THAPAR UNIVERSITY

PROPOSED COURSES SCHEME

&

SYLLABUS

FOR

B.E.

ELECTRONICS (INSTRUMENTATION AND CONTROL)

2015

Applicable from July 2015 to all undergraduate engineering programs

ENGINEERING DEPARTMENTs –COURSE SCHEME (EIC)

SEMESTER – I

SR. NO.	COURSE NO.	TITLE	L	T	P	CR
1	UMA003	MATHEMATICS-I	3	1	0	3.5
2	UTA007	COMPUTER PROGRAMMING-I	3	0	2	4.0
3	UPH004	APPLIED PHYSICS	3	1	2	4.5
4	UEE001	ELECTRICAL ENGINEERING	3	1	2	4.5
5	UHU003	PROFESSIONAL COMMUNICATION	2	0	2	3.0
6	UTA008	ENGINEERING DESIGN-I	2	4	0	4.0
TOTAL			16	7	8	23.5

SEMESTER – II

SR. NO.	COURSE NO.	TITLE	L	T	P	CR
1	UMA004	MATHEMATICS-II	3	1	0	3.5
2	UTA009	COMPUTER PROGRAMMING-II	3	0	2	4.0
3	UES009	MECHANICS	2	1	2*	2.5
4	UEC001	ELECTRONIC ENGINEERING	3	1	2	4.5
5	UCB008	APPLIED CHEMISTRY	3	1	2	4.5
6	UTA010	ENGINEERING DESIGN-II (Catapult and more such projects) (with 6 self effort hours)	1	0	2	5.0
TOTAL			15	4	8	24

***** *Each student will attend one lab session of 2 hours in a semester for a bridge project in this course (mechanics)*

SEMESTER – III

SR. NO.	COURSE NO.	TITLE	L	T	P	CR
1	UMA031	OPTIMIZATION TECHNIQUES	3	1	0	3.5
2	UTA002	MANUFACTURING PROCESS	2	0	3	3.5
3	UES010	SOLIDS AND STRUCTURES	3	1	2	4.5
4	UES011	THERMO-FLUID	3	1	2	4.5
5	UTA011	ENGINEERING DESIGN-III (Buggy and more such projects with 8 self effort hours)	2	0	4	8.0
6	UEI403	ELECTRICAL AND ELECTRONIC MEASUREMENTS	3	1	2	4.5
TOTAL			16	4	13	28.5

SEMESTER – IV

SR. NO.	COURSE NO.	TITLE	L	T	P	CR
1	UHU005	HUMANITIES FOR ENGINEERS	2	0	2	3.0
2	UES012	ENGINEERING MATERIALS	3	1	2	4.5
3	UMAXXX	NUMERICAL ANALYSIS	3	1	2	4.5
4	UENXXX	ENERGY AND ENVIRONMENT	3	0	0	3.0
5	UEIXXX	SENSORS AND SIGNAL CONDITIONING WITH PROJECT (With 7 self-effort hours)	3	1	2	8.0
6	UEIXXX	TECHNIQUES ON SIGNALS AND SYSTEMS	3	1	0	3.5
TOTAL			17	4	8	26.5

** The L T P of Department Specific subjects may vary for different branches but the weekly contact hours should not exceed 32. The design projects have higher number of credits to compensate for self-effort hours each student is expected to put in.*

SEMESTER-V

SR. NO.	COURSE NO.	TITLE	L	T	P	CR
1	UEIXXX	CONTROL SYSTEMS	3	1	2	4.5
2	UEEXXX	ANALOG AND DIGITAL SYSTEMS	3	1	2	4.5
3	UEIXXX	INDUSTRIAL	3	1	2	4.5
4	UEIXXX	FUNDAMENTALS OF MICROPROCESSORS AND MICROCONTROLLERS	3	1	2	4.5
5	UEEXXX	NETWORK ANALYSIS AND SYNTHESIS	3	1	0	3.5
6	UEIXXX	ELECTIVE-I	3	1	0	3.5
7	-	INNOVATION AND ENTREPRENEURSHIP (With 5 self effort hours)	1	0	2	4.5
TOTAL			19	5	10	29.5

SEMESTER-VI

SR. NO.	COURSE NO.	TITLE	L	T	P	CR
1	UEIXXX	PROCESS DYNAMICS AND CONTROL	3	0	2	4.0
2	UEIXXX	ADVANCED CONTROL SYSTEMS	3	1	0	3.5
3	UEEXXX	POWER ELECTRONICS	3	1	2	4.5
4	UEIXXX	DIGITAL SIGNAL	3	1	2	4.5

		PROCESSING AND APPLICATIONS				
5	UEIXXX	BIO-MEDICAL INSTRUMENTATION	3	0	2	4.0
6	-	CAPSTONE PROJECT START (4 Self effort hours)	0	0	2	0.0
TOTAL			15	3	10	20.5

SEMESTER-VII

SR. NO.	COURSE NO.	TITLE	L	T	P	CR
1	UEIXXX	DATA ACQUISITION AND SYSTEM DESIGN	3	0	2	4.0
2	UEIXXX	ADVANCED PROCESS	3	1	2	4.5
3	UEIXXX	VIRTUAL	2	0	3	3.5
4	UEIXXX	CAPSTONE PROJECT (COMPLETION) (8 SEH)	0	0	2	8.0
5	UEEXXX	ELECTRICAL MACHINES	3	1	2	4.5
6		ELECTIVE-II	3	1	2	4.5
TOTAL			14	3	12	29.0

SEMESTER-VIII

SR. NO.	COURSE NO.	TITLE	L	T	P	CR
1	-	PROJECT	–	–	–	20.0
OR						
Alternate Project Semester						
1	-	DESIGN PROJECT	–	–	–	13.0
2	UEEXXX	ALTERNATE SOURCES OF	3	0	2	4.0
3	UEIXXX	ENVIRONMENTAL	3	0	0	3.0
TOTAL			6	0	2	20.0
OR						
1	-	START- UP SEMESTER	–	–	–	20.0

SR.NO.	COURSE NO.	TITLE	L	T	P	CR
1	UEEXXX	ENGINEERING	3	1	0	3.5
2	UEIXXX	BIO–SENSOR AND MEMS	3	1	0	3.5

3	UEIXXX	OPTICAL	3	1	0	3.5
4	UEIXXX	BIO–MEDICAL DSP	3	1	0	3.5
5	UEIXXX	ROBOTICS AND	3	1	0	3.5

ELECTIVE–II

SR. NO.	**COURSE NO.**	**TITLE**	**L**	**T**	**P**	**CR**
1	UEIXXX	ARTIFICIAL INTELLIGENT	3	1	2	4.
2	UEIXX	DIGITAL IMAGE	3	1	2	4
3	UCSXX	DATA STRUCTURES	3	1	2	4
4	UEIXX	ANALYTICAL	3	1	2	4
5	UCSXXX	OBJECT ORIENTED PROGRAMMING AND APPLICATIONS	3	1	2	4.5
6	UEIXX	EMBEDDED	3	1	2	4

TOTAL CREDITS: 201.5

UEI403: ELECTRICAL AND ELECTRONIC MEASUREMENTS

L	T	P	Cr
3	1	2	4.5

Course Objectives: To understand concepts of various electrical and electronic measuring instruments.

