various types of practical problems in DSP.

Unit I

INTRODUCTION: Signals and their origin – Characterization and Classification of continuous time signals and Discrete time signals, Classification and properties of systems, Time domain characterization of DT system – Convolution – Difference equation

Unit II

DT SIGNALS IN TRANSFORM DOMAIN: Discrete Fourier Transforms (DFT) and its properties, Power and energy spectral density – Radix 2FFT, Computational advantages of FFT over DFT – Decimation in time FFT algorithm – Decimation – In Frequency FFT algorithm, Z – Transform and its properties – Inverse Z – transform

Unit III

DESIGN OF IIR FILTERS: Block diagram Representation of digital filter – Basic IIR digital filter structures – Structure Realization – Preliminary consideration in digital filter design – Bilinear transformation

Unit IV

DESIGN OF FIR FILTERS: Basic FIR Filter Structure, Structure realization of FIR filter, FIR Filter design based on windowed Fourier series, Frequency sampling method, Equiripple linear phase FIR filter design, Window based FIR filter design , Least square error FIR filter design

Unit V

MULTI – RATE DIGITAL SIGNAL PROCESSING: Mathematical description of change of sampling rate – Interpolation and Decimation – Direct digital domain approach – Decimation by an integer factor – Interpolation by an integer factor – Sampling rate conversion by a rational factor, Filter implementation for sampling rate conversion, Direct form FIR structures, Polyphase filter structures, multistage implementation of multirate system – Application – Phase shifters – Audio sub band coding

Text Books

1. John .G.Proakis, "Digital Signal Processing Principles, Algorithms and Applications", Addision Wesley, USA, 2006.
2. Sanjit .K. Mitra "Digital Signal Processing A Computer based approach", Tata McGraw, New Delhi, 2001.

References Book

1. Emmanuel C.Ifeachor “Digital Signal Processing A Practical Approach”, Addison–Wesley, California, 2002.

12EI302 INDUSTRIAL INSTRUMENTATION

Credits: 4: 0: 0

Course Objective:

- To provide the basic concepts of various industrial process measurements and measuring instruments.
- To give an exposure about smart instruments.

Course Outcome:

At the end of the course, Students will have the

- Exposure of various industrial process measurements and measuring instruments.
- Knowledge about smart instruments.

Unit I

PRESSURE MEASUREMENT: Pressure standards – Dead weight tester – Different types of manometers– Elastic elements – Electrical methods using strain gauge – High pressure measurement – Vacuum gauges – Mcleod gauge – Thermal conductivity gauges – Ionization gauge – Differential pressure transmitters – Installation and maintenance of pressure gauges

Unit II

FLOW MEASUREMENT: Positive displacement flow meters – Inferential flow meter – Turbine flow meter –Variable head flow meters – Rotameter – Electromagnetic flow meter – Ultrasonic flow meter – Coriolis mass flow meter – Calibration of flow meters – Installation and maintenance

Unit III

TEMPERATURE MEASUREMENT: Temperature standards – Fixed points – Filled system thermometers – Bimetallic thermometer – Thermocouple – Laws of thermocouple – Cold junction compensation – Measuring circuits – Speed of response – linearization – Resistance thermometer – 3 lead and 4 lead connections – Thermistors – IC temperature sensors – Radiation pyrometer – Optical Pyrometer – Installation, Maintenance and calibration of thermometers and thermocouples

Unit IV

LEVEL MEASUREMENT: Visual techniques – Float operated devices – Displacer devices – Pressure gauge method – Diaphragm box – Air purge system – Differential pressure method – Hydro – Step for boiler drum level measurement – Electrical methods – Conductive sensors – Capacitive sensors – Ultrasonic method – Point level sensors – Solid level measurement

Unit V

SMART INSTRUMENTATION AND RELIABILITY ENGINEERING: Smart intelligent transducer – Comparison with conventional transducers – Self diagnosis and remote calibration features – Smart transmitter with HART communicator – Reliability Engineering – Definition of reliability – Reliability and the failure rate – Relation between reliability and MTBF – MTTR – Maintainability – Availability – Series and parallel systems

Text Books

1. Doeblin E.O.I, Measurement Systems: Application and Design, Fifth Edition, McGraw – Hill Publishing Co.; 5th edition (September 1, 2003).
2. Patranabis, D., 'Principles of Industrial Instrumentation', Second Edition Tata McGraw Hill Publishing Co. Ltd.. New Delhi. 1997, ISBN 0074623346.

Reference Books

1. Liptak B. 'Process Measurement and Analysis', 3rd Edition Chilton book company Radnor, Pennsylvania, 1995 ISBN 0 – 7506 – 2255.
2. Tatamangalam R., 'Industrial Instrumentation Principles and Design', Springer Verlag, 2000 ISBN 1852332085.
3. Noltingk, B.E., "Instrumentation Reference Book", II Edition Butterworth Heinemann, 1996.
4. JainR. K, 'Mechanical and Industrial Measurements', Khanna Publishers, New Delhi, 1999.
5. SinghS.K, 'Industrial Instrumentation and Control', Tata McGraw Hill,Reprint 2004.

12EI303 INSTRUMENTATION

Credits: 4:0:0

Course Objective:

- To introduce the fundamental concepts of Instrumentation System
- To understand the importance of Instrumentation

Course Outcome:

- Select suitable transducer for a specific instrumentation system
- Analyze the characteristics of transducers
- Computer based instrumentation for real time applications

Unit I

INSTRUMENTATION SYSTEM: Introduction – Philosophy of Measurement – The general instrumentation system – Static and Dynamic Characteristics – The overall transfer function – Dynamic response of the sensor – The measurement system as a series of networks

Unit II

RESISTANCE AND INDUCTANCE TRANSDUCER: Basic principle – Potentiometer – resistance strain gauge– Measurement of torque– Stress measurement on rotating members – semi conductor strain gauges – Contact pressure humidity measurement – Basic principle– Linear variable differential transformer – LVDT equations – RVDT – application of LVDT – LVDT pressure transducer – Synchros – Synchros as position transducer – Induction potentiometer – Variable reluctance accelerometer – Microsyn

Unit III

CAPACITANCE AND PIEZOELECTRIC TRANSDUCERS: Basic principle – Capacitance displacement transducer – Differential pressure transducer feedback type capacitance proximity pickup – Condenser microphone – Pulse width modulating circuit – Introduction – Material for piezoelectric transducer – Equivalent circuit of a piezoelectric crystal – Piezoelectric coefficients – Mode of deformation – General form of piezoelectric transducers – Environmental effects

Unit IV

DIGITAL METHODS OF MEASUREMENTS: Digital voltmeters and multimeters – Digital frequency, period and time measurements – Digital tachometers – Digital phase meters – Automation in digital instruments – Digital data recording – Digital Transducers

Unit V

COMPUTER BASED INSTRUMENTATION: Evolution of Virtual Instrumentation – Architecture of Virtual Instrumentation – Virtual Instruments Versus Traditional Instruments – Advantages of VI – PC based Data acquisition system – Interfacing techniques to the IBM PC – Plug– In data acquisition boards – Interface Buses: PCI, PXI, VXI

Text Books

1. Jackson R G, "Novel Sensors and Sensing", Institute of Physics Publishing, Bristol and Philadelphia, 2004.
2. Doeblin E.O, "Measurement Systems– Applications and Design", McGraw Hill,New York, 2003.
3. Kalsi H S, "Electronics Instrumentation,"Second Edition, Tata Mcgrawhill, New Delhi, 2009
4. John Park ,Steve Mackay," Practical Data Acquisition for Instrumentation and Control Systems" Elsevier 2003.

Reference Books

1. Mathivanan "PC– based instrumentation: concepts and practice" PHI, 2008
2. Dr.S.Renganathan, "Transducer Engineering", Allied publishers, New Delhi,2003.
3. D.Patranabis, "Principles of Electronic Instrumentation," PHI, 2008
4. S. Sumathi and P. Surekha , "LabVIEW based Advanced Instrumentation Systems" Springer, 2007.
5. H K P Neubert, "Instrument Transducers", Oxford University Press, Cambridge,2000.

12EI304 ADVANCED PROCESS CONTROL

Credits: 3:1:0

Course Objective:

- To equip the students with the basic knowledge of Process Modeling.
- To understand various controllers and control algorithms.
- To introduce the concept of Multivariable systems and decoupling.
- To analyze complex control schemes.

Course Outcome:

At the end of the course, Students will be able to

- Develop mathematical model of a physical process.

- Design various controllers.
- Understand the knowledge of MIMO process and decoupling.
- Demonstrate various control algorithms in the real time complex process.

Unit I

INTRODUCTION TO PROCESS CONTROL: Process Control System: Terms and objectives, Piping and Instrumentation diagram, Instrument terms and symbols – Regulator and servo control – Classification of variables – Process characteristics: Process equation, Degrees of freedom, Modeling of simple systems – Thermal, Gas, Liquid systems, Process lag, Load disturbance and their effect on processes – Self – Regulating processes – Interacting and non – Interacting processes

Unit II

CONTROL ACTION AND FINAL CONTROL ELEMENT: Controller modes: Basic control action, Two position, Multi – Position, Floating control modes – Continuous controller modes: Proportional, Integral, Derivative – Composite controller modes: PI, PD, PID, Integral wind – Up and prevention. Auto/Manual transfer, Response of Controllers for different types of test inputs – Selection of control mode for different process with control scheme – Control Valve sizing – Control valve types: Linear, Equal percentage and quick opening valve

Unit III

CONTROLLER TUNING AND ADVANCED CONTROL STRATEGIES :Optimum controller settings – Tuning of controllers by process reaction curve method – Damped oscillation method – Ziegler Nichol's tuning – Pole placement method – Feed forward control – Ratio control – Cascade control – Split range control – Averaging control – Inferential control

Unit IV

DESIGN OF CONTROLLERS FOR MULTIVARIABLE SYSTEMS: Introduction to multivariable system – Evolution of loop interaction – Evolution of relative gains – Single loop and overall stability – Model equations for a binary distillation column – Transfer function matrix – Method of inequalities – Decoupling control – Centralized controller

Unit V

COMPLEX CONTROL TECHNIQUES: Internal model control – Adaptive control – Model predictive control: Dynamic matrix control – model – Generalized predictive control

Text Books

1. Stephanopoulos G., "Chemical Process Control, Prentice Hall, New Delhi, 2003.
2. Coughanowr D.R., "Process Systems Analysis and Control", McGraw – Hill Higher Education, Singapore,2008.

Reference Books

1. Wayne BequetteB,' Process control: modeling, design, and simulation' Prentice Hall , New Jersey – 2003.
2. Smith C.L and Corripio.A..B, "Principles and Practice of Automatic Process Control", John Wiley and Sons, New York, 2006.
3. Dale E. Seborg, Thomas F. Edgar, Duncan A. Mellichamp, "Process Dynamics and Control" ,Willey India, 2006.
4. Marlin. T.E., Process Control, Second Edition McGraw Hill NewYork, 2000.

12EI305 DISCRETE CONTROL SYSTEM

Credits: 3:1:0

Course Objective:

- To inculcate the concepts of discrete time Control systems.
- To introduce polynomial equations approach to control system design.
- To inculcate the different types of digital control algorithm.

Course Outcome:

At the end of the course, Students

- Will have the knowledge of discrete time Control systems.
- Will be able to design control system using polynomial equations approach.
- Will have an exposure in different types of digital control algorithm.

Unit I

INTRODUCTION: Review of Z Transform – Impulse Sampling and data Hold – Reconstructing original signal from sampled signal – Pulse Transfer function – Mapping between the S plane and Z plane – Stability Analysis in Z domain – Transient and steady state response analysis – modified Z transform

Unit II

STATE SPACE ANALYSIS: State Space representation of discrete time Signals – Solving discrete time State Space Equations – Pulse Transfer Function Matrix – Discretization of continuous time State Space Equations

Unit III

POLE PLACEMENT AND OBSERVER DESIGN: Controllability – Observability – Useful Transformations in State Space Analysis and Design – Design Via Pole placement – State observer – Servo Systems

Unit IV

POLYNOMIAL EQUATIONS APPROACH TO CONTROL SYSTEM DESIGN: Diophantine Equations – Polynomial Equations Approach to Regulator system– Polynomial Equations Approach to Control system Design – Design of Model Matching Control Systems

Unit V

DIGITAL CONTROL ALGORITHM: Implementation of different digital control algorithms: Digital PID, Deadbeat, Dahlin, Smith predictor and Internal Model Control algorithm with examples

Text Books

1. Ogata, "Discrete – Time Control Systems", Pearson Education, Sigapore,2002.
2. Ky M. Vu, Optimal Discrete Control Theory The Rational Function Structure Model, Library and archives Canada cataloguing in publication, Canada,2007.

Reference Books

1. Gene F. Franklin,J. David Powell, “Digital control of dynamic systems”, Pearson Education Limited – 2002.
2. Gopal M, Digital Control and State variable Methods, Second Edition, Tata McGrawHill, New Delhi, 2003.

12EI306 VIRTUAL INSTRUMENTATION LABORATORY

Credits: 0:0:2

Course Objective:

- To strengthen the knowledge of Virtual Instrumentation Using LabVIEW.
- To introduce the concept Data Acquisition Using LabVIEW.

Course Outcome:

At the end of the course, Students will have

- Knowledge of LabVIEW.
- The knowledge on DAQ Cards.
- Ability to analyze real world signals using LabVIEW.

List Of Experiments:

1. Introduction to LabVIEW I
2. Introduction to LabVIEW II
3. Waveform Generation
4. Frequency Measurement
5. Analog Input/Output Interface
6. Network Interface
7. Thermocouple Interface.
8. Stepper Motor Control
9. Analysis of Filter Using NI-ELVIS
10. Embedded Implementation Of Digital Filter Using SPEEDY33
11. Tank Level Control
12. Speed Control of DC Motor

12EI307 ADVANCED CONTROL SYSTEMS

Credits: 3:1:0

Course Objective:

- To Understand the basics of mathematical modeling.
- To study the stability analysis of linear and non linear systems.

Course Outcome:

At the end of the course, Students will be able to

- Apply the modeling concepts.

- Do stability analysis of linear and non linear systems.

Unit I

MODELING OF DYNAMIC SYSTEMS: Definition of System– Mathematical modeling – State space representation of system – Centrifugal Governor – Ground vehicle – Permanent Magnet stepper motor – Inverted Pendulum

Unit II

ANALYSIS OF MATHEMATICAL MODELS: State space method– Phase plane – Isoclines – Numerical methods – Taylor Series – Euler's method – Predictor Corrector method – RungeKutta method – Principle of Linearization of Differential Equation

Unit III

STATE SPACE ANALYSIS: Reachability and controllability – Observability and constructability – Companion forms – Controller / Observer form – State feed – back control – State estimator – Full order and reduced order Estimator – Combined controller estimator compensator

Unit IV

STABILITY OF NONLINEAR SYSTEM: Stability of Nonlinear system – Lyapunov stability theorems – Lyapunov function for nonlinear system – Krasovskii's method – Variable gradient method – Phase plane analysis, Singular points, Constructing phase portraits – Limit cycle – Describing function analysis

Unit V

ROBUST PID CONTROL: Introduction to robust control: PID Tuning– Modifications of PID control scheme – Two Degrees of Freedom Control – Design consideration of Robust Control

Text Books

1. Stanislaw Zak, 'Systems and Control', Oxford University Press, 2003.
2. Gopal M, Digital Control and State variable Methods, Tata McGrawHill, New Delhi, 2003.

Reference Books

1. Ogata K, "Modern Control Engineering", Pearson Education, New Jersey 2009.
2. Vidyasagar .M, "Nonlinear system analysis", Prentice Hall Inc., New Jersey 2002.
3. Singiresu S. Rao, "Applied Numerical Methods" Prentice Hall, Upper Saddle River, New Jersey, 2001.
4. Jean – Jacques E. Slotine, Weiping Li, "Applied nonlinear control", Prentice Hall Inc., New Jersey, 2004.

12EI308 SOFT COMPUTING

Credits: 4:0:0

Course Objective:

- To introduce the basic concepts of intelligent controllers and its applications in Control.

Course Outcome:

At the end of the course, Students

- Will have understanding of Basic Neural Network, Fuzzy Logic and Genetic algorithms.
- Will know how to use Soft Computing to solve realworld problems mainly pertaining to Control system applications.