Electrical Standards: Standards of e.m.f. and resistance, Frequency dependence of resistance, Inductance and Capacitance, Time and frequency standards.
Electromechanical Indicating Instruments: PMMC galvanometer, Ohmmeter, Electrodynamometer, Moving iron meter, Rectifier and thermo-instruments, Comparison of various types of indicating instruments.
Power and Energy Measurement: Electrodynamometer type of wattmeter and power factor meter, Power in poly phase system: two wattmeter method, Single-phase induction and Electronic energy meters.
Instrument Transformers: Current and Voltage transformers, Constructional features, Ratio and Phase angle errors.
Magnetic Measurements: Determination of B-H curve and hysteresis loop, Measurement of iron losses with Llyod Fisher square.
Bridge Measurements: AC bridges: Applications and conditions for balance, Maxwell's bridge, Hay's bridge, Schering bridge, Wien's bridge, De Sauty's bridge, Insulation testing, Ground resistance measurement, Varley and Murray loop test.
Electronic Instruments: Electronic multimeter, Digital voltmeters, General characteristics ramp type voltmeter, Quantization error, Digital frequency meter/Timer, Q meter and its applications, Distortion meter, Wavemeter and Spectrum Analyzer, Block diagram and Applications of oscilloscopes, Storage type digital oscilloscopes.
Laboratory Work:
Experiments around sensitivity of wheat stone bridge, Comparison of various types of indicating instruments, Single-phase induction type energy meter, AC bridges, Measurement of iron losses with Llyod Fisher square, Storage type digital oscilloscopes.
Project: Development of power supplies using transformers.
Course Learning Outcomes (CLO): After the completion of the course the students will be able to:
1. compare various electromechanical indicating instruments,
2. measure power and energy
3. design various AC bridges
4. analyze various waveform with the help of storage oscilloscope

Text Book:
1. Golding, E.W., and Widdis, F.C., Electrical Measurements and Measuring Instruments, Pitman (2003).
2. Helfrick, A.D., and Cooper, W.D., Modern Electronic Instrumentation and Measurement Techniques, Prentice Hall of India (2007).

Reference Books:
1. Kalsi, H.S., Electronic Instrumentation, Tata McGraw-Hill (2007).
2. Nakra, B.C., Chaudhry, K.K., Instrumentation Measurement and Analysis, Tata McGraw-Hill (2003).

Evaluation Scheme:

S.NO.	Evaluation Elements	Weightage
1	MST	25
2	EST	35
3	Sessional (May include Assignments//Quizzes/Lab Evaluations)	40

UEIXXX: SENSORS AND SIGNAL CONDITIONING (WITH PROJECT)

L	T	P	Cr
3	**1**	**2**	**8**

Course Objectives: To introduce the basics of measurements. To elucidate sensors and signal conditioning circuits. To introduce different error analysis methods. To familiarize with different sensors and transducers. To explain signal conditioning circuits.

Introduction: Definition, Application and types of measurements, Instrument classification, Functional elements of an instrument, Input-output configuration of measuring instruments, Methods of correction for interfering and modifying inputs, Standards, Calibration, Introduction to Static characteristics and Dynamic characteristics, Selection of instruments, Loading effects.

Error Analysis: Types of errors, Methods of error analysis, Uncertainty analysis, Statistical analysis, Gaussian error distribution, Chi-Square test, Correlation coefficient, Student's t-test, Method of least square, Curve fitting, Graphical analysis, General consideration in data analysis, Design of Experiment planning.

Sensors/Transducers: Definition, Types, Basic principle and applications of Resistive, Inductive, Capacitive, Piezoelectric and their Dynamic performance. Fiber optic sensors, Bio-chemical sensors, Hall-Effect, Photoemissive, Photo Diode/ Photo Transistor, Photovoltaic, LVDT, Strain Gauge Digital transducers: Principle, Construction, Encoders, Absolute and incremental encoders, Silicon micro transducers.

Signal Conditioning: Operational Amplifiers: application in instrumentation, Charge amplifier, Carrier amplifier, Introduction to active filters, Classification, Butterworth, Chebyshev, Couir filters, First order, Second order and higher order filters, Voltage to frequency and frequency to voltage converters.

Laboratory Work: Measurement of Linear Displacement, Angular displacement, Temperature, Light intensity, Capacitance, Resistance, Inductance.

Project: Projects based upon sensors and signal conditioning i.e. temperature measuring system, Pressure Measuring system, Level measuring system etc.

Course Learning Outcomes (CLO):

After the successful completion of the course the students will be able to:

1. Apply different methods for the measurement of length and angle
2. Elucidate the construction and working of various industrial parameters / devices used to measure pressure, sound and flow
3. Explicate the construction and working of various industrial parameters / devices used to measure temperature, level, vibration, viscosity and humidity
4. Ability to analyse, formulate and select suitable sensor for the given industrial applications
5. Describe signal conditioning circuits

Text Books:

1. *Doebelin, E.O. and Manic, D.N., Measurement Systems: Applications and Design, McGraw –Hill (2004).*
2. *Sawhney, A.K. and Sawhney, P., A Course in Electrical and Electronic Measurements and Instrumentation, Dhanpat Rai (2008).*

Reference Books:

1. *Murthy, D.V.S., Transducers and Instrumentation, Prentice Hall of India (2003).*
2. *Nakra, B.C. and Chaudhry, K.K., Instrumentation, Measurement and Analysis, Tata McGraw Hill (2003).*

Evaluation Scheme:

S.NO.	**Evaluation Elements**	**Weightage (%)**
1	MST	20
2	EST	30
3	Sessional (May include Assignments//Quizzes/Lab Evaluations)	50

UEIXXX: TECHNIQUES ON SIGNALS AND SYSTEMS

L	T	P	Cr
3	1	0	3.5

Course Objectives: To introduce the basic concepts and processing of analog and digital signals.

Introduction: Signals and Systems, Classification of signals, Continuous time signals and its classifications, Standard continuous time signals, Classification of continuous time systems, Discrete time signals and its classifications, Concept of frequency in discrete time signals, Standard discrete time signals, Discrete time systems, Classification of discrete time systems, Nyquist rate, Sampling theorem, Aliasing, Convolution, Correlation.

Fourier Transform: Introduction, Condition for existence of Fourier Integral, Fourier Transform and its properties, Energy density and Power Spectral Density, Nyquist Theorem, System Analysis using Fourier Transform.

Z–Transform: Introduction, Region of Convergence(ROC), Properties of z–transform. Initial value theorem, Final Value theorem, Partial Sum, Parseval's Theorem, z–transform of standard sequences, Inverse z–transform, Pole–Zero plot, System function of LTI system, Causality and Stability in terms of z–transform.

Random Signals: Introduction, Probability, Random variables, Gaussian distribution, Transformation of random variables, random processes, stationary processes, Correlation and Covariance Functions.

Course Learning Outcomes (CLO):
After the successful completion of the course the students will be able to:

1. Apply sampling theorem for different applications
2. Solve problems related to Fourier transforms
3. Apply Fourier transforms for different applications
4. Apply z-transform and Laplace transform for system characterization
5. Elucidate the concepts of random signals

Text Books:

1. *Oppenheim, A.V. and Willsky, A.S., Signals and Systems, Prentice Hall of India (1997).*
2. *Proakis, J.G. and Manolakis, D.G., Digital Signal Processing: Principles, Algorithms and Applications, Prentice Hall (2007).*

Reference Books:

1. *Lathi, B.P., Signal Processing and Linear System, Oxford University Press (2008).*
2. *Roberts, M.J., Fundamentals of Signals and Systems, McGraw Hill (2007).*

Evaluation Scheme:

S.NO.	Evaluation Elements	Weightage (%)
1	MST	30
2	EST	45
3	Sessional (May include Assignments//Quizzes/Lab Evaluations)	25

UEIXXX: CONTROL SYSTEMS

L	T	P	Cr
3	**1**	**2**	**4.5**

Course Objectives: To understand concepts of the mathematical modeling, feedback control and stability analysis in Time and Frequency domains

Basic Concepts: Historical review, Definitions, Classification, Relative merits and demerits of open and closed loop systems, Linear and non-linear systems, Transfer function, , Block diagrams and signal flow graphs.