Unit I

INTRODUCTION TO NEURAL NETWORKS: Introduction – Biological neurons and their artificial models – Learning, Adaptation and neural network's learning rules – Types of neural networks – Single layer, multiple layer – Feed forward, feedback networks; back propagation – Learning and training – Hopfield network

Unit II

NEURAL NETWORKS FOR CONTROL APPLICATIONS: Neural network for non – linear systems – Schemes of neuro control – System identification forward model and inverse model – Indirect learning neural network control applications – Case studies

Unit III

INTRODUCTION TO FUZZY LOGIC: Fuzzy sets – Fuzzy operation – Fuzzy arithmetic – Fuzzy relations – Fuzzy relational equations – Fuzzy measure – Fuzzy functions – approximate reasoning – Fuzzy propositions – Fuzzyquantifiers – If then rules

Unit IV

FUZZY LOGIC CONTROL : Structure of fuzzy logic controller – Fuzzification models – data base – Rule base –Inference engine defuzzification module – Non – Linear fuzzy control – PID like FLC – Sliding mode FLC – Sugeno FLC – Adaptive fuzzy control – Fuzzy control applications – Case studies

Unit V

GENETIC ALGORITHM AND ITS APPLICATIONS: Fundamentals of genetic algorithm: Evolutionary computation – Search space –Encoding – Reproduction – Elements of genetic algorithm – Genetic modeling – Comparison of GA and traditional search methods – Genetic Algorithm in scientific models and theoretical foundations – Applications of Genetic based machine learning – Genetic Algorithm and parallel processors – Composite laminates – Constraint optimization – Multilevel optimization – Case studies

Text Books

1. Jacek M Zurada, 'Introduction to Artificial Neural Systems', Jaico Publishing House, 1999.
2. Rajasekaran.S and G.A VijayalakshmiPai, 'Neural Networks, Fuzzy logic and Genetic Algorithms, Synthesis and Applications', Prentice Hall of India, New Delhi – 2003.

Reference Books

1. Klir G.J. &Folger T.A. 'Fuzzy sets, uncertainty and Information', Prentice Hallof India Pvt. Ltd.,1993.
2. Zimmerman H.J. 'Fuzzy set theory –and its Applications' – Kluwer Academic Publishers,1994.
3. Driankov, Hellendroon, 'Introduction to Fuzzy Control', Narosa publishers.

4. FarinWah S.S, Filev, D. Langari, R. 'Fuzzy control synthesis and analysis', John.
5. Melanie Mitchell, 'An introduction to Genetic Algorithm', Prentice – Hall of India,New Delhi, Edition: 2004.
6. Kosko, B. 'Neural Networks and Fuzzy Systems', Prentice – Hall of India Pvt. Ltd.,1994.

12EI309 REAL TIME AND EMBEDDED SYSTEMS

Credits: 4:0:0

Course Objective:

- To introduce the basic concepts of Embedded Systems and the various techniques used for Embedded Systems with real time examples .

Course Outcome:

At the end of the course, Students will be able to

- Understand the basics of embedded systems and the interface issues related to it
- Learn the different techniques on embedded systems.
- Understand the real time models, languages and operating systems.
- Analyze real time examples.

Unit I

SYSTEM DESIGN: Definitions – Classifications and brief overview of micro – Controllers microprocessors and DSPs – Embedded processor architectural definitions – Typical application scenario of embedded systems

Unit II

INTERFACE ISSUES RELATED TO EMBEDDED SYSTEMS:A/D, D/A converters – Interfacing to External Devices – Switches – LED/LCD Displays – Relays – Dc Motor – Stepper Motor

Unit III

TECHNIQUES FOR EMBEDDED SYSTEMS: State Machine and state Tables in embedded design – Event based, Process based and Graph based models – Petrinet Models – Simulation and Emulation of embedded systems – High level language descriptions of S/W for embedded system – Java based embedded system design

Unit IV

REAL TIME MODELS, LANGUAGE AND OPERATING SYSTEMS: Real time languages – Real time kernel, OS tasks, Task states, Task scheduling, Interrupt processing, Clocking communication and synchronization, Control blocks, Memory requirements and control, Kernel services

Unit V

MICRO C/OS – II REAL TIME OPERATING SYSTEM: Study of Micro C/OS – II RTOS – RTOS System Level Functions – Task Service Functions – Time Delay Functions – Memory Allocation Related Functions – Semaphore Related Functions – Mailbox Related Functions – Queue Related Functions

Text Books

1. RajKamal, "Embedded Systems Architecture, Programming and Design", Tata McGrawHill , Second Edition, 2008.
2. Tim Wilhurst, "An Introduction to the Design of Small Scale Embedded Systems, Palgrave, 2004.

Reference Books

1. Tammy Noergaard, "Embedded Systems Architecture", Elsevier, 2005.
2. Frank Vahid, Tony Givargis, "Embedded Systems Design", Wiley India, 2006.

12EI310 OPTIMAL CONTROL THEORY

Credits: 4:0:0

Course Objective:

- To provide an introductory account of the theory of optimal control and its applications .
- The purpose of this course is to give students background in dynamic optimization: the Calculus of Variations, Pontryagin's Minimum Principle, and Bellman's Dynamic Programming.

Course Outcome:

At the end of the course, Students will

- Have the basic knowledge of optimal control and its applications .
- Be equipped with dynamic optimization: the Calculus of Variations, Pontryagin's Minimum Principle, and Bellman's Dynamic Programming.

Unit I

INTRODUCTION: Problem formulation – Mathematical model – Physical constraints – Performance measure – Optimal control problem – Form of optimal control – Performance measures for optimal control problem – Selection of performance measure

Unit II

DYNAMIC PROGRAMMING: Optimal control law – Principle of optimality – An optimal control system – A recurrence relation of dynamic programming – Computational procedure – Characteristics of dynamic programming solution – Hamilton – Jacobi – Bellman equation – Continuous linear regulator problems

Unit III

CALCULUS OF VARIATIONS: Functions and Functional – Maxima and minima of function– Variation of functional – Extremal of functional – Euler Lagrange equation

Unit IV

VARIATIONAL APPROACH TO OPTIMAL CONTROL PROBLEMS: Necessary conditions for optimal control – Linear regulator problems – Linear tracking problems – Pontryagin's minimum principle and state inequality constraints

Unit V
MINIMUM TIME PROBLEMS: Minimum control effort problems – Singular intervals in optimal control problems – Numerical determination of optimal trajectories – Two point boundary value problems – Methods of steepest descent – Variation of extremals – Quasilinearization – Gradient projection algorithm

Text books

1. Donald E. Kirk, Optimal Control Theory: An Introduction, Prentice – Hall networks series, New Jersey, 2004.
2. Singiresu S. Rao "Engineering Optimization: Theory and Practice" New Age International (P) Ltd., Publishers New Delhi – 2004.

Reference Books

1. GopalM, "Digital Control and State Variable Methods", Tata McGraw – Hill Companies New Delhi, 2009.
2. Dimitri P. Bertsekas.'Dynamic Programming and Optimal Control' Vol –1 Athena Scientific, Bell mount MA, 2000.

12EI311 INDUSTRIAL COMMUNICATION SYSTEMS

Credits: 4:0:0
Course Objective:

- To understand the System Interconnection and protocols.
- To introduce the concept of communication protocols and give an overview of Data Communication Standards.
- To discuss the types of cables used for transmission.
- To discuss the operation and applications of the Protocols used in Industries .

Course Outcome:

At the end of the course, Students will be able to

- Identify the protocol.
- Choose the require protocol and the communication modes for the given system.
- Select a suitable cable for the transmission .

Unit I
OVERVIEW & BASIC PRINCIPLES: Open systems interconnection (OSI) model – Protocols – Physical standard – Smart Instrumentation systems – Bits, bytes and characters – Communication principles – Communication modes – Asynchronous systems – Synchronous systems – Error detection – Transmission characteristics – Data coding – The universal asynchronous receiver/transmitter (UART) – The high speed UART (16550).

Unit II
DATA COMMUNICATION STANDARDS: Standards organizations – Serial data communications interface standards – Balanced and unbalanced transmission lines – EIA232 interface standard – Troubleshooting serial data communication circuits – Test equipment –

Ethernet – Ethernet Protocol operation – Ethernet hardware requirements – The RS485 interface standard – Troubleshooting and testing with RS485 – The 20 mA current loop – Serial interface converters – Interface to serial printers – Parallel data communications interface standards – General purpose interface bus (GPIB) or IEEE488 or I EC625 – The universal serial bus (USB**)**

Unit III

CABLING, ELECTRICAL NOISE AND ERROR DETECTION: Origin of errors – Factors affecting signal propagation – Types of error detection, control and correction – Copper – Based cables – Twisted pair cables – Coaxial cables – Fiber – Optic cables – Definition of noise – Frequency analysis of noise – Sources of electrical noise – Electrical coupling of noise –Shielding – Good shielding performance ratios – Cable ducting or raceways – Cable spacing – Earthing and grounding requirements – Suppression technique – Filtering

Unit IV

MODEM AND MULTIPLEXER: Modes of operation – Synchronous or asynchronous – Interchange circuits – Flow control – Distortion – Modulation techniques – Components of a modem – Types of modem – Radio modems – Error detection/correction – Data compression techniques – Modem standards – Troubleshooting a system using modems – Multiplexing concepts – Terminal multiplexers – Statistical multiplexers

Unit V

INDUSTRIAL PROTOCOL: PROFIBUS: Basics, Architecture, Communication model, profileC– Modbus protocol – HART Protocol: Physical layer – Data link layer – Application layer – Foundation fieldbus – Use of fieldbuses in industrial plants

Text books

1. Steve Mackay, John Park and Edwin Wright, "Practical Data Communication for Instrumentation and Control", Newnes Elsevier, USA, 2002.

Reference Books

1. TanenbaumA.S, "Computer Networks", Fourth Edition, Prentice – Hall of India, Hyderabad, 2002.
2. William A Shay, "Understanding Data Communications and networks", Pacific Grove, USA, 2003.

12EI312 INDUSTRIAL INSTRUMENTATION AND PROCESS CONTROL LABORATORY

Credits:0:0:2

Course Objective:

- To demonstrate the various process Measurements.
- To inculcate the various controller design.
- To give an exposure about Programmable Logic Controller.

Course Outcome:

At the end of the course, Students will be able to

- Measure various process measurements using the appropriate instruments.
- Design control algorithms for different control loops.

- Write ladder logic in Programmable Logic Controller for Control purpose.

List of Experiments

1. a.Study of Current to Pressure Converter.
   b. Study of Pressure to Current Converter.
   c. Study of Pneumatic Control Valve.
2. Control of Level Process Station Using LabVIEW.
3. Control of Flow Process Station Using LabVIEW.
4. Control of Pressure Process Station Using LabVIEW.
5. Control of Temperature Process Using LabVIEW.
6. a.Calibration of Pressure Gauge Using U – Tube Manometer.
   b.Calibration of Pressure Gauge Using Dead Weight Tester.
7. Measurement of Viscosity using RedWood Viscometer.
8. a.Measurement of pH and Conductivity.
9. Programmable Logic Controllers.
10. Simulink ToolBox – Internal Model Control, PID Controller.
11. Control System Analysis Using MatLab.
12. Complex Control techniques Using MatLab.

12EI313 EMBEDDED SYSTEMS LABORATORY

Credits: 0:0:2

Course Objective:

- To impart the basic knowledge about Embedded systems.
- To learn about the Embedded Processors with Real World applications.
- To understand the concepts of Embedded programming.

Course Outcome:

At the end of the course, Students will be able to

- Write programs in an IDE and download it to the Embedded hardware.
- Discuss the basics of embedded hardware and the interface issues related to it.
- Learn about the Serial communication protocol related to Embedded systems.

List of Experiments:

1. Activation of Buzzer
2. Generating delay using timer for buzzer
3. Activation of LED
4. Activation of LED using Switch
5. Seven segment Display
6. Real Time Clock
7. Digital to Analog Converter
8. Generation of Sawtooth and Triangular waveforms
9. Sine waveform generation
10. Digital Voltmeter
11. Keypad Scanning
12. Stepper motor interfacing

12EI314 ROBUST CONTROL

Credits: 4:0:0

Course Objective:

- To inculcate the concepts of Robust Control.
- To introduce Modeling of Unstructured Systems.
- To train the students in Hinfinity design and H infinity Loop shaping procedure .

Course Outcome:

At the end of the course, Students

- Will have an exposure about Robust Control.
- Can model Unstructured Systems.
- Will have exposure in Hinfinity design and Hinfinity Loop shaping procedure .

Unit I

INTRODUCTION: Uncertainty and control an overview – Uncertain and approximate model – categories of uncertainty – Control System Representation – System Stabilities – Co prime Factorization and stabilizing controllers – Signals and system norms: Vector norms and signal norms – System norms

Unit II

MODELING OF UNSTRUCTURED SYSTEMS: Unstructured Uncertainties **–** Parametric Uncertainty – Linear fractional transformations – Structured Uncertainties – Robust Design Specifications: Small gain theorem and Robust Stabilization, Performance Consideration, Structured Singular Values

Unit III

H – INFINITY DESIGN: Mixed Sensitivity H – Infinity Optimization– 2 degree of freedom H – Infinity design – H – Infinity suboptimal solutions – Discrete time cases

Unit IV

H – INFINITY LOOP SHAPING DESIGN PROCEDURE: Robust Stabilization against normalised Co – Prime Factor Perturbations – Loop Shaping Design Procedure – Discrete time case – Mixed Optimization Design Method with LSDP – μAnalysis and Synthesis: Consideration of Robust performance, μsynthesis – DK Iteration method, μ K Iteration method

Unit V

LOWER ORDER CONTROLLERS: Absolute – Error – Approximation Methods– Reduction via Fractional Factors – Relative – Error Approximation Methods – Frequency Weighted Approximation Methods

Text Books

1. Gu D W, Petkov, Konstantinov M M, “Robust Control with MATLAB”, Springer, 2005.
2. Skogestad and Postlethwaite, “Multivariable Feedback Control**:** Analysis and Design”, John – Wiley & Sons Inc., 2005.

References Books

1. Ian R Petersen, Valery A Ugrinovskii, and Andrey V Savkin, “Robust control design using H – infinity methodUncertain Models and Robust Control”, Springer Verlag – London Ltd – 2000.

2. Fenglin, “Robust control design an Optimal approach”, John Wiley & sons England, 2007.

12EI315 SYSTEM IDENTIFICATION

Credits: 4:0:0

Course Objective:

- To inculcate the concepts of Probability Theory and Random Process.
- To inculcate system identification concepts.
- To introduce estimation problems in Instrumentation and control .

Course Outcome:

At the end of the course, Students

- Will have an exposure Probability Theory and Random Process.
- Will have the knowledge of system identification concepts.
- Will be able to do estimation problems in Instrumentation and control .

Unit I

Probability Theory – Random Variables – Function of Random Variable – Joint Density – Mean and Variance – Random Vectors Random Processes – Random Processes and Linear Systems

Unit II

Linear Signal Models – Linear Mean Square Error Estimation – Auto Correlation and Power Spectrum Estimation – Z – Transform Revisited Eigen Vectors/Values

Unit III

The Concept of Innovation – Least Squares Estimation Optimal IIR Filters – Introduction to Adaptive Filters – State Estimation – Kalman Filter – Model and Derivation

Unit IV

Kalman Filter – Derivation – Estimator Properties – The time – Invariant Kalman Filter – Kalman Filter – Case Study – System identification Introductory Concepts – Linear Regression – Recursive Least Squares

Unit V

Variants of LSE – Least Square Estimation– Model Order Selection Residual Tests – Practical Issues in Identification – Estimation Problems in Instrumentation and Control

Text Books

1. Geoffrey Grimmett, David Stirzaker “Probability and random processes” Oxford University Press, Third Edition– 2001.
2. Monson H Hayes, Petkov, Konstantinov M, “Statistical Digital Signal Processing and Modeling”, Wiley India Private Ltd., 2002.
3. Tohru Katayama, “Subspace Methods for System Identification” ,Springer, Verlag London Ltd., 2005.

4. Loan D Landau, GainlucaZito, Gu D W, Petkov, Konstantinov M M, “Digital Control Systems Design, Identification and implementation”, Springer, Verlag London Ltd., 2006.

References Books

1. RikPintelon, GainlucaZito, Gu D W, Petkov, Konstantinov M M, “System Identification A Frequency Domain Approach”, IEEE press New York, 2001.
2. Karl J. Astrom, BiornWittenmark, “Adaptive Control” Pearson Education Asia, Second Edition, 2001.
3. Dan Simon, ”Optimal State Estimation: Kalman, H (infinity) and non linear approaches, John Wiley & Sons Inc. 2006.

12EI316 PROCESS MODELLING AND SIMULATION

Credits: 4:0:0

Course Objective:

- To inculcate the concepts of Process Modelling.
- To inculcate lumped and distributed parameter models.
- To introduce grey box models. Empirical model building.

Course Outcome:

At the end of the course, Students

- will have the exposure of Process Modelling.
- will have the exposure of lumped and distributed parameter models.
- will be able to use grey box models and Empirical Model building.

Unit I

INTRODUCTION TO MODELLING – A systematic approach to model building – Classification of models – Conservation principles – Thermodynamic principles of process systems

Unit II

DEVELOPMENT OF STEADY STATE MODELS: Lumped parameter systems– Dynamic models: Lumped parameter systems – Distributed parameter systems

Unit III

DEVELOPMENT OF GREY BOX MODELS: Empirical model building – Statistical model calibration and validation– Population balance models

Unit IV

SOLUTION STRATEGIES FOR LUMPED PARAMETER MODELS – Stiff differential equations – Solution methods for initial value and boundary value problems – Euler’s method – RK method – finite difference methods – Solving the problems using MATLAB

Unit V

SOLUTION STRATEGIES FOR DISTRIBUTED PARAMETER MODELS: Solving parabolic, Elliptic and hyperbolic partial differential equations – Finite element and finite volume methods

Text Books

1. Hangos K. M. and I. T. Cameron, "Process Modelling and Model Analysis", Academic Press, 2001.
2. Wayne Bequette B, "Process control: modeling, design, and simulation", Pearson Education Inc., 2003.

Reference Book

1. Singiresu S. Rao, "Applied Numerical Methods for Engineers and Scientists"Prentice Hall, Upper Saddle River, NJ, 2001.

12EI317 ADAPTIVE CONTROL

Credits: 4:0:0
Course Objective:

- To inculcate the need of Adaptive Control.
- To train the students in Model Reference Adaptive System Design.
- To introduce Auto tuning and Gain Scheduling.
- To inculcate the practical issues in Adaptive control Implementation.

Course Outcome:

At the end of the course, Students

- Will understand the need of Adaptive Control.
- Will be able to design Model Reference Adaptive System.
- Can able to do Gain Scheduling.
- Will have an exposure about the practical issues in Adaptive control Implementation.

Unit I
INTRODUCTION: Linear Feedback– Effect of Process variations: Non – Linear Actuators – Flow and speed variation – Variations in Disturbance Characteristics – Adaptive schemes – The Adaptive control Problem – Applications

Unit II
MODEL REFERENCE ADAPTIVE SYSTEMS : Introduction – MIT Rule – Determination of the Adaptation Gain – Lyapunov Theory – Design of MRAC using Lyapunov Theory – Bounded input, Bounded output Stability – Applications to Adaptive control – Output feedback – Relations between MRAC and STR – Nonlinear Systems

Unit III
AUTO TUNING: Introduction– PID Control Auto tuning techniques – Transient Response methods: Ziegler – Nichols Step response method – Characterization of step response – Method based on relay feedback: Ziegler – Nichols closed loop method – Method of Describing function – Relay oscillations

Unit IV

GAIN SCHEDULING: Introduction – The principle– Design of gain scheduling Controllers – nonlinear Transformations – Applications of Gain scheduling: Ship steering – PH Control – Combustion control – Fuel Air control in car Engine – Flight control systems

Unit V

PRACTICAL ISSUES AND IMPLEMENTATION: Introduction – Controller Implementation – Controller Design – Solving the Diophantine equation – Estimator Implementation – Square Root Algorithms – Interaction of Estimation and control – prototype algorithms – Operational issues

Text Books

1. Karl J. Astrom, BiornWittenmark, "Adaptive Control" Pearson Education Asia, Second Edition, 2001.
2. Gang Tao, "Adaptive Control design and Analysis", John Wiley & Sons, New Jersey,2003.

Reference Book

1. Petrosloannou, BarisFidan, "Adaptive Control Tutorial ", Library of Congress CataloginginPublication Data,2006.

12EI318 EMBEDDED SYSTEM SOFTWARE DESIGN

Credits: 4:0:0

Course Objective:

- To study the software designing used in embedded systems.

Course Outcome:

- To study the object oriented analysis and design for real time systems.
- To study the development activities of real time system using UML.
- To study the requirements, structure, and behaviour of real time systems.
- To study the Object Structure and Behavior analysis.
- To study the architectural design

Unit I

REAL TIME SYSTEMS AND OBJECTS: Introduction to real time system – Dealing with time – Model based development – Development of ROPES process – Advantages of objects – Object orientation with UML – Objects – Attributes – Behavior – Messaging – Concurrency – classes – Relations among classes and objects – UML Diagrams and notation

Unit II

REQUIREMENTS ANALYSIS OF REAL TIME SYSTEMS: Use cases – Actors – Requirements – Use case relations – Using use cases – Filling out the details of the use case – sequence diagram – Message properties – Capturing time and timeliness – Statecharts and use cases – Identifying use cases

Unit III

ANALYSIS:DEFINING OBJECT STRUCTURE: Key Strategies for Object – Identification – Underline the Noun Strategy – Identify the Casual Objects – Identify Services (Passive

Contributors) – Identify Real – World Items – Identify Physical Devices – Identify Key Concepts – Identify Transactions – Identify Persistent Information – Identify Visual Elements. Identify Control Elements– Identify object association – Class diagrams

Unit IV

ANALYSIS: DEFINING OBJECT BEHAVIOR: Object Behavior – Defining object state behavior – UML state charts – Basic state charts – The role of scenarios in the definition of behavior – Timing Diagrams – Sequence Diagrams – Event hierarchies – Defining operations – Types of operations – Strategies for defining operations

Unit V

ARCHITECTURAL DESIGN: Overview of design – Architectural design – physical architectural issues – Software architectural issues – Representing physical architecture in UML – Architectural patterns – Master – Slave pattern – Microkernel pattern – Proxy pattern – Broker pattern – Concurrency design – Representing Threads – System task diagram – Concurrent state diagrams – Identifying threads

Text Book

1. Bruce Powel Douglas, "Real – Time UML, Second Edition: Developing Efficient Objects for Embedded Systems (The Addison – Wesley Object Technology Series)", 2 edition ,Addison – Wesley, 2000

Reference Books

1. Peter Coad, Edward Yourdon, " Object Oriented Analysis, First Indian Reprint 2001.
2. Simon Bennett , Steve Mcrobb, Ray Farmer, "Object Oriented Systems Analysis And Design Using Uml, Second Edition.
3. Phillip A Laplante , "Real Time Systems Design And Analysis, Third Edition Second Reprint.

12EI319 ADVANCED MICRO CONTROLLERS

Credits: 4:0:0

Course Objective:

- To learn recent trends in advanced microcontroller applications.

Course Outcome:

- Students will have an ability to program microcontrollers for embedded applications.
- Students will have the knowledge of several different processors are employed in order to illustrate architecture differences and to show common characteristics.
- Students can be able to design the microcontroller for their projects.

Unit I

MICROCONTROLLER: Introduction – Architecture of microcontrollers – Types – Examples – Selection applications – Microcontroller resources – Bus width – Program and data memory – Parallelports– On chip ADC &DAC – Reset – Watchdog timer – Real – Time clock

Unit II

Intel 8051: Architecture of 8051 – Memory Organization – Counters and timers – USART – interrupts – Peripherals and interfacing – Digital and analog interfacing methods – Addressing modes – Instruction set – Programming examples

Unit III
8096/80196 FAMILY: Architecture of 8096 – Addressing Modes – Instruction set – Memory map in Intel 80196family MCU system – I/O ports – Programmable timers – Interrupts

Unit IV
HIGH PERFORMANCE RISC ARCHITECTURE: Introduction to 16/32 bit processor – ARM architecture – The ARM instruction set – The thumb instruction set – Programmers model – Operating Mode Selection, Registers

Unit V
PIC MICRO CONTROLLER: CPU Architecture – Instruction set – Interrupts – Timers – Memory – I/O port expansion –I2C bus for peripheral chip access – A/D converter – UART

Text Books

1. Raj Kamal – "Microcontrollers – Architecture, Programming, Interfacing and System Design", Pearson Education, USA, 2005.
2. SteaveFurber," ARM system–on–chip architecture" Addison Wesley, New Delhi, 2000.

Reference Books:

1. John.B.Peatman, "Design with PIC Micro Controller", Pearson Education, USA, 2003.
2. Mohammad Ali Mazide, Janice GillispicMazidi, RolinD.Mckinlay, " The 8051 micro controller and embedded systems using assembly and C", prentice Hall of India, Hyderabad, 2006.
3. Kenneth Ayala ,"The 8051 Microcontroller", Thomson Delmar Learning , New Jersey, 2004.

12EI320 DIGITAL IMAGE PROCESSING TECHNIQUES

Credits: 4:0:0

Course Objective:

- To learn the fundamentals of digital image processing techniques.

Course Outcome:

- To understand the basic concept of image processing.
- To learn the Image enhancement techniques.
- To understand the theory of Image Morphology, Segmentation.
- To analyze the methods of image Representation, Description and Recognition.

Unit I
DIGITAL IMAGE FUNDAMENTALS: Fundamental steps in Digital Image processing – Components of an Image Processing Systems – Light and the Electromagnetic Spectrum – Examples of fields that use Digital Image Processing – Visual Perception – Image sensing and

Acquisition – Image sampling and Quantization – Imaging Geometry – Basic relationships between pixels

Unit II

IMAGE ENHANCEMENT IN SPATIAL AND FREQUENCY DOMAIN: Basic Gray Level Transformations – Histogram Processing – Arithmetic and Logic Operations – Smoothing Spatial filters – Sharpening Spatial filters – Introduction to Frequency and the Frequency Domain – Smoothing Frequency Domain Filters – Sharpening Frequency filters

Unit III

IMAGE MORPHOLOGY AND SEGMENTATION: Dilation and Erosion – Opening and Closing – Hit or Miss Transformation – Basic Morphological Algorithms – Detection of discontinuities – Edge linking and Boundary detection – Threshold – Region based Segmentation – Use of Motion in Segmentation

Unit IV

IMAGE REPRESENTATION AND DESCRIPTION: Representation Approaches – Boundary Descriptors: Shape Numbers, Fourier Descriptors, Statistical Moments – Regional Descriptors: Topological Descriptors – Texture: Statistical, Structural and Spectral Approaches – Relational Descriptors

Unit V

OBJECT RECOGNITION: Patterns and Pattern Classes – Matching – Recognition based on Decision – Theoretic Methods: Optimum Statistical Classifiers – Structural Methods: Matching Shape Numbers, String Matching, Syntactic Recognition of Strings, Syntactic Recognition of Trees.

Text Book

1. Rafael C. Gonzalez, Richard E. Woods "Digital Image Processing" Third Edition, illustrated, revised Published by Prentice Hall, 2007, ISBN 013168728X, 9780131687288.

Reference Book

1. Pratt, W.K "Digital Image Processing, 3rd ed., John Wiley & Sons, New York, 2002.

12EI321 ADVANCED PROGRAMMABLE SIGNAL PROCESSOR

Credits: 4:0:0

Course Objective:

- The course is aimed at providing the advanced programmable processors to meet range of practical applications.

Course Outcome:

- The students will know the in depth knowledge in programmable processors and its applications.

- The students can apply object oriented techniques and FPGA codings to the problem of extending a larger software system to implement digital signal processing techniques.

Unit I

OVERVIEW OF DIGITAL SIGNAL PROCESSING AND APPLICATIONS: Signals and their Origin – Convolution and Inverse Filtering – Sampling theorem and discrete time system – Linearity, Shift invariance, Causality and stability of discrete time systems – Z Transform – Advantages of Digital Signal Processing – DSP in the sample and transform domain – Fast Fourier Transform – Digital Filters – Multi – rate Signal Processing

Unit II

INTRODUCTION TO PROGRAMMABLE DSP: Multiplier and Multiplier Accumulator – Modified Bus structures and Memory Access schemes in P – DSPs – Multiple Access Memory – Multi – ported Memory – VLIW Architecture–Pipelining –Special Addressing Modes in P – DSPs – On – Chip Peripherals

Unit III

ARCHITECTURE OF TMS320C5X: Introduction – Bus Structure – Central Arithmetic Logic Unit – Auxiliary Register ALU – Index Register – Auxiliary Register Compare Register – Block Move Address Register – Block Repeat Registers – Parallel Logic Unit – Memory – Mapped Registers – Program controller – Some Flags in the status Registers – On Chip Memory – On Chip Peripherals

Unit IV

TMS320C5X ASSEMBLY LANGUAGE INSTRUCTIONS AND INSTRUCTION PIPELININGIN C5X: Assembly Language Syntax – Addressing Modes – Load / Store Instructions – Addition/Subtraction Instructions – Move Instructions – Multiplication Instructions – The NORM Instruction – Program Control Instruction – Peripheral Control – Pipeline Structure – Pipeline operation – Normal pipeline operation, Convolution using MAC, MACD instructions – FIR filter implementation

Unit V

DSP WITH FPGA: FPGA Technology pros and cons behind FPGA and programmable signal processors, FPGA structure, Implementation of basic MAC Unit, FIR filter, IIR filter in FPGA

Text Book

1. Venkataramani B & M.Bhaskar, "Digital Signal Processor", TMH, New Delhi, 2003.

Reference Books

1. Meyer U – Baese "Digital Signal Processing with Field Programmable GateArrays", Spinger, New York, 2003.
2. Michael John Sabastian Smith, " Application Specific Integrated Circuits",Pearson Education,USA,2005.
3. Stephen Brown, ZvonkoVranesic, "Fundamentals of Digital Logic with VHDLDesign", McGraw – Hill Higher Education, New Delhi – 2005.

12EI322 DIGITAL SYSTEM DESIGN

Credits: 4:0:0

Course Objective:

- To provide an in depth knowledge of the design of digital circuits and the use of Hardware Description Language in digital system design.

Course Outcome:

- Students will be able to design different programmable logic devices.
- Students will have the knowledge of FPGA architecture.
- Students will be able to design the combinational & sequential logic circuits in FPGA.
- Students can be able to write the program in VHDL & Verilog code.

Unit I
PROGRAMMABLE LOGIC DEVICES: Basic concepts – Design of combination and sequential circuits using PLD's – Programming techniques – Programmable read only memory (PROMs) – Programmable Logic Array (PLA) – Programmable Array Logic (PAL) – Design of state machines using ASM – ASM chart – ASM realization

Unit II
FPGA AND CPLD: Types of ASICs – Semi custom and full custom IC design – Design Flow – Type of FPGA– Xilinx XC3000 Series – Xilinx XC4000 Series – Logic Cell Array (LCA) – Configurable Logic Blocks (CLB) Input/output Blocks (I/OB) – Programmable Interconnects – CPLD – Altera Max 7000 Series

Unit III
SYNCHRONOUS SEQUENTIAL NETWORKS: Structure and operation of clocked synchronous sequential networks (CSSN) – Analysis of CSSN – Modeling CSSN – State assignment – Realization using PLD – Static and Dynamic Hazards – Detecting hazards – Eliminating hazards – Essential hazards

Unit IV
INTRODUCTION TO VHDL: Basic concepts – Identifiers – Data operators – Data types – data objects –Behavioral modeling – Data flow modeling – Structural modeling – Subprograms and over loading – Packages and libraries

Unit V
Introduction to Verilog: Typical design flow – Basic concepts –Data types – Data operators – modules and ports –Gate level modeling – Data flow modeling – Behavioral modeling – Timing and delays examples

Text Books

1. Stephen Brown and Zvonk Vranesic "Fundamentals of Digital Logic with VHDL Deisgn" Tata McGraw Hill, New Delhi 2002.
2. Samir Palnitkar, "Verilog HDL", Pearson Publication, USA, 2006.

Reference Books

1. Charles H. Roth Jr. "Fundamentals of Logic design" Jaico Publishing HouseMumbai, 2004.

2. Parag K Lala, “Digital System design using PLD” BS Publications, Hyderabad,2003
3. Samir Palnitkar, “Verilog HDL”, Pearson Publication, USA, 2006.
4. J. Bhaskar, “A VHDL Synthesis Primer”, BS Publications, Hyderabad, 2004.
5. M.J.S .Smith, "Application Specific Integrated Circuits”, Addison –WesleyLongman Inc., New Delhi, 2006.

12EI323 ADVANCED EMBEDDED SYSTEMS LABORATORY

Credits: 0:0:2

Course Objective:

- To illustrate concepts discussed in the syllabus and to give the students the opportunity to build and test the digital systems. The lab exercises will make use of the Xilinx 9.2 ISE tool for designing and implementing digital systems on FGPA. The system consists of an integrated set of tools that allows one to capture designs, simulate, implement and test them.

Course Outcome:

- Students will have knowledge about the concepts and methods of digital system design techniques.
- Students able to design combinational and sequential digital systems.
- Students able to analyze the results of logic and timing simulations and to use these simulation results to debug digital systems.
- Students will have the knowledge through hands – on experimentation the Xilinx tools for FPGA design as well as the basics of VHDL to design, simulate and implement the digital systems.

List of Experiments :

1. (a)Realization of Half adder, Full adder, Half Subtractor, Full Subtractor.

   (b)Realization of Encoder, Decoder.
   (a)Realization of Flip flops and counters.
   (b)Realization of S – RAM.
2. Implementation of Logic gates using Spartan 2E FPGA Kit.
3. Implementation of IO Module using Spartan 2E FPGA Kit.
4. Implementation of Multiplexer &Demultiplexer using Spartan 2E Fpga Kit.
5. Implementation of ADC using Spartan3E FPGA kit.
6. Implementation of DAC using Spartan3E FPGA kit.
7. Implementation of LCD using Spartan3E FPGA kit.
8. Implementation of DC Motor using vertex II pro.
9. LED Activation Using ARM7 Development Board.
10. Implementation Of DC Motor In ARM7 Development Board.
11. (a)Implementation Of Multitasking In ARM7 Development Board.
    (b)Mini Project

12EI324 COMPUTER ARCHITECTURE

Credits: 4:0:0

Course Objective:

- To expose the fundamental concepts of computer architecture.