Components: D.C. and A.C. Servomotors, D.C. and A.C. Tachogenerators, Potentiometers and optical encoders, Synchros and stepper motors

Analysis: Steady-state errors and error constants, Concepts and applications of P, PD, PI and PID types of control.

Stability: Definition, Routh-Hurwitz criterion, Root locus techniques, Nyquist criterion, Bode plots, Relative stability, Gain margin and phase margins.

Compensation: Lead, Lag and lag-lead compensators, Design of compensating networks for specified control system performance.

State Space Analysis: Concepts of state, State variables and state models, State space equations, Transfer function, Transfer model, State space representation of dynamic systems, State transition matrix, Decomposition of transfer function, Controllability and observability.

Laboratory : Linear system simulator, Compensation design, D.C. position control and speed control, Synchro characteristics, Servo demonstration, Stepper motor, Potentiometer error detector, Rate control system, Series control system, Temperature control system.

Course Learning Outcomes (CLO):

After the successful completion of the course the students will be able to:

1. develop the mathematical model of the physical systems.
2. analyze the response of the closed and open loop systems.
3. analyze the stability of the closed and open loop systems.
4. design the various kinds of compensator.
5. develop and analyze state space models

Text Books:

1. *Gopal, M., Digital Control System, Wiley Eastern (1986).*
2. *Nagrath, I.J. and Gopal, M., Control System Engineering, New Age International (P) Limited, Publishers (2003).*
3. *Ogata, K., Modern Control Engineering, Prentice–Hall of India Private Limited (2001).*

Reference Books:

1. *Kuo, B.C., Automatic Control System, Prentice–Hall of India Private Limited (2002).*
2. *Sinha, N.K., Control System, New Age International (P) Limited, Publishers (2002).*

Evaluation Scheme:

S.NO.	**Evaluation Elements**	**Weightage**
1	MST	25
2	EST	35
3	Sessional (May include Assignments//Quizzes/Lab Evaluations)	40

UEIXXX: INDUSTRIAL INSTRUMENTATION

L	T	P	Cr
3	1	2	4.5

Course objectives: To provide the knowledge of Pressure, Sound, Flow, Temperature, Level,Humidity, Torque, Viscosity and Vibration measurements.

Metrology (Measurement of Length, Angle and Area): Dimensional measurement, Dial gauges, Gauge blocks, Comparators, Flatness measurement, Optical flats, Sine bar, Angle gauges, Planimeter.

Motion and Vibration Measurement: Translational and rotational displacement using potentiometers, Strain gauges, Differential transformer, Different types of tachometers, Accelerometers

Pressure Measurement: Moderate pressure measurement, Bourdon tube, Bellows and diaphragms, High pressure measurement: Piezoelectric, Electric resistance, Low pressure measurement: Mcleod gauge, Knudsen Gauge, Viscosity gauge, Thermal conductivity, Ionization gauge, Dead weight gauges.

Flow Measurement: Obstruction meter, Orifice, Nozzle, Venturi, Pitot tube, Rotameter, Turbine, Electromagnetic, Vortex, Positive displacement, Anemometers, Weirs and flumes, Laser Doppler anemometer, Ultrasonic flow meter, Mass flow meter.

Temperature Measurement: Bimetallic thermometers, Liquid-in-glass, Pressure thermometer, Semiconductor sensors, Digital thermometers, Pyrometers.

Level Measurement: Visual level indicators, Purge method, Buoyancy method, Resistance, Capacitance and inductive probes, Ultrasonic, Laser, Optical fiber, Thermal, Radar, Radiation.

Miscellaneous Measurements: Humidity, Dew point, Viscosity, nuclear radiation measurements.

Laboratory work: Experiments around Measurement of Length, Angle, Pressure, Temperature, Flow, Level, Humidity, Vibration using different techniques.

Course Learning Outcomes (CLO): After the successful completion of the course the students will be able to:

1. illustrate the different methods for the measurement of length and angle
2. elucidate the construction and working of various industrial devices used to measure pressure, sound and flow
3. explicate the construction and working of various industrial devices used to measure temperature, level, vibration, viscosity and humidity
4. ability to analyze, formulate and select suitable sensor for the given industrial applications

Text Books:

1. *Doeblin, E.O., Measurement systems, Applications and Design, McGraw–Hill (1982).*
2. *Nakra, B. C. and Chaudhry, K. K., Instrumentation Measurement and Analysis, Tata McGraw–Hill (2003).*

Reference Books:

1. *Murthy, D.V.S., Transducers and Instrumentation, Prentice–Hall of India Private Limited (2003).*
2. *Sawhney, A.K., A Course in Electrical and Electronic Measurements and Instrumentation, Dhanpat Rai and Co. (P) Ltd. (2007).*

Evaluation Scheme:

S.NO.	Evaluation Elements	Weightage
1	MST	25
2	EST	35
3	Sessional (May include Assignments//Quizzes/Lab Evaluations)	40

UEIXXX: FUNDAMENTALS OF MICROPROCESSORS ANDMICROCONTROLLERS

L	T	P	Cr
3	**1**	**2**	**4.5**

Course Objectives: To make the students able to understand microprocessors and microcontroller and their applications.

INTEL 8086 Microprocessor: Pin Functions, Architecture, Characteristics and Basic Features of Family, Segmented Memory, Addressing Modes, Instruction Set, Data Transfer Instructions, Arithmetic, Logical, Shift and Rotate Instructions, String Instructions, Flag Control Instructions, Transfer of Control Instructions, Processor Control Instructions, Programming Examples, Interrupt Structures, Multitasking and Multiprogramming, MIN/MAX Modes of 8086,Co-processors 8087 and 8089.

Introduction to 8051 Microcontroller : 8051-architecture and pin diagram, Registers, Timers Counters, Flags, Special Function Registers, Addressing Modes, Data types, instructions and programming, Single –bit operations, Timer and Counter programming, Interrupts programming, Serial communication, Memory accessing and their simple programming applications.

Hardware interfacing: I/O Port programming, Bit manipulation, Interfacing to a LED, LCD, Keyboard, ADC, DAC, Stepper Motors and sensors.

Laboratory work: Introduction to INTEL kit, Programming examples of 8086, Interfacing using 8086 kits,ADC, DAC, 8253, Microprocessor based project, Programming and Application development around 8051, Interfacing to LED, LCD, Keyboard, ADC, DAC, Stepper Motors and sensors etc.

Course Learning Outcome (CLO):

After the successful completion of the course the students will be able to:

1. demonstrate the concept of microprocessor and to be able to design a microprocessor based system to get desired results.
2. use 8086 microprocessor in advanced applications, which will give them a good platform to work further.
3. graduates will be able to update with current trends through self-study and show genuine need to learn on continuous basis.
4. students will be able to use hardware interfacing of 8051 to develop solutions of real world electrical problems.

Text Books:

1. *Hall, D.V., Microprocessor- Interfacing Programming and Hardware, Tata McGraw–Hill (1997).*
2. *Ayala, K.J., The 8051 Microcontroller Architecture, Programming and applications, Penram International Publishing (India) Pvt. Ltd. (2007).*
3. *Mazidi, M.A., The 8051 Microcontroller and Embedded System, Pearson Education (2008).*

Reference Books:

1. *Brey, B.B., The INTEL Microprocessors, Prentice–Hall of India Private Limited (2002).*
2. *Liu, Y. C. and Gibson, G.A., Microcomputer Systems: The 8086/8088 Family– Architecture, Programming and Design, Prentice–Hall of India Private Limited (2007).*
3. *Uffenbeck, J., The 8086/ 8088 Family, Prentice–Hall of India Private Limited (1994).*
4. *Predko, M., Customizing The 8051 Microcontroller, Tata McGraw–Hill (2002).*

Evaluation Scheme:

S.NO.	**Evaluation Elements**	**Weightage (%)**
1	MST	25
2	EST	35
3	Sessional (May include Assignments//Quizzes/Lab Evaluations)	40

UEEXXX: NETWORK ANALYSIS AND SYNTHESIS

L	T	P	Cr
3	1	0	3.5

Course Objective: To make the students understand concepts of graph theory, two port networks, and network synthesis.