Course Outcome:

- To know the basics of computer designing.
- To study the pipelining and scheduling.
- To understand the Hardware versus software speculation mechanisms.
- To study the storage devices.
- To analyze the different memory architectures.

Unit I

FUNDAMENTALS OF COMPUTER DESIGN: Review of fundamentals of CPU, Memory and IO – Performance evaluation – Instruction set principles –Design issues – Example Architectures

Unit II

INSTRUCTION LEVEL PARALLELISM: Pipelining and handling hazards – Dynamic Scheduling – Dynamic hardware prediction – Multiple issue – Hardware based speculation – Limitations of ILP – Case studies

Unit III

INSTRUCTION LEVEL PARALLELISM WITH SOFTWARE APPROACHES: Compiler techniques for exposing ILP – Static branch prediction – VLIW & EPIC – Advanced compilers upport – Hardware support for exposing parallelism – Hardware versus software speculation mechanisms – IA 64 and tanium processor

Unit IV

MEMORY AND I/O: Cache performance – Reducing cache miss penalty and miss rate – Reducing hit time – Main memory and performance – Memory technology – Types of storage devices – Buses – RAID – Reliability, Availability and dependability – I/O performance measures – Designing an I/O system

Unit V

MULTIPROCESSORS AND THREAD LEVEL PARALLELISM: Symmetric and distributed shared memory architectures – Performance issues – Synchronization –Models of memory consistency – Multithreading

Text Book

1. John L.Hennessey and David A.Patterson, "Computer Architecture: A Quantitative Approach", Third Edition, Morgan Kaufmann, 2006.

Reference Books

1. William Stallings, " Computer Organization and Architecture", Prentice Hall of India, 6 Edition Fourth Indian Reprint 2005.

2. Kai Hwang " Advanced Computer Architecture ". TMH Edition 2001 Thirteenth Reprint 2006.
3. Nicholas Carter, Raj Kamal, ”Computer Architecture” Indian Special Edition 2006, First Reprint 2007.
4. DezsoSima, Terence Fountain, Peter Kacsuk, Advanced Computer Architectures Eighth Indian Reprint2005.

12EI325 MOBILE COMMUNICATION

Credits: 4:0:0

Course Objective:

- To study the Mobile communication.

Course Outcome:

- To study the basics of transmission.
- To study the Telecommunication Systems.
- To study the Broadcast Systems.
- To analyze the different mobile communication layers.
- To study the applications of Mobile communication.

Unit I

INTRODUCTION: Introduction – Wireless Transmission: Frequencies for radio transmission, Signals, Antennas, Signal Propagation, Multiplexing, Modulation, Spread Spectrum, Cellular Systems Medium Access Control: Motivation, SDMA, FDMA, TDMA, CDMA – Comparison

Unit II

TELECOMMUNICATION SYSTEMS: Telecommunication Systems: GSM, DECT, TETRA, UMTS and IMT – 2000Satellite Systems: Basics – Routing – Localization – Handover

Unit III

BROADCAST SYSTEMS: Broadcast Systems: Cyclic repetition of data – Digital audio broadcasting, Digital video Broadcasting Wireless LAN: Infrared vs radio transmission, Infrastructure and ad hoc networks, IEEE 802.11,HYPERLAN, Bluetooth

Unit IV

WIRELESS ATM: Wireless ATM: Motivation, Working group, WATM services, Reference model, Functions, Radio access layer, Handover, Location management, Addressing, Quality of service, Access point control protocol Mobile network layer: Mobile IP, Dynamic host configuration protocol, Ad – hoc networks

Unit V

MOBILE TRANSPORT LAYER: Mobile transport layer: Traditional TCP, Indirect TCP, Snooping TCP, Mobile TCP, Fast retransmission/fast recovery, Selective retransmission, Transaction oriented TCP Support for mobility: File systems, World Wide Web, Wireless application protocol

Text Book

1. Jochen Schiller, Mobile Communications, Second Edition, Pearson Education, 2004.ISBN 81 – 297 – 0350 – 5.

Reference Book

1. Yi – Bing Lin and ImrichChlamtac, Wireless and Mobile Network Architecture, Second Edition, JohnWiley and Sons, 2001.

12EI326 MOBILE COMPUTING

Credits: 4:0:0

Course Objective:

- To study the computing techniques of Mobile communication.

Course Outcome:

- To study the Pervasive Computing techniques.
- To study the Smart Sensor applications.
- To study application of JAVA in Mobile Computing.
- To study different protocols.
- To study different security techniques.

Unit I

INTRODUCTION: Introduction – Pervasive Computing – Principles – Pervasive Information Technology – Information Access Devices – Handheld Computers – Palm OS – Based Devices – Windows CE – Based Handheld Computers – EPOC Based Handheld Computers – Phones – Cellular Phones – Data Transmission Capabilities – Smart Phones – Screen Phones

Unit II

SMART IDENTIFICATION: Smart Identification – Smart Cards – Smart Labels – Smart Tokens – Embedded Controls – Smart Sensors and Actuators –Smart Appliances – Appliances and Home Networking – Automotive Computing– Entertainment Systems – Television Systems – Game Consoles

Unit III

JAVA: Java – Characteristics – Libraries –Java Editions – Micro Editions – Personal Java & Embedded Java – Development Tool For Java – Operating Systems – Windows CE –Palm OS – Symbian OS – Java Card –Client Middleware – Programming APIS – Smart Card Programming – Messaging Components – Database Components

Unit IV

COMPUTER NETWORKING : Connecting The World – Internet Protocols And Formats – Http – Html – Xml –Mobile Internet The WAP 1.1Architecture – Wireless Application Environment 1.1 – WAP 2.0 Architecture – I Mode – Voice – Voice Technology Trends – Voice On The Web –Web Services – Architecture – WSDL – UDDI – Soap – WSRP–

Connectivity – Wireless Wan – Short Range Wireless Communication – Home Networks – Universal Plug And Play

Unit V

DATA SECURITY: Security – Information Security – Security techniques and algorithms – Security Protocols – Public Key Infrastructure – Trust – Security Models – Security frameworks for Mobile Environment – Services – Home services – Travel services – Business Services – Consumer Services

Text Books

1. UweHansmann, LotharMerk, Martin S.Nicklous and Thomas Stober, Principles of Mobile Computing, Second Edition, Springer International Edition, 2003. ISBN 81 – 8120 – 073 – 3.
2. Asoke K Talukder, Roopa R Yavagal, Mobile Computing, Tata McGraw – Hill Publishing CompanyLimited 2005. ISBN 0 – 07 – 058807 – 4.

Reference Books

1. Yi – Bing Lin and ImrichChlamtac, Wireless and Mobile Network Architecture, JohnWiley and SonsInc., 2001. ISBN 0 – 471 – 39492 – 0.
2. Jochen Schiller, Mobile Communication, Pearson Education, 2000. ISBN 81 – 7808 – 170 – 9.

12EI327 TELEMETRY

Credits: 4:0:0

Course Objective:

- The aim of this course is to understand the principles of telemetry, multiplexing, modem protocols, and antenna theory for practical applications.

Course Outcome:

- Analyze signals, its transmission principles with discussion on modulations and associated circuits.
- Understand the use of fiber optics in communication.
- Understand the key characteristics of frequency and time division multiplexing together with their relative benefits and drawbacks.

Unit I

TELEMETRY PRINCIPLES: The basic system – Classification – Non electrical and electrical telemetry – Local transmitters and converters – Frequency telemetering – Power line carrier communication, Signals – Theorems – Exponential Fourier series – Amplitude and frequency modulations – Phase modulation, Bits and symbols – Time function pulse – modulation codes –Intersymbol Interference – Error rate and probability of error

Unit II

FREQUENCY AND TIME DIVISION MULTIPLEXED SYSTEM: Frequency division multiplexed system: IRIG standards – FM and PM circuits, PLL, Time Division multiplexed system: TDM – PAM ,TDM – PCM system, Digital multiplexer – PCM Reception – Differential PCM

Unit III

MODEMS AND TRANSMISSION LINES: Modems – Quadrature amplitude modulation – Modem protocol – Transmitters and Receivers techniques – RF transmission lines – Microwave lines – Wave guide components – Micro strip lines – Digital transmission system in Satellite Telemetry

Unit IV

FIBRE OPTICAL TELEMETRY: Optical Fibre Cable – Dispersion – Losses – Connectors and Splices – Sources and Detectors – Transmitter and Receiver Circuits – Coherent Optical Fibre Communication Systems – Wavelength Division Multiplexing

Unit V

INTERNET BASED TELEMETERING: Data Acquisition System – Microprocessor – Based DAS – Remote Control – Networking – BLANs – Internet based Telemetering – Wireless LANs – Random Access System – Principles of Telephony

Text Book

1. Patranabis D, "Telemetry Principles", Tata McGraw Hill, New Delhi, 2007.

Reference Books

1. Taub and Schilling, "Principles of Communication", Third Edition, Tata McGraw Hill, New Delhi 2008.
2. Doeblin E.D, Measurement Systems – Applications and Design, McGraw Hill, New York,
   2003.

12EI328 VLSI SIGNAL PROCESSING

Credits: 4:0:0

Course objective:

- To introduce the basic approaches and methodologies implementation of signal processing systems in FPGA.

Course outcome:

- The students will design various algorithms for DSP applications in FPGA.

Unit I

INTRODUCTION TO DSP SYSTEMS: Introduction To DSP Systems – Typical DSP algorithms, Data flow graph representations, Loop bound and iteration bound – Longest path Matrix algorithm; Pipelining and parallel processing– Pipelining of FIR digital filters, Parallel processing, Pipelining and parallel processing for low power

Unit II

RETIMING, FOLDING AND UNFOLDING : Retiming – Definitions and properties, Retiming techniques; Unfolding– An algorithm for Unfolding, Properties of unfolding, Sample period reduction and parallel processing application; Folding– Folding transformation– Register minimizing techniques– Register minimization in folded architectures

Unit III

CONVOLUTION: Fast convolution – Cook – Toom algorithm, Modified Cook – Took algorithm– Winograd Algorithm, Iterated Convolution– Cyclic Convolution

Unit IV

FILTERS : Parallel FIR filters, Pipelined and parallel recursive filters– Inefficient/efficient single channel interleaving, Look – Ahead pipelining in first – Order IIR filters, Look – Ahead pipelining with power of two decomposition parallel processing of IIR filters, Combined pipelining and parallel processing of IIR filters, Pipelined adaptive digital filters, Relaxed look – ahead, Pipelined LMS adaptive filter

Unit V

BIT – LEVEL ARITHMETIC ARCHITECTURES: Bit – Level Arithmetic Architectures – parallel multipliers with sign extension, Parallel carry – Ripple array multipliers, Parallel carry – save multiplier, 4x4 bit Baugh – Wooley carry – Save multiplication tabular form and implementation, Design of Lyon‘s bit – Serial multipliers using Horner‘s rule, bit – Serial FIR filter, CSD representation, CSD multiplication using Horner‘s rule for precision Improvement

Text Book

1. KeshabK.Parhi, VLSI Digital Signal Processing systems, Design and implementation, Wiley, Inter Science, reprint 2008.

References Books

1. Gary Yeap, Practical Low Power Digital VLSI Design, Kluwer Academic Publishers, reprint 2009.
2. Wayne Wolf, “Modern VLSI Design – system on chip”, Pearson education Pvt Ltd, New Delhi, 2004.

12EI329 EMBEDDED LINUX

Credits: 4:0:0

Course Objective:

- To expose the students to the fundamentals of embedded Linux programming.

Course Outcome:

- Students will be able to work on basic Linux Programming.
- Students will be capable to develop embedded Linux program.
- Students will be able to program in real – time systems with memory management.

Unit I

FUNDAMENTALS OF OPERATING SYSTEMS: Overview of operating systems – Process and threads – Processes and Programs –Programmer view of processes – OS View of processes – Threads – Scheduling – Non – preemptive and preemptive scheduling – Real Time Scheduling – Process Synchronization – Semaphores – Message Passing – Mailboxes – Deadlocks – Synchronization and scheduling in multiprocessor Operating Systems

Unit II

LINUX FUNDAMENTALS: Introduction to Linux – Basic Linux commands and concepts – Logging in – Shells – Basic text editing – Advanced shells and shell scripting – Linux File System – Linux programming – Processes and threads in Linux – Inter process communication – Devices– Linux System calls

Unit III

INTRODUCTION TO EMBEDDED LINUX: Embedded Linux – Introduction – Advantages – Embedded Linux Distributions – Architecture – Linux kernel architecture – User space – linux startup sequence – GNU cross platform Tool chain

Unit IV

BOARD SUPPORT PACKAGE AND EMBEDDED STORAGE: Inclusion of BSP in kernel build procedure – The boot loader Interface – Memory Map –Interrupt Management – PCI Subsystem – Timers – UART – Power Management –Embedded Storage – Flash Map – Memory Technology Device (MTD) – MTD Architecture – MTD Driver for NOR Flash – The Flash Mapping drivers – MTD Block and character devices – Mtdutils package – Embedded File Systems – Optimizing storage space – Turning kernel memory

Unit V

EMBEDDED DRIVERS AND APPLICATION PORTING: Linux serial driver – Ethernet driver – I2C subsystem – USB gadgets – Watchdog timer –Kernel Modules – Application porting roadmap – Programming with pthreads – Operting System Porting Layer – Kernel API Driver – Case studies – RT Linux – uClinux

Text Books

1. Dhananjay M. Dhamdhere, “Operating Systems A concept based Approach”, TataMcgraw – Hill, New Delhi, 2002.
2. Raghavan P ,Amol Lad , SriramNeelakandan, “Embedded Linux System Designand Development”, Auerbach Publications. London, 2006.

Reference Books

1. Matthias KalleDalheimer, Matt Welsh, “Running Linux”, O’Reilly, U.K, 2005.
2. Mark Mitchell, Jeffrey Oldham and Alex Samuel “Advanced Linux Programming” New Riders, USA, 2001.
3. KarimYaghmour, “Building Embedded Linux Systems”, O'Reilly, UK, 2003.

12EI330 MEDICAL INSTRUMENTATION

Credits: 4:0:0

Course Objective:

- With widespread use and requirements of medical instruments, this course gives knowledge of the principle of operation and design of biomedical instruments.

- It attempts to render a broad and modern account of biomedical instruments.
- It gives the introductory idea about human physiology system which is very important with respect to design consideration.

Course Outcome:

At the end of the course the students

- Will have knowledge about the principle of operation and design of biomedical instruments and specific applications of biomedical engineering.

Unit I

BIOPOTENTIALS AND THEIR MEASUREMENTS: Cell and its structure – Resting potentials – Action potentials – Bioelectric potentials – Measurement of potentials and their recording – Basic principles of ECG, EEG, EMG– Electrode theory – Bipolar and Unipolar electrode – Surface electrode – Electrode impedance – Equivalent circuit for extra cellular electrodes – Micro electrodes

Unit II

COMPUTER BASED MEDICAL INSTRUMENTATION: Computerised versions of ECG, EEG, EMG, Tread Mill Test ECG – Foetal monitor, Cardiac arrthymias and its monitoring through Hotler monitor, Event monitors, Bispectral Index EEG for depth of anesthesia monitoring

Unit III

OPERATION THEATRE EQUIPMENT AND CRITICAL CARE INSTRUMENTATION: Patient monitors, Pulse oximetry, ICU ventilators, Suction apparatus, Anesthesia equipment, Electro surgery, Operating microscopes, Motorized operation table, Infusion pumps and syringe pumps, Nerve stimulator, Defibrillators, Bio – telemetry

Unit IV

MEDICAL IMAGING TECHNIQUES:X rays – Scanning techniques – Ultrasound scanner – Color Doppler system, CT, MRI scanning techniques – Coronary angiogram, Nuclear imaging

Unit V

SPECIALIZED THERAPEUTIC AND DIAGNOSTIC EQUIPMENT: Cardiac pacemakers, Heart lung machines, Hemodialysis, Clinical laboratory instrumentation, Audiometer, Phonocardiogram

Text Book

1. Khandpur R.S, “Handbook of Biomedical Instrumentation”, Tata McGraw – Hill, New Delhi, 2003.

Reference Books

1. John G. Webster, “Medical Instrumentation Application and Design”, John Wiley and sons, New York, 2009.
2. Leslie Cromwell, “Biomedical Instrumentation and measurement”, Prentice hall of India, New Delhi, 2007.