Graph theory: Graph, Tree and link branches, Network matrices and their relations, Choice of linearly independent network variables, Topological equations for loop current and topological equation for nodal voltage, Duality

Network Theorems: Source transformation, Superposition Theorem,Thevenin's theorem, Norton's theorem, Millman's theorem, Reciprocity theorem and Maximum power transfer theorem as applied to A.C. circuits, Compensation theorem, Tellegen's theorem and their applications.

Two Port Networks: Two port network description in terms of open circuits impedance, Short circuit admittance, Hybrid and inverse hybrid, ABCD and inverse ABCD parameters, Inter-connection of two port network, Indefinites admittance matrix and its applications

Network Functions: Concepts of complex frequency, Transform impedance, Networks function of one port and two port network, concepts of poles and zeros, property of driving point and transfer function.

Passive Network Synthesis: Introduction, Positive Real Functions **:** Definition, Necessary and sufficient conditions for a function to be positive real, Elements of circuit synthesis, Foster and cauer forms of LC Networks, Synthesis of RC and RL networks.

Course Learning Outcomes (CLO):

After the successful completion of the course the students will be able to:

1. understanding the various laws and theorems related to electric networks.
2. understanding the concept of two port networks.
3. familiarisation with network synthesis.

Text Books:

1. *Hayt, W., Engineering Circuit Analysis, Tata McGraw–Hill (2006).*
2. *Hussain, A., Networks and Systems, CBS Publications (2004).*
3. *Valkenberg, Van, Network Analysis, Prentice–Hall of India Private Limited (2007).*
4. *Gayakwad, A. Op-Amps and Linear Integrated Circuits, Prentice–Hall of India (2006).*

Reference Books:

1. *Chakarbarti,A., Circuit Theory, Dhanpat Rai and Co. (P) Ltd. (2006).*
2. *Roy Chowdhuary, D., Networks and Systems, New Age International (P) Limited, Publishers (2007).*
3. *Sudhakar, A., Circuits and Networks, Tata McGraw–Hill (2006).*
4. *Suresh Kumar, K.S. Electrical circuits and Networks, Pearson Education, (2009).*

Evaluation Scheme:

S.NO.	Evaluation Elements	Weightage (%)
1	MST	30
2	EST	45
3	Sessional (May include Assignments//Quizzes/Lab Evaluations)	25

UEIXXX: PROCESS DYNAMICS AND CONTROL

L	T	P	Cr
3	0	2	4.0

Course objective: To make the students understand basic ideas, challenges, techniques, and applications of process control for controlling various processes.

Introduction: Historical perspective, Incentives of process control, Synthesis of control system. Classification and definition of process variables.

Mathematical Modeling: Need and application of mathematical modeling, Lumped and distributed parameters, Analogies, Thermal, Electrical and chemical systems, Modeling of CSTR, Modeling of heat exchanger, Interacting and non-interacting type of systems, Dead time elements

Control Modes: Definition, Characteristics and comparison of on-off, Proportional (P), Integral (I), Differential (D), PI, PD, PID, Dynamic behavior of feedback controlled processes for different control modes ,Control system quality, IAE, ISE, IATE criterion, Tuning of controllers Ziegler-Nichols, Cohen-Coon methods

Realization of Control Modes: Realization of different control modes like P, I, D, In Electric, Pneumatic, Hydraulic controllers.

Actuators: Hydraulic, Pneumatic actuators, Solenoid, E-P converters, Control valves, Types, Functions, Quick opening, Linear and equal percentage valve, Ball valves, Butterfly valves, Globe valves, Pinch valves, Valve application and selection

Advanced Controls: Introduction to advanced control schemes like Cascade, Feed forward, Ratio, Selective, Override, Split range and Auctioneering control

Laboratory Work: I to P, P to I, Valve characteristics, Simulation of different control modes, Experiments around Basic Process RIG.

Course Learning Outcomes (CLO):

After the successful completion of the course the students will be able to:

1. demonstrate fundamental understanding of process control.
2. develop the mathematical model of various chemical processes.
3. explain different control modes and their application in controlling various processes.
4. explain the working of electric, hydraulic and pneumatic controllers.
5. demonstrate the working and application of different type of actuators and control valves

Text Books:

1. *Johnson, C.D., Process Control Instrumentation Technology, Prentice–Hall of India Private Limited (1992).*
2. *Stephanopoulos, G., Chemical Process Control, Prentice–Hall of India Private Limited (1983).*

Reference Books:

1. *Harriot, P., Process Control, Tata McGraw–Hill (1982).*
2. *Liptak, B.G., Instrument Engineers Handbook, Butterworth, Heinemann (2002).*
3. *Seborg, D.E. and Edgar, T., Process Dynamics and Control, John Wiley and Sons (1989).*

Evaluation Scheme:

S.NO.	**Evaluation Elements**	**Weightage (%)**
1	MST	25
2	EST	40
3	Sessional (May include Assignments//Quizzes/Lab Evaluations)	35

UEIXXX: ADVANCED CONTROL SYSTEMS

L	T	P	Cr
3	**1**	**0**	**3.5**

Course objective: To learn the methods for analyzing the behavior of nonlinear control systems and the designing of control systems.

Nonlinear Control Systems: Introduction to Nonlinear systems and their properties, Common Non-linearities, Describing functions, Phase plane method, Lyapounov's method for stability study, concept of Limit Cycle.

Optimal Control Theory: Introduction, Optimal control problems, Mathematical procedures for optimal control design: Calculus of variations, Pontryagin's optimum policy, Bang-Bang Control, Hamilton-Jacobi Principle

z-Plane Analysis of Discrete-Time Control Systems: Introduction, Impulse sampling and data hold, Reconstructing original signal from sampled signals, concept of pulse transfer function, Realization of digital controllers.

Design of Discrete-time Control Systems: Introduction, Stability analysis of closed-loop systems in the z-plane, Transient and steady state response analysis, Design based on the root-locus method, Design based on the frequency-response method.

State-Space Analysis: Introduction, State-space representations of discrete-time systems, Solving discrete-time state-space equations, Pulse transfer function matrix, Discretization of continuous time state space equations,Lyapunov stability analysis, Controllability and Observability, Design via pole placement, State observer design.

Course Learning Outcomes (CLO):
After the successful completion of the course the students will be able to:
1. demonstrate non-linear system behavior by phase plane and describing function methods and the
2. perform the stability analysis nonlinear systems by Lyapunovmethoddevelop design skills in optimal control problems
3. derive discrete-time mathematical models in both time domain (difference equations, state equations) and z-domain (transfer function using z-transform).
4. predict and analyze transient and steady-state responses and stability and sensitivity of both open-loop and closed-loop linear, time-invariant, discrete-time control systems.
5. acquire knowledge of state space and state feedback in modern control systems, pole placement, design of state observers and output feedback controllers

Text Books:
1. *Slotine& Li, Applied Non-Linear Control*, Englewood Cliffs, NJ: Prentice-Hall, (1991).
2. *Bandyopadhyay, M.N., Control Engineering: Theory and Practice, Prentice-Hall of India Private Limited (2003).*
3. *Ogata, K., Discrete-time Control Systems, Pearson Education (2005).*

Evaluation Scheme:

S.NO.	**Evaluation Elements**	**Weightage**
1	MST	30
2	EST	45
3	Sessional (May include Assignments//Quizzes/Lab Evaluations)	25

UEIXXX: DIGITAL SIGNAL PROCESSING AND APPLICATIONS

L	T	P	Cr
3	**1**	2	**4.5**

Course Objective: To understand the basic concepts and techniques for digital signal processing, familiarization with DSP concepts by studying the design of different digital filters and transform-domain processing.