3. Standard Handbook of Biomedical Engineering & Design – Myer Kutz, McGraw – Hill Publisher, UK,2003.

12EI331 MEDICAL SENSORS

Credits: 4:0:0

Course Objective:

- An introduction to the field of medical sensors and an in – depth and quantitative view of device design and performance analysis. An overview of the current state of the art to enable continuation into advanced biosensor work and design.

Course Outcome:

At the end of the course the students will

- Evaluate a sensor based on standard performance criteria and appropriateness for an application.
- Given a specific biosensor application, identify the key design criteria and suggest and an appropriate biosensor approach which is most likely to meet those design criteria.
- Compare the relative advantages and disadvantages of the major approaches to biosensor design.
- Communicate the most relevant challenges facing the biosensor research field and given a particular challenge suggest a reasonable approach to finding a solution to the challenge.

Unit I

INTRODUCTION: Methods for biosensors fabrication: Self assembled monolayers, Screen printing, Photolithography, Microcontact printing, MEMS – Physiological Pressure Measurement: Units of pressure, Physiological pressure ranges and measurement sites – Direct measurement – Dynamic response of catheter transducer systems – Catheter tip pressure transducers – Implantable pressure transducers, Telemetering capsules, Pressure measurements in small vessels, Collapsible vessels, Interstitial spaces – Differential pressure measurement – Indirect pressure measurement – Cuff design – Detection of korotkoff sounds – Oscillometric method – Doppler Ultrasound – Instantaneous arterial pressure – Internal pressure measurement by reaction forces

Unit II

MOTION AND FORCE MEASUREMENT: Units of quantities – Displacement and Rotation measurements by contact and noncontact methods – Linear and angular velocity measurements – Translational and angular acceleration – Force measurement, Muscle contraction measurements – Design of elastic beam – Force in isolated muscle – Invivo – Measurements – Stresses in the bone – Force plate – Stabilometer

Unit III

FLOW MEASUREMENT: Units – Blood flow measurement in single vessels – Electromagnetic, Ultrasonic Flowmeters – Indicator dilution method – Impedance cardiography – Laser Doppler flowmetry – RBC velocity measurement – Miscellaneous mechanical flowmeters – Tissue blood flow measurement – Venous occlusion plethysmography – Clearance technique – Measurement by heat transport – Laser Doppler flowmeter – NMR flowmeter – Respiratory gas flow measurement – Rotometer, Pnemotachograph, Hot – Wire anemometer – Time of flight – Ultrasonic vortex flowmeter, Spirometer – Lung plethysmography

Unit IV

TEMPERATURE, HEAT FLOW AND EVAPORATION MEASUREMENT: Units – Thermistors, Thermocouples, Thermo sensitive elements, Diodes, Transistors, Crystal resonators, Non contact temperature measurement techniques – Infrared measurements, Thermography, Microwave imaging clinical thermometers – Rectal, Esophageal, Bladder temperature measurement, Tympanic thermometers, Zero heat flow thermometers – Heat flow measurements – Transducers – Direct calorimetry – Evaporation measurement, Humidity transducers – Electrolytic water vapor analyzer, Dewpoint – Hygrometer – Impedence, Capacitive sensors, Thermoelectric Psycrometer, Evaporative water loss from skin and mucosa

Unit V

CHEMICAL MEASUREMENT: Electrode theory – Surface potential electrodes – ECG,EMG,EEG electrodes – Micro & suction electrodes – Chemical transducer – Electrochemical transducers – Transducer with optical, Acoustic and thermal principles – Mass spectrometer – Chromatography – Electrophoresis – Magnetic resonance – Other optical methods – Other analytical methods – Continous measurement – Intravascular, tissue – Ex vivo measurements – Transcutaneous measurements – Respiratory gas analysis

Text Book

1. Tatsuo Togawa, Toshiyo Tamura, p. Ake Oberg, "Bio – Medical Transducers and Instruments" – CRC Press, USA, 2010.

Reference Books

1. GáborHarsányi, "Sensors in biomedical applications: fundamentals, technology & applications", CRC Press, USA, 2000.
2. Joseph D. Bronzino," The biomedical engineering handbook", Volume 2, CRC Press, USA, 2000.

12EI332 MEDICAL IMAGE PROCESSING

Credits: 4:0:0

Course Objective:

- To learn the fundamentals of medical image processing techniques.

Course Outcome:

At the end of the semester students will

- Understand the basic concept of image processing.
- Understand the theory of Image Morphology, Segmentation and Enhancement techniques.
- Analyze the methods of medical image reconstruction.

Unit I

IMAGE FUNDAMENTALS: Image perception, MTF of the visual system, Image fidelity criteria, Image model, Image sampling and quantization – Two dimensional sampling theory, Image quantization, Optimum mean square quantizer, Image transforms – 2D – DFT and other transforms

Unit II

IMAGE PREPROCESSING: Image enhancement – Point operation, Histogram modeling, Spatial operations, Transform operations, Image restoration – Image degradation model, Inverse and Weiner filtering – Image Compression – Spatial and Transform methods

UNIT III

MEDICAL IMAGE RECONSTRUCTION: Mathematical preliminaries and basic reconstruction methods, Image reconstruction in CT scanners, MRI, fMRI, Ultra sound imaging, 3D Ultra sound imaging, Nuclear Medicine Imaging Modalities – SPECT,PET, Molecular Imaging

Unit IV

IMAGE ANALYSIS AND CLASSIFICATION: Image segmentation – Pixel based, Edge based, Region based segmentation – Image representation and analysis, Feature extraction and representation, Statistical, Shape, Texture, Feature and image classification – Statistical, Rule based, Neural Network approaches

Unit V

IMAGE REGISTRATIONS AND VISUALIZATION: Rigid body visualization, Principal axis registration, Interactive principal axis registration, Feature based registration, Elastic deformation based registration, Image visualization – 2D display methods, 3D display methods, Virtual reality based interactive visualization – Digital image watermarking.

Text Books

1. Atam P.Dhawan, ‘Medical Image Analysis’, Wiley Interscience Publication, NJ, USA 2003
2. Kavyan Najarian and Robert Splerstor,” Biomedical signals and Image processing”,CRC – Taylor and Francis,New York,2006
3. Anil. K. Jain, ‘Fundamentals of Digital Image Processing’, Pearson education, Indian Reprint 2003

References Books

1. R.C.Gonzalez and R.E.Woods, ‘Digital Image Processing’, Second Edition, Pearson Education, 2002.
2. Alfred Horowitz, ‘MRI Physics for Radiologists – A Visual Approach’, Second edition Springer Verlag Network, 1991.
3. John L.Semmlow,”Biosignal and Biomedical Image Processing Matlab Based applications” Marcel Dekker Inc.,New York,2004
4. Jerry L.Prince and Jnathan M.Links,” Medical Imaging Signals and Systems”- Pearson Education Inc. 2006

12EI333 ANATOMY AND PHYSIOLOGY

Credits: 4:0:0

Course Objective:

- To define the different anatomical terms .
- To explain the overall structure – function relationship of all systems.
- To apply this basic knowledge to changes in bodily functions as a result of disease and determine the reason for functional changes.

Course Outcome:

At the end of the course the students will

- Be able to study the structural and functional details of human body
- Be able to relate how each body system works in coordination
- Understand and appreciate how homeostasis is achieved in the body

Unit I

INTRODUCTION TO CELL STRUCTURE: Cell structure and organelles, Function of each component of the cell – Membrane potential – Blood, Blood cells – Composition – Origin of RBC – Estimation of RBC – WBC –Platelet

Unit II

CIRCULATORY AND RESPIRATORY SYSTEMS: Structure and functioning of heart, Structure and functioning of lungs, Trachea and its branches, General circulation – Capillary circulation, Venous return, Neural control of cardio vascular system – Pulmonary Ventilation, Regulation of breathing, Hypoxia

Unit III

NERVOUS AND SENSORY SYSTEMS: Structure and function of nervous tissues, Reflex action, Afferent nervous system, Regulation of posture – Physiology of emotion, Regulation of temperature, Cerebrospinal fluid, Sensory end organs, Tongue, Mechanism of sight, Hearing and smelling

Unit IV

DIGESTIVE AND EXCRETORY SYSTEM: Structure of alimentary canal, Related digestive glands, Liver, Mechanism of alimentary canal, Secretion of digestive fluids, Function of liver – Structure of kidney, Bladder and colon, Physiology of perspiration, Physiology of urine formation, Physiology of micturition, Physiology of defecation

Unit V

ENDOCRINE SYSTEM: Pituitary gland, Thyroid and parathyroid glands, Pancreas, Ovary and testis

Text Book:

1. Arthur.C.Guyton, "Textbook of Medical Physiology" Prism Book (P) Ltd, USA, 2008.

Reference Book:

1. Ranganathan, T.S. "Text Book of Human Anatomy", S.Chand&Co. Ltd.,New Delhi 2007.

12EI334 SOFT COMPUTING TECHNIQUES

Credits: 4:0:0

Course Objective:

- To introduce the basic concepts of neural networks and its applications in Control and biomedical applications.
- To introduce fuzzy logic concept and its applications in biomedicine.

Course Outcome:

At the end of the semester students

- Will have solid understanding of Basic Neural Network, Fuzzy Logic and Genetic algorithms.
- Know how to use Soft Computing to solve real world problems mainly pertaining to Biomedical applications.

Unit I

INTRODUCTION TO NEURAL NETWORKS: Introduction – Biological neurons and their artificial models – Learning, Adaptation and neural network's learning rules – Types of neural networks – Single layer, Multiple layer – Feed forward, Feedback networks, Back propagation – Learning and training

Unit II

SPECIAL NETWORKS AND APPLICATIONS: Associative memory – BAM – Hopfield network – ART Network – SOM – Case studies: Depth of anesthesia monitoring using neural networks, Bio signal classification, Pattern recognition

Unit III

INTRODUCTION TO FUZZY LOGIC: Fuzzy sets – Fuzzy operation – Fuzzy arithmetic – Fuzzy relations – Fuzzy relational equations – Fuzzy measure – Fuzzy functions – Approximate reasoning – Fuzzy propositions –Fuzzy quantifiers – If then rules

Unit IV

FUZZY LOGIC CONTROL: Structure of fuzzy logic controller – Fuzzification models – Data base – Rule base – Inference engine – Defuzzification module Case studies: Blood pressure monitoring during anesthesia using fuzzy logic, Image processing using fuzzy logic, Home heating system

Unit V

GENETIC ALGORITHM AND ITS APPLICATIONS: Fundamentals of genetic algorithm: Evolutionary computation – Search space – Encoding – Reproduction – Elements of genetic algorithm – Genetic modeling – Comparison of GA and traditional search methods – Genetic Algorithm in scientific models and theoretical foundations – Applications of Genetic based machine learning – Genetic Algorithm and parallel processors – Composite laminates – Constraint optimization – Multilevel optimization – Case studies

Text Books

1. Jacek M Zurada, ‘Introduction to Artificial Neural Systems’, Jaico Publishing House,1999.
2. Rajasekaran S. and G.A VijayalakshmiPai, ‘Neural Networks, Fuzzy logic and Genetic Algorithms, Synthesis and Applications’, Prentice Hall of India, New Delhi – 2003.

Reference Books

1. Klir G.J. &Folger T.A. ‘Fuzzy sets, uncertainty and Information’, Prentice –Hall of India Pvt. Ltd.,1993.
2. Zimmerman H.J. ‘Fuzzy set theory – and its Applications’ – Kluwer Academic Publishers,1994.
3. Kosko, B. ‘Neural Networks and Fuzzy Systems’, Prentice – Hall of India Pvt. Ltd.,1994

12EI335 MODELING OF PHYSIOLOGICAL SYSTEMS

Credits: 4:0:0

Course Objective:

- To understand basic ideas related to modeling and different modeling techniques of certain physiological systems like respiratory system, thermal regulation system and lung model.

Course Outcome:

At the end of the semester students will

- Understand the concepts of mathematical modeling.
- Model each physiological system and study the i/p – o/p characteristics.
- Be able to simulate models based on the given system parameters and hence use it for diagnostic purposes.

Unit I

INTRODUCTION: Introduction to Physiological control systems, Illustration – Example of a physiological control system – Difference between engineering and physiological control systems – Art of modeling Physiological systems, Generalized system properties – Models with combination of system elements – Linear models of physiological systems – Distributed parameters versus lumped parameter models – Linear systems and superposition principles

Unit II

OPEN LOOP VERSUS CLOSED LOOP SYSTEMS: Determination of steady state operating point – Regulation of cardiac output – Cardiac output curve – Venous return curve, Regulation of glucose, Chemical regulation of ventilation – Model of the heart – windkessel simplification – Models of Neuronal dynamics – Hodgkin Huxley model, Stability analysis of pupillary light reflex – Study of frequency domain analysis of circulatory control model and glucose insulin regulation model by MATLAB tools

Unit III

RESPIRATORY SYSTEM: Gas transport mechanisms of lungs – Oxygen and carbon dioxide transport in blood and tissues – Mass balancing by lungs – Modeling oxygen uptake by RBC and pulmonary capillaries

Unit IV

ULTRA FILTRATION SYSTEM: Transport through cells and tubules, Diffusion, Facilitated – Diffusion and active transport, Methods of waste removal, Counter current model of urine formation in kidneys, Modeling Henley's loop

Unit V

MODELING BODY DYNAMICS: Principles of mechanical properties of bones, Tissues – Modeling bones, Stress propagation in bones, Hills model of muscle mechanism – Current Trends: Pharmacokinetic modeling illustrated with example like drug diffusion, Computer aided modeling.

Text Books

1. Physiological control systems: Analysis, Simulation and Estimation. By: Michael C.K.Khoo. Pub: Prentice Hall of India Pvt. Ltd. New Delhi.
2. Biomedical engineering principles: an introduction to fluid, heat, and mass transport processes, Volume 2 of Biomedical engineering and instrumentation , David O. Cooney.

Reference Books

1. Katz, A.M. "Physiology of the Heart", Lippincott Williams & Wilkins, USA,2006.
2. Carson, Cobelli, : "Introduction of Modeling in Physiology and Medicine ", Academic Press, Netherland,2008.
3. Vasilis.Z.Mararelis, " Nonlinear Dynamic Modeling of Physiological System", John Wiley & Sons, New Jersey,2004.
4. Daniel Weiner, Johan Gabrielsson, "Pharmacokinetic and Pharmacodynamic Data Analysis: Concepts and Applications, Sweden, 2000.

12EI336 SPECIAL PURPOSE INSTRUMENTATION

Credits: 4:0:0

Course Objective:

- To provide various techniques and methods of analysis which occur in the various regions of the spectrum. These are the powerful tools used in clinical and research laboratories.
- To give unique methods of separation of closely similar materials, the most powerful being gas chromatography.
- To provide the important radio chemical methods of analysis.
- To learn about the techniques used in clinical labs.

Course Outcome:

At the end of the semester students

- will be able to understand the spectroscopic techniques, NMR techniques, chromatographic techniques used for characterization of materials, devices and biological molecules
- Gain a better understanding of clinical lab techniques such as blood cell counter, centrifugation, microtomy, electrophoresis and microscopy

Unit I

INTRODUCTION TO ANALYTICAL INSTRUMENTS AND SPECTROPHOTOMETERS: Fundamental elements of Analytical instrumentation system – Spectral methods of analysis – Beer's Law – UV – Visible spectrophotometers – Single beam and double beam instruments – Sources and detectors – IR spectrophotometers– FTIR spectrometers – Atomic absorption spectrophotometers – Flame emission spectrophotometers – Sources of flame photometry – Applications

Unit II

NMR, MASS SPECTROMETER & RADIATION TECHNIQUES: NMR – Basic principle – NMR spectrometers – Applications – Introduction to mass spectrophotometers – Nuclear radiation detectors – GM counter – Proportional counter – Solid state detectors introduction to X ray spectroscopy

Unit III

AUTOMATED CHEMICAL ANALYSIS SYSTEM, PH METERS AND CHROMATOGRAPHY: Automated chemical analysis system – Benefits – Types – Working, PH meters – Dissolved oxygen analyser – CO monitor – NO_2analyser – H_2S analyser – Chromatography – Paper, TLC, Gas chromatography – Liquid chromatography – Principles, Types and applications – High pressure liquid chromatography

Unit IV

CLINICAL INSTRUMENTATION TECHNIQUES: Haematology – Automated cell counters, Centrifugation – Types – Fractionation of cells, Automatic tissue processor – Microtome – Types – Microtome knives – Hot air oven, Autoclave, Biocabinet safety

Unit V

ELECTROPHORESIS AND MICROSCOPY: Electrophoresis – Principles – Types – Factors affecting electrophoresis – Microscopes – Classification – Methods of microscopy – Light microscope – Compound microscope – Phase contrast microscope – Fluorescent microscope – Electron microscope and their applications

Text Books

1. Khandpur R.S,"Handbook of Analytical Instruments", Tata MCGraw – Hill Publishing company limited,2006.
2. MousumiDebnath,"Tools and techniques of Biotechnology", Pointer publications, 2005.