Introduction: Review of Discrete Time Signals and Systems and z-Transforms, Solution of Difference Equations Using One-sided z-Transform, Frequency domain Characteristics of LTI Systems, LTI Systems as Frequency-Selective Filters.

Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT): Discrete Fourier Transform and its Properties, Divide and Conquer Approach, Decimation in Time and Decimation in Frequency FFT Algorithms.

Digital Filter Structure: Describing Equation of digital filter, Structures for FIR Systems: Direct Form Structure, Cascade Form Structure, Structure for IIR Systems: Direct Form Structures, Cascade Form Structure, Parallel Form Structure and Lattice Structure.

Design of Digital Filters: Causality and its Implications, Difference between analog filters and digital filters, FIR filter design using windows, Design of IIR filters from analog filters using: Approximation of Derivatives, Impulse Invariance and Bilinear Transformation, Frequency transformations.

Analysis of Finite Word length Effects: Introduction, The quantization process and errors, Analysis of coefficient quantization effects in FIR filters, A/D noise analysis, Analysis of arithmetic round off errors, Limit cycles in IIR filters,

Laboratory work: Convolution and correlation, Solution of difference equations using z- Transform and Fourier tools, FFT and spectrum analysis, design of high pass, low pass, band pass and band stop FIR filter using window method, design of IIR filter using Matched Z Transform (MZT), Bilinear Z Transform (BZT), Pole Zero Placement and Impulse Invariant methods.

Course Learning Outcomes (CLO):
After the successful completion of the course the students will be able to:
1. Analyze the signals in time and frequency domain
2. Apply the transformation tools on signals and systems and analyze their significance and applications.
3. design the structures of different types of digital filters
4. design various digital filters and analyze their frequency response
5. Analyse finite word length effects.

Text Books

1. *Proakis, J.G. and Manolakis, D.G., Digital Signal Processing, Prentice Hall of India Private Limited (2006).*
2. *Rabiner, C.R. and Gold, B., Theory and Applications of Digital Signal Processing,Prentice Hall of India Private Limited (2000).*

Reference Books:

1. *Antonion, A., Digital Filters: Analysis Design and Application, Prentice Hall of India Private Limited (1999).*
2. *Oppenhein, A.V. and Schafer, R.W., Digital Signal Processing, Prentice Hall of India Private Limited (1998).*

Evaluation Scheme:

S.NO.	Evaluation Elements	Weightage (%)
1	MST	25
2	EST	35
3	Sessional (May include Assignments//Quizzes/Lab Evaluations)	40

UEIXXX: BIO-MEDICAL INSTRUMENTATION

L	T	P	Cr
3	**0**	**2**	**4.0**

Course Objectives: The objective of this course is to introduce student to basic biomedical engineering technology and introduce different biological signals, their acquisition, measurements and related constraints.

Introduction of Bio-medical Instrumentation, Sources of Bioelectric Potentials and Electrodes: Introduction to man-instrument system, components of the man-instrument system, Physiological system of the body, Problems encountered in measuring a living system. Resting and action potentials, Propagation of action potentials, Bioelectric potentials, Biopotential electrodes, Biochemical transducers. Review of transducers

Cardiovascular System and Measurements: The heart and cardiovascular system, ECG, blood pressure and its measurement, respiration and pulse rate, characteristics and measurement of blood flow meter, cardiac output, phethysmography, pacemaker, defibrillators, heart sounds and its measurement,

Respiratory and Neuro-muscular System: The physiology of the respiratory system, test and instrument for the mechanics of breathing, the somatic nervous system, EEG, EMG and GSR.

Measurement and Recording of Noninvasive Diagnostic Instrumentation, Patient Care and Electrical Safety: Principle of ultrasonic measurement, ultrasonic, thermography, elements of intensive care monitoring,X-ray, CT – Scan and MRI, tonometer, dialysis**,** diathermy,Shock hazards from electrical equipment.

Laboratory work: Study the variance in pulse rate of subject in a batch, use Spiro meter on the subject, auditory system checkup using Audiometer, Measurement of Heart Rate using Stethoscope, Blood pressure using Sphygmomanometer, Pulse Rate and SpO_2 using Pulse Oximeter, Skin Conductance and Skin Potential using Galvanic Skin Response Module, Pulse Rate using Polyrite machine, Respiration Rate using Polyrite. Electromygram test using EMG biofeedback Trainer.

Course Learning Outcomes (CLO):

After the successful completion of the course the students will be able to:

1. differentiate and analyse the biomedical signal sources.
2. elucidate cardiovascular system and related measurements.
3. explain the respiratory and nervous systems and related measurements
4. measure non-invasive diagnostic parameters.

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Text Books:

1. *Cromwell, L. and Weibell, F.J. and Pfeiffer, E.A., Biomedical Instrumentation and Measurement, Dorling Kingsley (2006) 2nd ed.*
2. *Carr, J.J. and Brown, J.M., Introduction to Biomedical Equipment Technology, Prentice Hall (2000) 4th ed.*

Reference Books:

1. *Geddes, L.A., and Baker, L.E., Principles of Applied Biomedical Instrumentation, Wiley InterScience (1989) 3rd ed.*
2. *Khandpur, R.S., Handbook of Biomedical Instrumentation, McGraw Hill (2003) 2nd ed.*
3. *Webster, J.G., Medical Instrumentation Application and Design, John Wiley (2007) 3rd ed.*

Evaluation Scheme:

S.NO.	**Evaluation Elements**	**Weightage**
1	MST	25
2	EST	40
3	Sessional (May include Assignments//Quizzes/Lab Evaluations)	35

UEIXXX: DATA ACQUISITION AND SYSTEM DESIGN

L	T	P	Cr
3	0	2	4

Course Objectives: To understand concepts of acquiring the data from transducers/input devices, their interfacing and instrumentation system design.

Data Acquisition Techniques: Analog and digital data acquisition, Sensor/Transducer interfacing, unipolar and bipolar transducers, Sample and hold circuits, Interference, Grounding and Shielding.

Data Acquisition with Op-Amps: Operational Amplifiers, CMRR, Slew Rate, Gain, Bandwidth. Zero crossing detector, Peak detector, Window detector. Difference Amplifier, Instrumentation Amplifier AD 620, Interfacing of IA with sensors and transducer, Basic Bridge amplifier and its use with strain gauge and temperature sensors, Filters in instrumentation circuits,

Data Transfer Techniques: Serial data transmission methods and standards RS 232-C: specifications connection and timing, 4-20 mA current loop, GPIB/IEEE-488, LAN, Universal serial bus, HART protocol, Foundation-Fieldbus, ModBus, Zigbee and Bluetooth.

Data Acquisition System (DAS): Single channel and multichannel, Graphical Interface (GUI) Software for DAS, RTUs, PC-Based data acquisition system.

Laboratory Work: Op-amp as a comparator and its application, Integrator and differentiator, Active filters, Simulation of the above applications using ORCAD, Instrumentation Amplifier/AD 620, Interfacing of sensors and transducers using DAQ cards.