Reference Books

1. John G Webster, "Medical instrumentation application and design", John wiley & Sons (Asia) Pvt Ltd, 3rd edition.
2. Willard, H.H., Merrit L.L., Dean J.A Seattle F.L., 'Instrumental Methods of Analysis', CBS Publishing and Distribution, 1995.
3. RobertD.Braun, Introduction to Instrumental Analysis, McGraw–Hill, Singapore, 1987.

12EI337 MEDICAL DIAGNOSTICS AND THERAPEUTIC LABORATORY

Credits: 0:0:2

Course Objective:

- To provide basic knowledge of physiological signals.
- To make the students to know about various physiological measuring instruments and to diagnose the various disease.
- To make the students to know about various measurement techniques.

Course Outcome:

At the end of the course the students

- Will have knowledge about physiological signals.
- Can apply the various measurement techniques.

List of Experiments:

1. Blood pressure measurement
2. Determination of auditory capacity using audio meter
3. Determination of blood flow velocity using ultrasonic Doppler blood flow meter
4. Surgical diathermy
5. Recording of EOG signals
6. Recording of ECG waveforms using bio – kit physio – graph
7. Recording of EMG waveforms using bio – kit physio – graph
8. Recording of PCG waveforms using bio – kit physio – graph
9. Recording of peripheral pulse waveforms using bio – kit physio – graph
10. Recording of EEG waveforms using bio – kit physio – graph
11. Determination of percentage of oxygen saturation in blood using pulse oximeter
12. TENS – physiotherapy

12EI338 MEDICAL IMAGING TECHNIQUES

Credits: 4:0:0

Course Objective:

- This course gives knowledge of the principle of operation and design of Radiological equipments.

Course Outcome:

At the end of the course, the students

- Will have in – depth knowledge about Radiological equipments and itsimaging techniques.

Unit I

X – RAYS: Principles and production of soft and hard X rays, Selection of anodes, Heel Pattern – Scattered radiation, Porter Bucky system, Cooling system

Unit II

RADIO DIAGNOSIS: Radiography, Angiography, Fluoroscopy, Image Intensifier, Multi section radiography

Unit III

SPECIAL RADIOLOGICAL EQUIPMENTS: Principle, Plane of Movement, Multi section Radiography, CAT, Principle of NMR, MRI

Unit IV

APPLICATION OF RADIOISOTOPES: Alpha, Beta and Gamma emission, Principle of radiation detectors, Dot scanners, nuclearangiogram, Principles of Radiation therapy

Unit V :

RADIATION SAFETY: Hazardous effect of Radiation, Radiation protection Techniques, Safety Limits, Radiation Monitoring

Text Books

1. Isaac Bankman, I. N. Bankman , Handbook of Medical Imaging: Processing and Analysis(Biomedical Engineering),Academic Press,2000
2. Jacob Beutel (Editor), M. Sonka (Editor), Handbook of Medical Imaging, Volume 2. Medical Image Processing and Analysis , SPIE Press 2000

Reference Book

1. Khandpur R.S, “Handbook of Biomedical Instrumentation”, Tata McGraw – Hill, New Delhi,2003.

12EI339 REHABILITATION ENGINEERING

Credits: 4:0:0

Course Objective:

- To provide knowledge about various types of assist devices and its applications.

Course Outcome:

At the end of the course, students

- Will have a good knowledge about various types of assist devices.
- Will have the ability to choose which type of assist device is suitable for various disorders.
- Will have idea about the legal aspects related to rehabilitation.

Unit I

PROSTHETIC AND ORTHOTIC DEVICES: Hand and arm replacement, Different types of models for externally powered limb prosthetics, Feedback in orthotic system, Material for prosthetic and orthotic devices, Mobility aids

Unit II

AUDITORY AND SPEECH ASSIST DEVICES : Types of deafness, Hearing aids, Application of DSP in hearing aids, Vestibular implants, Voice synthesizer, Speech trainer

Unit III

VISUAL AIDS: Ultra sonic and laser canes, Intra ocular lens, Braille Reader, Tactile devices for visually challenged, Text voice converter, Screen readers

Unit IV

MEDICAL STIMULATOR: Muscle and nerve stimulator, Location for Stimulation, Functional Electrical Stimulation, Sensory Assist Devices

Unit V

REHABILITATION MEDICINE AND ADVOCACY: Physiological aspects of Function recovery, Psychological aspects of Rehabilitation therapy, Legal aspect available in choosing the device and provision available in education, Job and in day to day life

Text Book

1. Albert M.Cook and Webster J.G, Therapeutic Medical devices, Prentice Hall Inc., NewJersy, 1982.

Reference Book

1. Levine.S.N.Editor, Advances in Bio Medical Engineering and Medical Physics, Inter University Publication, New York 1968.

12EI340 HOSPITAL MANAGEMENT SYSTEMS

Credits: 4:0:0

Course Objective:

- To understand the need and significance of Clinical Engineering and Health Policies.
- To familiarize the training strategies, quality management policies and information technology used in medicine and health care.

Course Outcome:

At the end of the course, students

- will appreciate the need for standard health policies and quality management in hospitals.
- will apply the knowledge of computer and information technology in health care.

Unit I

NEED AND SCOPES OF CLINICAL ENGINEERING: Clinical engineering program, Educational responsibilities, Role to be performed by them in hospital, Staff structure in hospital

Unit II

NATIONAL HEALTH POLICIES: Need for evolving health policy, Health organization in state, Health financing system, Health education, Health insurance, Health legislation

Unit III

TRAINING AND MANAGEMENT OF TECHNICAL STAFF IN HOSPITAL: Difference between hospital and industrial organization, Levels of training, Steps of training, Developing training program, Evaluation of training, Wages and salary, Employee appraisal method

Unit IV

STANDARDS, CODES AND QUALITY MANAGEMENT IN HEALTH CARE:

Quality management in hospitals and clinical laboratories, Necessity for standardization and quality management, NABH and NABL standards, FDA, Joint Commission of Accreditation of hospitals, ICRP and other standard organization, Methods to monitor the standards, Overview of Medical Device regulation and regulator y agencies

Unit V

COMPUTERS AND INFORMATION TECHNOLOGY IN MEDICINE AND HEALTHCARE: Computer application in ICU, Picture Archival System (PACS) for Radiological images department, Clinical laboratory administration, Patient data and medical records, Communication, Simulation

Text Book

1. Webster J.C. and Albert M.Cook, "Clinical Engineering Principle and Practice", Prentice Hall Inc., Englewood Cliffs, New Jersey, 1979 .

Reference Books

1. Goyal R.C., "Handbook of hospital personal management", Prentice Hall of India, 1996 .

12EI341 BIOMEDICAL SIGNAL PROCESSING

Credits: 4:0:0

Course Objective:

- To learn the techniques of signal processing that are fundamental to medical signal Processing applications.

Course Outcome:

At the end of the course, students

- Know various techniques in processing medical signals.
- Will have the ability to solve various types of practical approach in cardiac and other bio signals.

Unit I

INTRODUCTION TO RANDOM SIGNAL PROCESSING: Discrete Random Processes– Variance – Co – Variance – Scalar Product – Energy of Discrete Signals – Parseval's Theorem – Wiener Khintchine Relation – Sample Autocorrelation – Sum Decomposition Theorem Spectral Factorization Theorem – Characteristics of some dynamic biomedical signals, Noises – Random, Structured and physiological noises

Unit II

TIME SERIES ANALYSIS AND SPECTRAL ESTIMATION: Time series analysis – linear prediction models, Process order estimation, Lattice representation, Non stationary process, Fixed segmentation, Adaptive segmentation, Application in EEG, PCG signals, Time varying analysis of Heart – Rate variability, Model based ECG simulator – Spectral estimation – Blackman Tukey method, Periodogram and model based estimation – Application in Heart rate variability, PCG signals

Unit III

ADAPTIVE FILTERING AND WAVELET DETECTION: Filtering – LMS adaptive filter, Adaptive noise cancelling in ECG, Improved adaptive filtering in FECG, Wavelet detection in ECG – Structural features, Matched filtering, Adaptive wavelet detection, Detection of overlapping wavelets

Unit IV

BIOSIGNAL CLASSIFICATION AND RECOGNITION: Signal classification and recognition – Statistical signal classification, Linear discriminate function, Direct feature selection and ordering, Back propagation neural network based classification – Application in Normal versus Ectopic ECG beats

Unit V

TIME FREQUENCY AND MULTIVARIATE ANALYSIS: Time frequency representation, Spectrogram, Wigner distribution, Time – Scale representation, Scalogram, Wavelet analysis – Data reduction techniques, ECG data compression, ECG characterization, Feature extraction – Wavelet packets, Multivariate component analysis – PCA,ICA

Text Books

1. Willis J. Tompkins, Biomedical Digital Signal Processing, Prentice Hall of India, New Delhi, 2003.
2. KavyanNajarian and Robert Splerstor," Biomedical signals and Image processing", CRC – Taylor and Francis,New York,2006
3. K.P.Soman,K.IRamachandran,"Insight into wavelet from theory to practice", PHI, New Delhi,2004

Reference Books

1. Rangaraj M. Rangayyan, 'Biomedical Signal Analysis-A case study approach', Wiley-Interscience/IEEE Press, 2002
2. Emmanuel C. Ifeachor, Barrie W.Jervis, 'Digital Signal processing- A Practical Approach' Pearson education Ltd., 2002
3. Raghuveer M. Rao and AjithS.Bopardikar, Wavelets transform – Introduction to theory and its applications, Pearson Education, India 2000.
4. John L.Semmlow," Biosignal and Biomedical Image Processing Matlab Based applications" Marcel Dekker Inc.,New York,2004
5. Reddy. D. C.,"Biomedical Signal Processing – Principles and Techniques",TMH,New Delhi,2005
6. GariD.Clifford,FranciscoAzuaje and Patrick E.McSharry," Advanced Methods and Tech for ECG Data Analysis", ARTECH House,Boston,2006.
7. Arnon Cohen, Bio-Medical Signal Processing Vol I and Vol II, CRC Press Inc., Boca Rato, Florida 1999.

12EI342 BIO MEMS

Credits: 4:0:0

Course Objective:

- To understand a wide knowledge about MEMS and its role in medical Instrumentation area.

Course Outcome:
At the end of the course, students

- Will have basic knowledge about MEMS and Microsystems.
- Will have the exposure to micro opto electro mechanical systems.

Unit I
MEMS AND MICROSYSTEMS: Working principle of Microsystems, Materials for MEMS and Microsystems, Micromachining, System modeling and properties of materials

Unit II
MICROSENSORS AND ACUATORS: Mechanical sensors and actuators – Beam and cantilever, Piezoelectric materials, Thermal sensors and actuators – Micro machined thermocouple probe - Peltier effect heat pumps - Thermal flow sensors, Magnetic sensors and actuators – Magnetic Materials for MEMS Devices

Unit III
MICRO OPTO ELECTRO MECHANICAL SYSTEMS: Fundamental principle of MOEMS technology - Light modulators, Beam splitter - Micro lens, Digital micro mirror devices, Light detectors, Optical switch

Unit IV
MICROFLUIDIC SYSTEMS: Microscale fluid, Expression for liquid flow in a channel, Fluid actuation methods, Dielectrophoresis, Micro fluid dispenser - Micro needle, Micro pumps – Continuous flow system, Drug delivery system

Unit V
BIOMEDICAL APPLICATIONS: Micro total analysis systems (MicroTAS) – Detection and measurement methods, Microsystem approaches to polymerase chain reaction (PCR), DNA hybridization, Electronic nose,Bio chip

Text Books

1. Wanjun Wang, Steven A.Soper“ BioMEMS – Technologies and applications”, CRC Press, Boca Raton,2007.
2. Abraham P. Lee and James L. Lee, BioMEMS and Biomedical Nano Technology, Volume I, Springer 2006.

Reference Books

1. Tai Ran Hsu , “MEMS and Microsystems design and manufacture”, Tata McGraw Hill Publishing Company, New Delhi, 2002.
2. NitaigourPremchandMahalik, “ MEMS”, Tata McGraw Hill Publishing Company, NewDelhi, 2007.

12EI343 MEDICAL INFORMATICS

Credits: 4:0:0

Course Objective:

- To learn about the current scenario in medical informatics.
- To study the tools used in medical information systems.

- To understand real time applications of medical informatics used in biomedical field.

Course Outcome:

At the end of the course the students

- Will be able to demonstrate a thorough understanding of how medical information is created, interpreted, stored and used.
- will proficient in the use of Internet and on – line database resources to find relevant information .
- will understand how doctors use information to make decisions.
- will be aware of how telematics and information science will affect how they manage information when they qualify.

Unit I

INTRODUCTION TO MEDICAL INFORMATICS: Introduction to Medical informatics – Historical highlights – Medical Informatics programs–MI organizations – Structure of medical informatics – Medical informatics standards – Health level 7 – Medical data formats – PACS (picture Archiving Communication system standards) – DICOM standards and Quality improvement – Career in Medical informatics

Unit II

COMPUTER BASED MEDICAL INFORMATION RETRIEVAL: Database – DBMS basics – Types – Private, Public database – MEDLARS – PubMed– Bibliographic databases – Non bibliographic databases – Other databases important to medicine – Medical information from internet – web based search engines – Online databases – Electronic publishing – Electronic journals

Unit III

HOSPITAL INFORMATION SYSTEM & CPR: HIS Introduction – HIS functional areas – Advantages – Various modules – Central registration module – Patient care module – Blood bank module – Operation theatre module – Health information Resources – Electronic health record– Components –Need – Advantages and limitations, Paper based medical record, Personal health record

Unit IV

COMPUTER ASSISTED MEDICAL DECISION MAKING: Artificial intelligence in medicine – Expert systems in medicine – Need for expert systems – Applications – Computer aided decision making – General model – Tools for decision making – Various approaches – Categorical, Probabilistic, Artificial intelligence approaches – Semantic networks, Cognitive models, ANN – medical applications – Decision tree with examples

Unit V

APPLICATIONS OF MEDICAL INFORMATICS:

Computer assisted medical education and patient education: The Personal Health Record, Smart Cards, Wireless, RFID, Surgical Simulation – Virtual reality – Virtual environment – Three dimensional imaging – Virtual endoscopy – Tele education – Telemonitoring – Tele surgery – Materials and methods – Applications – Internet resources

Bio Informatics: Introduction to Bioinformatics – Biological databases – Protein sequence databases – Training for bioinformatics and computational biology – Importance of bioinformatics in medical treatment – Human genome project – Drug discovery and drug designing with suitable illustrations

Text Books

1. MohanBansal" Medical Informatics – A Primer", Tata MCGraw Hill publishing company limited 2003.
2. Lele R.D. "Computers in Medicine", Tata MCGraw – Hill Publishing company limited, second reprint 2008.

Reference Books

1. Robert Hoyt, Melanie Sutton, Ann Yoshihashi,"Medical Informatics: Practical Guide for the Healthcare Professional", 2007, ISBN – 13:978 – 1 – 4303 – 2162 – 0.
2. Edward HanceShortliffe, James J. Cimino," Biomedical informatics: computer applications in health care and biomedicine , Springer, 2006.
3. Joseph D Bronzino, "Biomedical engineering handbook Vol 2", 2000, CRC press.

12EI344 BIOMATERIALS

Credits: 4:0:0

Course Objective:

- To study the characteristics and classification of Biomaterials.
- To study about the different metals and ceramics used as biomaterials.
- To learn about polymeric materials and combinations that could be used as a tissue replacement implants.
- To study the artificial organ developed using these materials.

Course Outcome:

At the end of the course students will be able

- To understand the properties of the Bio compatible materials.
- To know the different types of Biomaterials.
- To design artificial organs using tissue materials.

Unit I

STRUCTURE OF BIO – MATERIALS AND BIO – COMPATIBILITY: Definition and classification of bio – Materials, Mechanical properties, Visco elasticity, Wound – healing process, Body response to implants, Blood compatibility, Biological evaluation of materials based on ISO 10993, Physical characterization, Surface characterization, Thermal characterization, SEM, TEM, X ray difractometry

Unit II

IMPLANT MATERIALS : Metallic implant materials, Stainless steels, Co – based alloys, Ti – based alloys, Ceramic implant materials, Aluminum oxides, Hydroxyapatite glass ceramics carbons, Medical applications

Unit III

POLYMERIC IMPLANT MATERIALS: Polymerisation – Polyolefin – Polyamicles – Acryrilic –Polymers –Rubbers – High strength thermoplastics – Medical applications

Unit IV
TISSUE REPLACEMENT IMPLANTS: Soft – tissue replacements, Sutures, Surgical tapes, Adhesive, Percutaneous and skin implants, Maxillofacial augmentation, Blood interfacing implants, Hard tissue replacement implants, Internal fracture fixation devices, Joint replacements

Unit V
ARTIFICIAL ORGANS: Artificial Heart, Prosthetic Cardiac Valves, Limb prosthesis, Externally Powered limb Prosthesis, Dental Implants.