Course Learning Outcomes (CLO):
After the successful completion of the course the students will be able to:
1. elucidate the elements of data acquisition techniques.
2. design and simulate signal conditioning circuits.
3. explain various data transfer techniques
4. understand the components of data acquisition system

Text Books:

1. *Coughlin, R.F., Operational Amplifiers and Linear Integrated Circuits, Pearson Education (2006).*
2. *Kalsi, H.S., Electronic Instrumentation, Tata McGraw Hill (2002).*
3. *Gayakwad, R.A., Op-Amp and Linear Integrated Circuits, Pearson Education (2002).*
4. *Mathivanan, N., Microprocessor PC Hardware and Interfacing, Prentice Hall of India Private Limited (2007).*

Reference Books:

1. *Ananad, M.M.S., Electronic Instruments and Instrumentation Technology, Prentice Hall of India Private Limited (2004).*
2. *Murthy, D.V.S., Transducers and Instrumentation, Prentice Hall of India Private Limited (2006).*

Evaluation Scheme:

S.NO.	Evaluation Elements	Weightage (%)
1	MST	25
2	EST	40
3	Sessional (May include Assignments//Quizzes/Lab Evaluations)	35

UEIXXX: ADVANCED PROCESS CONTROL

L	T	P	Cr.
3	1	2	4.5

Course Objectives: To make the students understand the basic concepts of advanced process control schemes, DCS, Artificial intelligence techniques used in Process Control, PLC and digital control system.

Introduction to advanced Control Schemes: Cascade, Feed-forward, Feed-forward plus Feedback, Ratio control, Inferential control, Dead time and Inverse response compensation, Adaptive control, Model reference adaptive control, Self tuning regulator Interactions and Decoupling of Control Loops: Design of cross controllers and selection of loops using Relative Gain Array

Distributed Control System (DCS): Evolution and advantages of computer control, Configuration of Supervisory, Direct digital control (DDC) and DCS.

Artificial Intelligence in Process Control: Expert systems, Neural networks, Fuzzy logic, Neuro Fuzzy , Genetic algorithm, Virtual instrumentation.

Programmable Logic Controllers: Comparison with hard wired relay and semiconductor logic, Hardware, Ladder diagram programming, Case studies, Introduction to CPLD, SPLD, FPGA

Digital Control: Sampling and reconstruction, Discrete systems analysis, Stability and controller design using z transform and difference equations, Smoothing filter realization using difference equations

Course Learning Outcomes (CLO):

After the successful completion of the course the students will be able to:

1. explain the concept of advanced control schemes used in process control.
2. explain the working of distributed control system
3. elaborate the use of artificial intelligence techniques in process control.
4. explain the fundamental concepts of PLC.
5. explain the concept of digital control system.

Text Books:

1. *Stephanopoulos, G., Chemical Process Control, Prentice–Hall of India Private Limited (1983).*
2. *Liptak, B.G., Instrument Engineers Handbook , Chilton Book Company (1994).*

Reference Books:

1. *Deb, S.R., Robotics Technology and Flexible Automation, Tata McGraw–Hill (1994).*
2. *Johnson, C.D., Process Control Instrumentation Technology, Prentice–Hall of India Private Limited (2007).*
3. *Zaidi, A., SPC Concepts, Methodologies and Tools, Prentice–Hall of India Private Limited (1995).*

Evaluation Scheme:

S.NO.	**Evaluation Elements**	**Weightage**
1	MST	25
2	EST	35
3	Sessional (May include Assignments//Quizzes/Lab Evaluations)	40

UEIXXX: VIRTUAL INSTRUMENTATION

L	T	P	Cr.
2	0	2	3.5

Course Objective: The objective of this course is to introduce the concept of virtual instrumentation and to develop basic VI programs using loops, case structures etc. including its applications in image, signal processing and motion control.

Review of Virtual Instrumentation: Historical perspective, Block diagram and Architecture of Virtual Instruments

Data-flow Techniques: Graphical programming in data flow, Comparison with conventional programming.

VI Programming Techniques: VIs and sub-VIs, Loops and Charts, Arrays, Clusters and graphs, Case and sequence structures, Formula nodes, Local and global variables, Strings and file I/O.

Data Acquisition Basics: ADC, DAC, DIO, Counters and timers.

Common Instrumentation Interfaces: RS232C/ RS485, GPIB, PC Hardware structure, DMA software and hardware installation.

Use of Analysis Tools: Advanced analysis tools such as Fourier transforms, Power spectrum, Correlation methods, Windowing and filtering and their applications in signal and image processing, Motion Control.

Additional Topics: System buses, Interface buses: PCMCIA, VXI, SCXl, PXI, etc.

Laboratory Work : Components of Lab VIEW, Celsius to Fahrenheit conversion, Debugging, Sub-VI, Multiplot charts, Case structures, ASCII files, Function Generator, Property Node, Formula node, Shift registers, Array, Strings, Clusters, DC voltage measurement using DAQ

Course Learning Outcomes (CLO):
After the successful completion of the course the students will be able to:
1. demonstrate the working of LabVIEW.
2. explain the various types of structures used in LabVIEW.
3. analyze and design different type of programs based on data acquisition.
4. demonstrate the use of LabVIEW for signal processing, image processing etc.

Text Books:
1. Johnson, G., LabVIEW Graphical Programming, McGraw –Hill (2006).
2. Sokoloft, L., Basic Concepts of LabVIEW 4, Prentice Hall Inc. (2004).
3. Wells, L.K. and Travis, J., LabVIEW for Everyone, Prentice Hall Inc. (1996).

Reference Book:
1. Gupta, S. and Gupta, J.P., PC Interfacing for Data Acquisition and Process Control, Instrument Society of America (1988).

Evaluation Scheme:

S.NO.	**Evaluation Elements**	**Weightage**
1	MST	25
2	EST	35
3	Sessional (May include Assignments//Quizzes/Lab Evaluations)	40

UEEXXX: ELECTRIC MACHINE AND DRIVES

L	T	P	Cr
3	**1**	**2**	**4.5**

Course Objectives: In this course fundamental electromechanical, power electronic, and control theory in the context of electric drive systems will be covered. The capabilities and limitations of different types of electric machines in various drive applications will also be addressed.

Fundmentals of electromechanical devices:flux linkage/current relationships, concept of energy and co-energy, calculation of forces and torques.

Power Electronic Converters: voltage control using uncontrolled switches, controlled rectification, inversion, voltage controllers, converter waveforms, acoustic noise and cooling

Control Theory: Importance of Feedback control, requirement of feedback loops in drive applications, current-limit control, speed, torque and position control for electric drives, concept of PLL in speed control application.

DC Motor Drives: EMF and torque production of DC motor, dc motor types, transient and steady-state characteristics, four quadrant operation, thyristor and chopper fed dc motor drives.

Induction Motor Drives:concept of rotating magnetic field and torque production, motor types, torque-speed and torque-slip characteristics, methods of starting of squirrel cage motors, generating and braking modes, speed control using stator voltage control, variable frequency operation, rotor resistance control and slip power recovery schemes.

Motor/Drive Selection:power ratings and capabilities, drive characteristics, load requirements and general application considerations.

Laboratory work: The lab will consist of giving the students hands-on experience with electric machines (AC and DC), power electronic circuitry, and control algorithms for electric drives.

Course Learning Outcomes:
On successful completion of this course, the student should be able to:

1. Analyse the various forces and torques in electromechanical devices
2. explain the working of power electronic converters and inverters
3. elucidate the concepts of feedback control theory
4. analyze and compare the performance of DC and AC machines in various drive applications
5. design controllers for electric drives which achieve the regulation of torque, speed, or position in the above machines.