Text Book

1. Jonathan Black, "Biological Performance of Materials Fundamentals of Biocompatibility", USA, 2004.

Reference Books

1. Joon Bu Park, Roderic S. Lakes, "Biomaterials: an introduction", New York, 2007.
2. Rater B.D. "Biomaterials Sciences – An Introduction to Materials in Medicine" Academic Press ,China 2004.
3. Joon Bu Park, Joseph D. Bronzino, 'Biomaterials: principles and applications', CRC press, USA, 2003.
4. TeohSweeHin, SweeHinTeoh, 'Engineering materials for biomedical applications' World Scientific Publishing Co, USA, 2004.
5. Sujata V. Bhat, 'Biomaterials', Narosa Publishing House, New Delhi, 2002.

12EI345 MEDICAL DEVICES SAFETY

Credits: 4:0:0

Course Objective:

- To provide a source of useful ideas, concepts, and techniques that could be selectively applied to reduce an intolerable rate of unacceptable errors, mistakes, goofs, or shortcomings in expected Medical Device performance.
- To avoid patient injury, achieving efficacious treatment, and controlling health care costs.
- Medical error has proved to be a difficult and recalcitrant phenomenon.

Course Outcome:
At the end of the course the students

- Will have the knowledge about the prevention of medical errors may seem to be a relatively simple task, and with heightened awareness, some improvements can be reported.
- Will be able to search for reasonable, acceptable, and more effective remedies and countermeasures in medical device errors.
- Will have better understanding, knowledge, and directed motivation, there should be rapid advancement in the medical device management discipline.

Unit I
RELIABILITY AND SAFETY TESTING: Reliability – Types of reliability – Reliability optimization & assurance – Reliability's effect on medical devices – The concept of failure – Causes of failure – Types of Failures in Medical devices – Safety testing – Device specific

safety goals, Failure assessment and Documentation – Visual inspection: External & Internal visual inspection – Measurement – Safety parameters, Function test

Unit II

RISK MANAGEMENT: Safety and risk management – Risk, Deciding on acceptable risk, Factors important to medical device risk assessment – Risk management – Tools for risk estimation – Liability – Manufacturer's and physician's responsibilities

Unit III

MEDICAL DEVICES HANDLING, ENVIRONMENTAL & ECOLOGICAL SAFETY: Safe medical devices – Handling and operation – Medical Application safety – Usability – Clinical assessment – Environmental safety – Interference with the environment – Environmental conditions, Impact on the environment – Ecological safety

Unit IV

MECHANICAL AND ELECTRICAL SAFETY: Safety Mechanics – Electrical Safety – Biological aspect – Limitation of Voltages - Macroshock and Microshock – Earth and Protection – Leakage currents – Magnetic fields and compatibility – Basic assumptions in safety technology – Safety classes

Unit V

MEDICAL DEVICES STANDARDS, REGULATIONS & DIRECTIVES: Medical Standards and Regulations – Device classification – Registration and listing – Declaration of conformance to a recognized standard – Investigational Device Exemptions (IDEs) – Institutional Review Boards (IRBs) – IDE format – Good laboratory practices (GLPs) – Good manufacturing practices (GMPs) – Human factors – Design control – The Medical Devices Directives (MDD) – Definition, Process and choosing the appropriate directive – Active Implantable Medical Devices Directive (AIMDD) – In Vitro Diagnostic Medical Devices Directive (IVDMDD).

Text Books

1. Bertil Jacobson and alan Murray, "Medical Devices Use and Safety", Elsvier Limited, 2007.
2. Richard Fries,"Reliable Design of Medical Devices – Second Edition", CRC Press, Taylor & Francis Group, 2006.
3. Norbert Leitgeb "SafetyofElectromedicalDevicesLaw – Risks – Opportunities", Springer Verlog/Wein, 2010.

Reference Books

1. Gordon R Higson, "Medical Device Safety – The regulation of Medical Devices for Public Health and Safety", IOP Publishing Limited, Bristol and Philadelphia, 2002.
2. Shayne Cox Gad, "Safety Evaluation of Medical Devices" Second Edition, Marcel Dekker Inc., 2002.

12EI346 BIO VIRTUAL INSTRUMENTATION LABORATORY

Credits: 0:0:2

Course Objective:

- To strengthen the knowledge of Virtual Instrumentation Using LabVIEW
- To introduce the concept Data Acquisition Using LabView

Course Outcome:

- Students will have knowledge of LabVIEW
- Students will have the knowledge on DAQ Cards
- Students will be able to analyze real world signal using LabVIEW

List of Experiments:

1. Introduction to LabVIEW I
2. Introduction to LabVIEW II
3. Waveform Generation
4. Frequency Measurement
5. Analog Input/Output Interface
6. Network Interface
7. Thermocouple Interface.
8. Embedded Implementation Of Digital Filter Using SPEEDY33
9. Analysis Of ECG
10. Analysis Of EMG
11. Analysis Of PCG
12. Analysis Of PPG

12EI347 EMBEDDED VIRTUAL INSTRUMENTATION LABORATORY

Credits: 0:0:2

Course Objective:

- To strengthen the knowledge of Virtual Instrumentation Using LabVIEW.
- To introduce the concept Embedded Programming Using LabView.

Course Outcome:

- Students will have knowledge of LabVIEW.
- Students will have the knowledge on Embedded Programing.
- Students will be able to Implement Embedded Application using - LabVIEW Graphical Programming

List of Experiments:

1. Introduction to LabVIEW I
2. Introduction to LabVIEW II
3. Waveform Generation
4. Frequency Measurement
5. Analog Input/Output Interface
6. Network Interface
7. Thermocouple Interface.
8. Generation of ECHO using SPEEDY33 - DSP Processor
9. Embedded Implementation Of Digital Filter Using SPEEDY33- DSP Processor
10. Embedded Implementation Control Algorithm Using SBRIO 9631 - FPGA

11. Embedded Implementation Control Algorithm Using ARM 7 Processor
12. Embedded Implementation Control Algorithm Using LM3S8962 ARM CORTEX-M3

12EI348 ADVANCED INSTRUMENTATION AND PROCESS CONTROL FOR FOOD ENGINEERS

Credits: 4:0:0

Course Objective:

- To introduce the concept of process instruments for various physical variables, system, automation.

Course Outcome:

At the end of the course the student will

- Apply the knowledge of Measurement to various applications.
- Analyze the characteristics of Instrumentation systems.

Unit I

BASIC CONCEPTS OF MEASUREMENT AND CONTROL: Purpose of Instrumentation– Measurement and its aim– Functional Elements of an Instrument– Performance Characteristics – Static and Dynamics Characteristics– Instrumentation symbols and labels – Control System– Open loop and closed loop systems– Response of First Order system for Unit Step input– Response of Second Order system for Unit Step Input.

Unit II

TEMPERATURE AND PRESSURE MEASUREMENT: Pressure measurement: Pressure Standards, Types of manometers, Elastic elements, McLeod gauge, Ionization gauge, Thermal Conductivity Gauge:Pirani Gauge, Thermocouple Gauge, Temperature Measurement: Temperature standards, Expansion Thermometer, Filled System Thermometer, Pyrometers, Thermocouple, RTD, Thermistor

Unit III

OTHER PROCESS MEASUREMENTS: Level Measurement: Direct methods, Radiation Level Detector, Ultrasonic Level Detector – Flow Measurement: Turbine flowmeter, Rotameter, Electromagnetic flowmeter, Ultrasonic flowmeter – Measurement of pH – Viscosity

Unit IV

PROCESS AUTOMATION: Process Variables– Degrees of Freedom– Control Modes: P– PI– PID – Final Control element: Actuators– Control Valve characteristics– Control Valve types

Unit V

COMPLEX CONTROL TECHNIQUES: Cascade control– Ratio control– Feed forward control– Split Range Control– Inferential Control – Case studies: Distillation column, Chemical reactor, Heat exchanger, Condenser, Evaporator

Text Books

1. Singh. S. K., “Industrial Instrumentation and Control”,2nd Edition, Tata McGraw– Hill, New Delhi, 2004.

2. Curtis Johnson, D., “Process Control Instrumentation Technology”, Prentice Hall of India,2006.
3. Coughanowr, and Koppel,“ Process systems analysis and control” , Tata McGraw– Hill, New Delhi,2004.

Reference Books

1. Seborg. D. E., Edger. T. F, and Millichamp. D. A, “Process Dynamics and Control”,John Wiley and Sons, Newyork,2004.
2. Roffle. B., Betlem. B. H. L., “Advanced Practical Control”, Springer, Newyork,2004.
3. Stephanopoulos, “Chemical Process Control”, 2nd Edition, Prentice Hall, NewDelhi, 2003.

LIST OF SUBJECTS

Subject code	Name of the Subject	Credits
13EI301	Control System Design	3:1:0
13EI302	Multi Sensor Data Fusion	4:0:0
13EI303	Design of Embedded Systems	4:0:0
13EI304	Control of Electric Drives	4:0:0
13EI305	Principles of Robotics	4:0:0
13EI306	Advanced Topics in Nonlinear Control	4:0:0
13EI307	System Identification and Adaptive Control	3:1:0
13EI308	Embedded Communication Software Design	4:0:0
13EI309	Adhoc networks	4:0:0
13EI310	Distributed Embedded Computing	4:0:0
13EI311	Applications of MEMS Technology	4:0:0
13EI312	Nanosensors and Transducers	4:0:0

13EI301 CONTROL SYSTEM DESIGN

Credits : 3:1:0

Objective:

- To impart the knowledge of controllers and compensators.
- To make the students to study the basic concepts of discrete domain representation of the system.
- To guide the students to design filters, optimal discrete controllers.

Outcome:

- Design controllers, compensators, optimal control systems, filters and estimate the states

Unit I

CONVENTIONAL DESIGN METHODS

Design specifications - PID controllers and compensators - Root locus based design - Bode based design - Design examples

Unit II

DESIGN IN DISCRETE DOMAIN

Sample and Hold - Digital equivalents - Impulse and step invariant transformations - Methods of discretisation - Effect of sampling - Direct discrete design – Discrete root locus - Design examples

Unit III

OPTIMAL CONTROL

Formation of optimal control problems - Results of Calculus of variations - Hamiltonian formulation - solution of optimal control problems - Evaluation of Riccati’s equation State and output Regulator problems - Design examples

Unit IV

DISCRETE STATE VARIABLE DESIGN

Discrete pole placement - State and output feedback - Estimated state feedback - Discrete optimal control - Dynamic programming - Design examples

Unit V

STATE ESTIMATION

State Estimation Problem - State estimation - Luenberger's observer - Noise characteristics - Kalman - Bucy filter - Separation Theorem - Controller Design - Wiener filter - Design examples.

References

1. M. Gopal "Modern control system Theory" New Age International, 2005.
2. Benjamin C. Kuo "Digital control systems", Oxford University Press, 2004.
3. G. F. Franklin, J. D. Powell and A. E. Naeini "Feedback Control of Dynamic Systems", PHI (Pearson), 2002.
4. Graham C. Goodwin, Stefan F. Graebe and Mario E. Salgado "Control system Design", PHI (Pearson), 2003.
5. G. F. Franklin, J. D. Powell and M Workman, "Digital Control of Dynamic Systems", PHI (Pearson), 2002.
6. B.D.O. Anderson and J.B. Moore., 'Optimal Filtering', Prentice hall Inc., N.J., Second version published in 2005.
7. Loan D. Landau, Gianluca Zito," Digital Control Systems, Design, Identification and Implementation", Springer, 2006.

13EI302 MULTI SENSOR DATA FUSION

Credits: 4:0:0

Objective:

- To impart the concepts multi sensor data fusion technique.
- To Give an exposure about the data fusion algorithm

Outcome:

- Use multi sensor data fusion technique for practical applications
- Develop data fusion algorithm for various systems

Unit I

MULTISENSOR DATA FUSION INTRODUCTION

Sensors and sensor data - Use of multiple sensors - Fusion applications - The inference hierarchy - Output data - Data fusion model - Architectural concepts and issues - Benefits of data fusion - Mathematical tools used – Algorithms - Co-ordinate transformations - Rigid body motion - Dependability and Markov chains - Meta-heuristics

Unit II

ALGORITHMS FOR DATA FUSION

Taxonomy of algorithms for multisensor data fusion - Data association - Identity declaration

Unit III

ESTIMATION

Kalman filtering - Practical aspects of Kalman filtering - Extended Kalman filters - Decision level identify fusion - Knowledge based approaches

Unit IV

ADVANCED FILTERING

Data information filter - Extended information filter - Decentralized and scalable decentralized estimation - Sensor fusion and approximate agreement - Optimal sensor fusion using range trees recursively. Distributed dynamic sensor fusion

Unit V

HIGH PERFORMANCE DATA STRUCTURES

Tessellated – Trees - Graphs and function - Representing ranges and uncertainty in data structures - Designing optimal sensor systems with in dependability bounds - Implementing data fusion system

References

1. David L. Hall and Sonya AH McMullen, Mathematical techniques in Multisensor data fusion 2nd Edition, Artech House, Inc., Norwood,MA, March,2004.
2. R.R. Brooks and S.S. Iyengar, Multisensor Fusion: Fundamentals and Applications with Software, Prentice Hall Inc., New Jersey, 1998.
3. Arthur Gelb, Applied Optimal Estimation, The Analytic Sciences Corporation, M.I.T. Press, 2001.
4. James V. Candy, Signal Processing: The Model Based Approach, McGraw –Hill Book Company, 1987.

13EI303 DESIGN OF EMBEDDED SYSTEMS

Credits: 4:0:0

Objective:

- To impart the concepts of Embedded Design life cycle
- To train the students to use in circuit emulator

Outcome:

- develop Embedded System
- Students will have the knowledge to use in circuit emulator

Unit I

EMBEDDED DESIGN LIFE CYCLE

Product specification – Hardware / Software partitioning – Detailed hardware and software design – Integration – Product testing – Selection Processes – Microprocessor Vs Micro Controller – Performance tools – Bench marking – RTOS Micro-Controller – Performance tools – Benchmarking – RTOS availability – Tool chain availability – Other issues in selection processes

Unit II

PARTITIONING DECISION

Hardware / Software duality – Coding Hardware – ASIC revolution – Managing the Risk – Co - verification – Execution environment – Memory organization – System startup – Hardware manipulation – Memory mapped access – Speed and code density

Unit III

INTERRUPT SERVICE ROUTINES

Watch dog timers – Flash Memory basic toolset – Host based debugging – Remote debugging – ROM emulators – Logic analyser – Caches – Computer optimisation – Statistical profiling

Unit IV

IN CIRCUIT EMULATORS

Bullet proof run control – Real time trace – Hardware break points – Overlay memory – Timing constraints – Usage issues – Triggers.

Unit V

TESTING

Bug tracking – reduction of risks & costs – Performance – Unit testing – Regression testing – Choosing test cases – Functional tests – Coverage tests – Testing embedded software – Performance testing – Maintenance.

References

1. Arnold S. Berger – "Embedded System Design", CMP books, USA 2002.
2. Sriram V Iyer and Pankaj Gupta "Embedded Real time System Programming" TATA McGraw Hill, 2004.
3. ARKIN, R.C., Behaviour - based Robotics, The MIT Press, 1998.

13EI304 CONTROL OF ELECTRIC DRIVES

Credits: 4:0:0

Objective:
- To inculcate the usage of Electric Drives
- To develop the mathematical modelling of frequency controlled drive

Outcome:
- Design control systems for Electric Drives
- Develop the mathematical model of frequency controlled drive

Unit I
CONVERTER FED DC DRIVES
Microcontroller hardware circuit - Flow charts – Waveforms - Performance characteristics of dc drives fed through single phase converter - 3-phase converters - Dual converters - 1-phase fully controlled converter and 3-phase fully controlled converter fed dc drive

Unit II
CHOPPER FED DC DRIVES
Microcontroller hardware circuits and waveforms of various modes of operation of chopper fed DC drives

Unit III
INVERTER FED INDUCTION MOTOR DRIVE
Microcomputer controlled VSI fed induction motor drive - Detailed power circuit - Generation of firing pulses and firing circuit - Flow charts and waveforms for 1-phase, 3-phase Non-PWM and 3-phase PWM VSI fed induction motor drives - Sampling techniques for PWM inverter

Unit IV
MATHEMATICAL MODELING OF FREQUENCY CONTROLLED DRIVE
Development of mathematical model for various components of frequency controlled induction drive - Mathematical model of the system for steady state and dynamic behaviour - Study of stability based on the dynamic model of the system

Unit V
CLOSED LOOP CONTROL OF MICROCOMPUTER BASED DRIVES
Voltage, Current, Torque and Speed measurements using digital measurement techniques - Types of controllers - Position and velocity measurement algorithm - Closed loop control of microcomputer based drives

Text Books

1. Bose.B.K., Power Electronics and Motor Drives - Advances and Trends, IEEE Press, 2006.
2. Buxbaum, A. Schierau, and K.Staughen, "A design of control systems for DC drives", Springer - Verlag, Berlin,1990.
3. Thyristor control of Electric drives, Vedam Subrahmanyam, Tata McGraw Hill,2008.