Text Books:
1. *Dubey, G.K., Fundamentals of Electric Drives, Narosa Publications (2001).*
2. *Mohan, N., Electric Drives: An Integrative Approach. MNPERE, (2001).*
3. *Krishnan, R., Electric Motor Drives: Modeling, Analysis, and Control. Prentice Hall, (2001).*

Reference Books:

1. *Hughes, A. and Drury, B., Electric Motors and Drives: Fundamentals, Types and Applications, Newnes,4th Ed., (2014).*
2. *Sharkawi, Mohammed.A.El, Fundamentals of Electric Drives, PWS - Brooks/Cole Pub. Company, (2000).*

Evaluation Scheme:

Sr. No.	Evaluation Elements	Weightage (%)
1	MST	25
2	EST	35
3	Sessional	40

UEIXXX: ENVIRONMENTAL INSTRUMENTATION

L	T	P	Cr
3	0	0	3.0

Course Objectives: To understand the concepts of pollution monitoring, to enable select, design and configure pollution monitoring instruments

Air Pollution: Impact of man of the environment: An overview, Air pollution sources and effects, Metrological aspect of air pollutant dispersion, Air pollution sampling and measurement, Air pollution control methods and equipment, Air sampling techniques, soil pollution and its effects, Gas analyzer, Gas chromatography, Control of specific gaseous pollutants, Measurement of automobile pollution, Smoke level meter, CO/HC analyzer.

Water pollution: Sources And classification of water pollution, Waste water sampling and analysis, Waste water sampling techniques and analyzers: Gravimetric, Volumetric, Calometric, Potentiometric, Flame photometry, Atomic absorption spectroscopy, Ion chromatography, Instruments used in waste water treatment and control, Latest methods of waste water treatment plants.

Pollution Management: Management of radioactive pollutants, Noise level measurement techniques, Noise pollution and its effects, Solid waste management techniques, social and political involvement in the pollution management system

Course Learning Outcomes (CLO):
After the successful completion of the course the students will be able to:

1. explain sources and effects of air and water pollutants
2. explain air pollution sampling and measurement techniques
3. explain water sampling and analysis techniques
4. explain solid waste management and noise level measurement techniques

Text Books:

1. *Bhatia, H.S., A Text Book in Environmental Pollution and control, Galgotia Publication (1998).*
2. *Dhameja, S.K., Environmental Engineering and Management, S.K Kataria (2000).*
3. *Rao, M.N. and Rao, H.V., Air Pollution, Tata McGraw Hill (2004).*
4. *Rao. C.S., Environmental Pollution Control, New Age International (P) Limited, Publishers (2006) 2nd ed.*

Evaluation Scheme:

S.NO.	Evaluation Elements	Weightage(%)
1	MST	30
2	EST	50
3	Sessional (May include Assignments//Quizzes/Lab Evaluations)	20

UEIXXX: BIOSENSORS AND MEMS

L	T	P	Cr
3	**1**	**0**	**3.5**

Course Objectives: To introduce the concept of biosensors and MEMS, design and fabrication, types and their applications.

Overview of biosensors and their electrochemistry: Molecular reorganization: Enzymes, Antibodies and DNA, Modification of bio recognition molecules for Selectivity and sensitivity, Fundamentals of surfaces and interfaces

Bioinstrumentation and bioelectronics devices: Principles of potentiometry and potentiometric biosensors, Principles of amperometry and amperometric biosensors, Optical Biosensors based on Fiber optics, FETs and Bio-MEMS, Introduction to Chemometrics, Biosensor arrays; Electronic nose and electronic tongue

MEMS Technology: Introduction Nanotechnology and MEMS, MEMS design, and fabrication technology – Lithography, Etching, MEMS material, Bulk micromachining, Surface micromachining, Microactuator, electrostatic actuation, Micro-fluidics.

MEMS types and their applications : Mechanical MEMS – Strain and pressure sensors, Accelerometers etc., Electromagnetic MEMS – Micromotors, Wireless and GPS MEMS etc
Magnetic MEMS – all effect sensors, SQUID magnetometers, Optical MEMS – Micromachined fiber optic component, Optical sensors, Thermal MEMS – thermo-mechanical and thermo-electrical actuators, Peltier heat pumps

Course Learning Outcomes (CLO):
After the successful completion of the course the students will be able to:

1. explain the concept of molecular reorganization, fundamentals of surfaces and interfaces
2. elucidate the principles of different types of biosensors
3. explain the concept of MEMS design, and fabrication technology
4. explain the different types of MEMS and its applications

Text Books:

1. *Gardner, J.W., Microsensors, Principles and Applications, John Wiley and Sons (1994).*
2. *Kovacs, G.T.A., Micromachined Transducer Sourcebook, McGraw–Hill (2001).*
3. *Turner, A.P.F., Karube,I., and Wilson G.S., Biosensors–Fundamentals and Applications, Oxford University Press (2008).*

Reference Book:

1. *Trimmer, W., Micromechanics and MEMS, IEEE Press (1990)*

Evaluation Scheme:

S.NO.	**Evaluation Elements**	**Weightage**
1	MST	30
2	EST	45
3	Sessional (May include Assignments//Quizzes/Lab Evaluations)	25

UEIXXX: OPTICAL INSTRUMENTATION

L	T	P	Cr
3	1	0	3.5

Course Objectives: To make the students able to understand different aspects of optical instrumentation.

Light Sourcing, Transmitting and Receiving: Concept of light, classification of different phenomenon based on theories of light, basic light sources and its characterization, polarization, coherent and incoherent sources, grating theory, application of diffraction grating, electro-optic effect, acousto-optic effect and magneto-optic effect.

Opto –Electronic devices and Optical Components: Photo diode, PIN, photo-conductors, solar cells, phototransistors, materials used to fabricate LEDs and lasers design of LED for optical communication, response times of LEDs, LED drive circuitry, lasers classification ruby lasers, neodymium lasers, CO_2 lasers, dye lasers, semiconductors lasers, lasers applications.

Interferometry: Interference effect, radiometry, types of interference phenomenon and its application, michelson's interferometer and its application refractometer, rayleigh's interferometers, spectrographs and monochromators, spectrophotometers, calorimeters, medical optical instruments

Optical Fiber Sensors: Active and passive optical fiber sensor, intensity modulated, displacement type sensors, multimode active optical fiber sensor (micro bend sensor) single mode fiber sensor-phase modulates and polarization sensors

Fiber optic fundamentals and Measurements: fundamental of fibers, fiber optic communication system, optical time domain reflectometer (OTDR), time domain dispersion measurement, frequency domain dispersion measurement.

Course Learning Outcomes (CLO):
After the successful completion of the course the students will be able to:
1. explain the basic concepts of optical transmitting and receiving
2. describe different opto- electronic devices
3. elucidate different methods of interferometry
4. describe selection of the appropriate optical fiber sensors for industrial application

Text Books:

1. *J.Wilson&J F B Hawkes, Opto Electronics: An Introduction, Prentice Hall of India, (2011),3rd ed.*
2. *RajpalS.Sirohi , Wave Optics and its Application, (2001),1st ed.*
3. *A Yariv , Optical Electronics/C.B.S. Collage Publishing, New York, (1985)*
4. *Pollock ,Fundamentals of OPTOELECTRONICS,(1994)*

Evaluation Scheme:

S.NO.	Evaluation Elements	Weightage (%)
1	MST	30
2	EST	45
3	Sessional (May include Assignments//Quizzes/Lab Evaluations)	25

UEIXXX BIO–MEDICAL DSP

L	T	P	Cr
3	1	0	3.5

Course Objectives: To provide students with skills and knowledge in characterization of medical data like ECG, EEG etc., by filtering, data reduction, feature extraction and its interpretation

Introduction: Characteristics of medical data, Software designof digital filters, Basic electrocardiography, ECG lead system, ECG signal characteristics, Sampling basics, Simple conversion system, Conversion requirements for biomedical signals.