References

1. R.Krishnan, "Electric Motor Drives, Modeling, Analysis and Control" Prentice Hall of India, 2002.
2. Bin Wu, "High Power Converters and AC Drives", IEEE Press, A John Wiley and Sons, Inc., 2006.
3. Dubey G.K., Power semiconductor controlled drives, Prentice - HALL 2000.
4. Leonard W, Control of Electric Drives, Springer Verlag, NY, 2001.
5. Bose B.K., Microcomputer control of power electronics and drives, IEEE Press, 1987.
6. Bose B.K., Adjustable Speed A.C. drives, IEEE Press, 1993.

13EI305 PRINCIPLES OF ROBOTICS

Credits: 4:0:0

Objective:

- To introduce the Basic concepts of robots, the instrumentation involved, Robot Dynamics and Kinematics and Applications

Outcome:

- Design Robot Control System.
- Develop Vision based Robotic applications.

Unit I
INTRODUCTION AND TERMINOLOGIES
Definition - Classification - History - Robots components - Degrees of freedom - Robot joints coordinates - Reference frames - Workspace - Robot languages - Actuators - Sensors - Position, Velocity and acceleration sensors - Torque sensors - Tactile and touch sensors proximity and range sensors - Social issues

Unit II
KINEMATICS
Mechanism - Matrix representation - Homogenous transformation - DH representation - Inverse kinematics - Solution and programming - Degeneracy and dexterity

Unit III
DIFFERENTIAL MOTION AND VELOCITIES
Jacobian - Differential motion of frames - Interpretation - Calculation of Jacobian - Inverse Jacobian - Design - Lagrangian mechanics - Dynamic equations - Static force analysis

Unit IV
ROBOT CONTROL SYSTEM
Sensor characteristics - Hydraulic, Pneumatic and electric actuators - Trajectory planning decentalised PID control - Non-linear decoupling control

Unit V
IMAGE PROCESSING AND VISION SYSTEMS
Two and three dimensional images - Spatial and frequency domain representation - Noise and edges - Convolution masks - Processing techniques - Thresholding - Noise reduction - Edge detection - Segmentation - Image analysis and object recognition

References

1. Saeed B. Niku ,"Introduction to Robotics ", Pearson Education, 2002
2. K.S.Fu, Ralph Gonzalez and C.S.G.Lee,"Robotics ", TATA McGraw Hill, Aug.,2008.
3. R.D. Klafter, TA Chmielewski and Michael Negin, "Robotic Engineering, An Integrated approach", Prentice Hall of India, 2003.

13EI306 ADVANCED TOPICS IN NONLINEAR CONTROL

Credits : 4:0:0

Objective:
- To introduce the concepts of non - linear control theory and stability analysis

Outcome:
- Design Stable controllers for non – linear systems
- Develop backstepping algorithms for control applications

Unit I
PERTURBATION THEORY
Vanishing and Non vanishing Perturbations – Continuity of solutions on the infinite interval – Interconnected systems – Slowly varying systems – Perturbation method – Averaging - Weakly nonlinear second-order oscillators – Exercises

Unit II
SINGULAR PERTURBATIONS
Standard singular perturbation model – Time scale properties – Singular perturbation on the infinite interval – Slow and fast manifolds – Stability analysis – Exercises

Unit III
GAIN SCHEDULING AND FEEDBACK LINEARIZATION
Control problem – Stabilization via linearization – Integral control via linearization – Gain scheduling – Input output linearization – Full state linearization – State feedback control – Tracking - Exercises

Unit IV
INPUT - OUTPUT STABILITY
L stability – L stability of state models – L2 gain – Feedback system: small gain theorem – Exercises – Passivity – State models - L2 and Lyapunov stability

Unit V
BACKSTEPPING CONTROL ALGORITHMS
Passivity based control – High gain observers – Stabilization – Regulation via integral control – Exercises

References

1. Hasan Khalil," Nonlinear systems and control", 3rd ed, PHI, 2001.
2. Slotine, J A E Slotine and W Li, "Applied Nonlinear control",1991, PHI
3. S.H. Zak," Systems and control", Oxford University Press, 2003.

13EI307 SYSTEM IDENTIFICATION AND ADAPTIVE CONTROL

Credits: 3: 1: 0

Objective:

- To impart the concepts of system identification and adaptive control

Outcome:

- Identify the given process
- Design adaptive control.

Unit I

MODELS FOR IDENTIFICATION

Models of LTI systems: Linear Models - State space Models - OE model - Model sets, Structures and Identifiability - Models for Time - varying and Non - linear systems: Models with Nonlinearities - Non-linear state - Space models - Black box models - Fuzzy models

Unit II

NON - PARAMETRIC AND PARAMETRIC IDENTIFICATON

Transient response and Correlation Analysis – Frequency response analysis – Spectral Analysis – Least Square – Recursive Least Square –Forgetting factor - Maximum Likelihood – Instrumental Variable methods

Unit III

NON - LINEAR IDENTIFICATION AND MODEL VALIDATION

Open and closed loop identification: Approaches – Direct and indirect identification – Joint input-output identification – Non - linear system identification – Wiener models – Power series expansions - State estimation techniques – Non linear identification using Neural Network and Fuzzy Logic

Unit IV

ADAPTIVE COTROL AND ADAPTATION TECHNIQUES

Introduction – Uses – Auto tuning – Self Tuning Regulators (STR) – Model Reference Adaptive Control (MRAC) – Types of STR and MRAC – Different approaches to selftuning regulators – Stochastic Adaptive control – Gain Scheduling

Unit V

CASE STUDIES

Inverted Pendulum - Robot arm - Process control application: heat exchanger, Distillation column - Application to power system - Ship steering control

References

1. Lennart Ljung, “System Identification Theory for the User”, Prentice Hall, Inc., NJ, 1999.
2. Torsten Soderstrom, Petre Stoica, “System Identification”, prentice Hall ` International (UK) Ltd,1994.
3. Astrom and Wittenmark,” Adaptive Control Second Edition”, Addison - Wesley Publishing Company 1995.
4. William S. Levine, “ Control Hand Book” CRC Press, Jaico Publishing House, 1999.
5. Narendra and Annasamy,” Stable Adaptive Control Systems, Prentice Hall, Inc., 2005.

13EI308 EMBEDDED COMMUNICATION SOFTWARE DESIGN

Credits: 4: 0: 0

Objective:

- To introduce the aspects of the design and development of an embedded system, including hardware and embedded software development.

Outcome:

- The students will able to develop embedded software

Unit I
OSI REFERENCE MODEL
Communication Devices – Communication Echo System – Design Consideration – Host Based Communication – Embedded Communication System – OS Vs RTOS

Unit II
SOFTWARE PARTITIONING
Limitation of strict Layering – Tasks and Modules – Modules and Task Decomposition – Layer2 Switch – Layer3 Switch / Routers – Protocol Implementation – Management Types – Debugging Protocols

Unit III
TABLES AND OTHER DATA STRUCTURES
Partitioning of Structures and Tables – Implementation – Speeding Up access – Table Resizing – Table access routines – Buffer and Timer Management – Third Party Protocol Libraries

Unit IV
MANAGEMENT SOFTWARE
Device Management – Management Schemes – Router Management – Management of Sub System Architecture – Device to manage configuration – System Start up and configuration

Unit V
MULTI BOARD COMMUNICATION SOFTWARE DESIGN
Multi Board Architecture – Single control Card and Multiple line Card Architecture – Interface for Multi Board software – Failures and Fault – Tolerance in Multi Board Systems – Hardware independent development – Using a COTS Board – Development Environment – Test Tools

References

1. Sridhar .T, “Designing Embedded Communication Software” CMP Books, 2003.
2. Comer.D, ”Computer networks and Internet”, Third Edition, Prentice Hall, 2001.

13EI309 ADHOC NETWORKS

Credits: 4:0:0

Objective:
To introduce the concept of various protocols applicable in embedded development

Outcome:
The students will able to design embedded interfaces

Unit I
WIRELESS LAN, PAN, WAN AND MAN
Characteristics of wireless channel -Fundamentals of WLANs, IEEE 802.11 standard - HIPERLAN Standard - First, Second, and third generation cellular systems – WLL -Wireless ATM - IEEE 802.16 standard – HIPERACCESS - AdHoc Wireless Internet

Unit II
MAC, ROUTING AND MULTICAST ROUTING PROTOCOLS
MAC Protocols: Design issues, goals and classification - Contention–based protocols with reservation and scheduling mechanisms - Protocols using directional antennas -Routing protocols: Design issues and classification - Table-driven - On-demand and Hybrid routing protocols - Routing protocols with efficient flooding mechanisms - Hierarchical and power - Aware routing protocols - Multicast Routing Protocols: Design issues and operation - Architecture reference model – Classification - Tree-based and Mesh-based protocols -Energy-efficient multicasting.

Unit III
TRANSPORT LAYER AND SECURITY PROTOCOLS
Transport layer Protocol: Design issues - Goals and classification - TCP over AdHoc wireless Networks – Security - Security requirements -Issues and challenges in security provisioning - Network security attack - Security routing - Quality of Service: Issues and challenges in providing QoS, Classification of QoS solutions, MAC layer solutions, Network layer solutions, QoS frameworks

Unit IV
ENERGY MANAGEMENT
Need - Classification of battery management schemes - Transmission power management
Schemes - System power management schemes
Wireless Sensor Networks: Architecture - Data dissemination - Date gathering - MAC
Protocols - Location discovery - Quality of a sensor network

Unit V
PERFORMANCE ANALYSIS
ABR beaconing - Performance parameters - Route-discovery time - End-to-end delay
Performance - Communication throughput performance - Packet loss performance - Route
reconfiguration/repair time - TCP/IP based applications

References

1. C. Siva Ram Murthy and B.S. Manoj, AdHoc Wireless Networks: Architectures and protocols, Prentice Hall PTR, 2004
2. C. - K.Toh, AdHoc Mobile Wireless Networks: Protocols and Systems, Prentice Hall PTR, 2001
3. Mohammad Ilyas, The Handbook of AdHoc Wireless Networks, CRC press, 2002
4. Charles E. Perkins, AdHoc Networking, Addison – Wesley, 2000
5. Stefano Basagni, Marco Conti, Silvia Giordano and Ivan Stojmenovic, Mobile AdHoc Networking, Wiley – IEEE press, 2004

13EI310 DISTRIBUTED EMBEDDED COMPUTING

Credits: 4: 0: 0

Objective:
To introduce the concept of internet, embedded agents and the architecture for distributed automation.

Outcome:

- Able to design higher end embedded applications using internet concepts.

Unit I
THE HARDWARE INFRASTRUCTURE
Broad Band Transmission facilities – Open Interconnection standards – Local Area Networks – Wide Area Networks – Network management – Network Security – Cluster computers.

Unit II
INTERNET CONCEPTS
Capabilities and limitations of the internet – Interfacing Internet server applications to corporate databases HTML and XML Web page design and the use of active components.

Unit III
DISTRIBUTED COMPUTING USING JAVA
IO streaming – Object serialization – Networking – Threading – RMI – Multicasting - Distributed databases – Embedded java concepts – Case studies

Unit IV
EMBEDDED AGENT
Introduction to the embedded agents – Embedded agent design criteria – Behaviour based, Functionality based embedded agents – Agent co - ordination mechanisms and benchmarks embedded - agent. Case study: Mobile robots.

Unit V
EMBEDDED COMPUTING ARCHITECTURE
Synthesis of the information technologies of distributed embedded systems – analog/digital co-design – Optimizing functional distribution in complex system design – Validation and fast prototyping of multiprocessor system - On-chip – A new dynamic scheduling algorithm for real - Time multiprocessor systems.

References

1. Dietel & Dietel, “JAVA how to program”, Prentice Hall, 2011.
2. Sape Mullender, “Distributed Systems”, Addison - Wesley, 1993.
3. George Coulouris and Jean Dollimore, “Distributed Systems – concepts and design”, Addison – Wesley 2009.
4. “Architecture and Design of Distributed Embedded Systems”, edited by Bernd Kleinjohann C - lab, Universitat Paderborn, Germany, Kluwer Academic Publishers, Boston, April 2001, 248 pp.

13EI311 APPLICATIONS OF MEMS TECHNOLOGY

Objective:
The understand the wide knowledge about MEMS and its applications

Outcome:
- The students will have exposure on the MEMS application

Unit I
MEMS: MICRO - FABRICATION, MATERIALS AND ELECTROMECHANICAL CONCEPTS
Overview of micro fabrication – Silicon and other material based fabrication processes – Concepts: Conductivity of semiconductors - Crystal planes and orientation - stress and strain - Flexural beam bending analysis - Torsional deflections - Intrinsic stress - Resonant frequency and quality factor.

Unit II
ELECTROSTATIC SENSORS AND ACTUATION
Principle, material, design and fabrication of parallel plate capacitors as electrostatic sensors and actuators – Applications.

Unit III
THERMAL SENSING AND ACTUATION
Principle – Material - Design and fabrication of thermal couples - Thermal bimorph sensors - Thermal resistor sensors - Applications

Unit IV
PIEZOELECTRIC SENSING AND ACTUATION
Piezoelectric effect - Cantilever piezo electric actuator model - Properties of piezoelectric materials – Applications.

Unit V
CASE STUDIES
Piezoresistive sensors - Magnetic actuation - Micro fluidics applications – Medical Applications - Optical MEMS.

References

1. Chang Liu, "Foundations of MEMS", Pearson International Edition, 2006.
2. Marc Madou , "Fundamentals of microfabrication",CRC Press, 2011.
3. Boston , "Micromachined Transducers Sourcebook",WCB McGraw Hill, 1998.
4. M.H.Bao "Micromechanical transducers: Pressure sensors, accelerometers and gyroscopes", Elsevier, Newyork, 2000.

13EI312 NANOSENSORS AND TRANSDUCERS

Credits: 4:0:0

Objective:

- To introduce the basic and advanced concepts of nanosensors and transducers for nanotechnology applications.

Outcome:

- Design nanosensors and transducers for various applications

Unit I

SENSOR CHARACTERISTICS AND PHYSICAL EFFECTS

Active and Passive sensors – Static characteristic: Accuracy, offset and linearity – Dynamic characteristic:First and second order sensors- Physical effects involved in signal transduction: Photoelectric effect – Photodielectric effect – Photoluminescence effect – Electroluminescence effect – Chemiluminiscence effect – Doppler effect – Barkhausen effect – Hall effect – Nernst / Ettinshausen effect – Thermoelectric effect – Piezoresistive effect – Piezoelectric effect – Pyroelectric effect – Magneto - mechanical effect (magnetostriction) – Magnetoresistive effect – Magneto optic Kerr effect – Kerr and Pockels effect

Unit II

SOLID STATE AND ACOUSTIC TRANSDUCERS

Solid state transducers: PN diodes or bipolar junction based transducers - Schottky diode based transducers - MOS capacitor based transducers -FET based transducers – Surface Plasmon resonance transducers - Acoustic wave transducers – Quartz crystal microbalance – Film Bulk acoustic wave resonator (BAW transducer) – Inter digitally launched surface acoustic wave transducer (SAW transducer) – Cantilever based transducers

Unit III

NANO FABRICATION AND PATTERNING TECHNIQUES

Synthesis of nanoparticles – Formation of thin films – Physical vapor deposition – Chemical vapor deposition(CVD) – Liquid Phase Techniques – Casting – Sol - gel – Nanolithography and nano patterning – LIGA - Ion implantation and Etching

Unit IV

NANO BASED INORGANIC SENSORS

Density and Number of states (DOS) (NOS) : DOS of 3D, 2D, 1D and 0D materials – One dimensional Transducer: gas sensors, gas sensing with nanostructured thin films – Nano optical sensors: Plasmon resonance sensors with nano particles – Magnetically Engineered Spintronic Sensors: AMR, Giant and colossal magnetoresistors – Magnetic tunneling junctions.

Unit V

ORGANIC BIOSENSORS

Proteins in nano technology enabled sensors: Structure of Protein, Role of protein in nanotechnology, Using protein in nanodevices - Antibodies in sensing, Antibody in nano particle conjugates - Enzymes in sensing, Enzyme nanoparticle hybrid sensors, Motor proteins in sensing, transmembrane sensors – Nano sensors based on Nucleotides and DNA: Structure of DNA – DNA decoders and microarrays –DNA protein conjugate based sensors – DNA based Bioelectronic sensors – DNA sequencing with nanopores – Sensors based on molecules with dendritic architectures – Biomagnetic sensors

Text Books

1. Nanotechnology enabled sensors by Kouroush Kalantar – Zadeh, Benjamin Fry, Springer Verlag New York, (2007).
2. Biosensing: International Research and Development, Jerome Schultz, Milar Mrksich, Sangeeta N. Bhatia, David J. Brady, Antionio J. Ricco, David R. Walt, Charles L. Wilkins, Springer 2006.