Adaptive filters: Principle noise canceller model, 50Hz adaptive canceling, Other applications of adaptive filtering, Basics of signal averaging, Signal averaging as digital filter, A typical average, Software for signal averaging , Limitations of signal averaging.

Data reduction techniques: Turning point algorithm, AZTECH algorithm, Fan algorithm, Huffman coding, SPIHT using wavelets and other techniques.

ECG Analysis: Power spectrum of ECG, Band pass filtering techniques, Differentiation techniques, Template matching techniques, A QRS detection algorithm, ECG interpretation, ST segment analyzer, Potable arrhythmia monitor.

Neurological signal processing: Brain and its potential, EEG signal and its characteristics, EEG analysis, Linear prediction theory, Auto regressive methods, Recursive parameter estimation, spectral error measure, Adaptive segmentation, Transient detection and elimination.

Course Learning Outcomes (CLO):

After the successful completion of the course the students will be able to:

1. describe adaptive filters and their application in biomedical signal processing
2. apply data reduction techniques in biomedical signals
3. analyse ECG signals
4. analyse EEG signals
5. describe neurological signal processing

Text Books:

1. *Prokis, J.G., Digital signal processing, Prentice–Hall of India Private Limited (1997).*
2. *Tomkin, W. J., Biomedical DSP, Prentice–Hall of India Private Limited (2003).*

Reference Books:

1. *Carr, J., Biomedical instrumentation, PHI Learning Pvt. Limited (2008).*

Evaluation Scheme:

S.NO.	Evaluation Elements	Weightage (%)
1	MST	30
2	EST	45
3	Sessional (May include Assignments//Quizzes/Lab Evaluations)	25

UEIXXX ROBOTICS AND AUTOMATION

L	T	P	Cr
3	1	0	3.5

Course Objectives: To introduce the concepts of Robotic system, its components and instrumentation and control related to robotics.

Basic Concepts in Robotics: Automation and robotics, Robot anatomy, Basic structure of robots, Resolution, Accuracy and repeatability, and Classification and Structure of robots, Point to point and continuous path systems.

Robotic Systemand Control Systems: Components of robotic system,Hydraulic systems, d.c. servo motors, Basic control systems concepts and models, Control system analysis, Robot activation and feedback components. Positional and velocity sensors, actuators. Power transmission systems,

Robot arm Kinematics and Dynamics: Robot joints, The direct kinematics problem, The inverse kinematics solution, Lagrange-Euler formation ,GeneralizedD'Alembert equations of motion, DenavitHartenberg convention and its applications.

Sensors and Instrumentation in robotics: Tactile sensors, proximity and range sensors, Force and torque sensors, Uses of sensors in robotics. Vision equipment, Image processing, Concept of low level and high level vision.

Computer based Robotics: Method of robots programming, GUI based robotic arm control, Interfacing with computer, communication and data processing, Introduction to Artificial Intelligence.

Course Learning Outcomes (CLO):

After the successful completion of the course the students will be able to:

1. explain the fundamentals of robotics and its components
2. illustrate the Kinematics and Dynamics of robotics
3. elucidate the need and implementation of related Instrumentation & control in robotics
4. illustrate the movement of robotic joints with computers/microcontrollers.
5. Explain sensors and instrumentation in robotics

Text Books:

1. *Nikku, S.B., Introduction to Robotics, Prentice–Hall of India Private Limited (2002).*
2. *Schilling. R. J., Fundamentals of Robotics: Analysis and Control, Prentice–Hall of India Private Limited (2006).*

Reference Books:

1. *Criag, J., Fundamentals of Robotics: Analysis and Control, Prentice–Hall of India Private Limited (2006).*
2. *Gonzalex, R. C. and Fu, K. S., Robotics Control Sensing, Vision and Intelligence, McGraw–Hill (2004). Koren,Y., Robotics for Engineers, McGraw–Hill (1985).*

Evaluation Scheme:

S.NO.	Evaluation Elements	Weightage (%)
1	MST	30
2	EST	45
3	Sessional (May include Assignments//Quizzes/Lab Evaluations)	25

UEIXXX: ARTIFICIAL INTELLIGENT TECHNIQUES AND APPLICATIONS

L	T	P	Cr
3	1	2	4.5

Course Objectives: To introduce the concept of artificial intelligence, methods, techniques and applications

Overview of Artificial Intelligence: The concept and importance of AI, Human intelligence vs. Machine intelligence.

Expert Systems: Expert systems: advantages, disadvantages, Expert system architecture, Functions of various parts, Mechanism and role of inference engine, Types of Expert system, Tuning of expert systems, Role of Expert systems in instrumentation and process control.

Artificial Neural Networks: Structure and function of a single neuron, Artificial neuron models, Types of activation functions, Neural network architectures, Neural learning,Evaluation of networks, Supervised learning, Back propagation algorithm, Unsupervised learning, winner–take all networks, Application of neural networks for Classification, Clustering, Pattern associations, Function approximation, Forecasting etc.

Fuzzy Logic: Fuzzy sets and systems, Operations on Fuzzy sets, Fuzzy relations, Membership functions, Fuzzy rule generation, De–Fuzzification, Fuzzy controllers,

Genetic Algorithms: Introduction and concept, Coding, Reproduction, Cross–over and mutation scaling, Fitness, Applications, Swarm intelligence, and their applications.

Laboratory work: Use of FIS, ANFIS, Simulink, Fuzzy logic, Neural Networks and GA applications in MATLAB.

Course Learning Outcomes (CLO):

After the successful completion of the course the students will be able to:

1. elucidate the knowledge and general concepts of artificial intelligence.
2. explain the concept of Artificial Neural Networks, Learning and Pattern Classification
3. illustratethe concept of fuzzy logic and its applications
4. illustrate the concept of geneticalgorithms and its applications

Text Books:

1. *Petterson, D.W., Introduction to Artificial Intelligence and Expert Systems, Prentice Hall of India (2007).*
2. *Zurada, J.M., Introduction to Artificial Neural Network System, Jaico Publication (2006).*
3. *Hagan, M.T., Neural network design, Prentice Hall of India .*
4. *Ross, T.J., Fuzzy logic with engineering applications, TMH*

Reference Books:

1. *Yegnanarayana, B., Artificial Neural Networks, Prentice–Hall of India Private Limited (2008).*
2. *Winston, P.H., Artificial Intelligence, Addison Wesley (1994).*

Evaluation Scheme:

S.NO.	Evaluation Elements	Weightage
1	MST	20
2	EST	40
3	Sessional (May include Assignments//Quizzes/Lab Evaluations)	40

UEIXXX DIGITAL IMAGE PROCESSING

L	T	P	Cr.
3	1	2	4.5

Course Objectives: To introduce the concepts of image processing and basic analytical methods to be used in image processing. To familiarize students with image enhancement and restoration techniques, To explain different image compression techniques. To introduce segmentation and morphological processing techniques.

Introduction: Fundamentals of Image formation, components of image processing system, image sampling and quantization.

Image enhancement in the spatial domain: Basic gray-level transformation, histogram processing, arithmetic and logic operators, basic spatial filtering, smoothing and sharpening spatial filters.

Image restoration: A model of the image degradation/restoration process, noise models, restoration in the presence of noise–only spatial filtering, Weiner filtering, constrained least squares filtering, geometric transforms; Introduction to the image enhance in frequency domain.

Image Compression: Need of image compression, image compression models, error-free compression, lossy predictive coding, image compression standards.

Morphological Image Processing: Preliminaries, dilation, erosion, open and closing, basic morphologic algorithms, The Hit-or-Miss Transformation

Image Segmentation: Detection of discontinuous, edge linking and boundary detection, thresholding, Hough Transform Line Detection and Linking, region–based segmentation.

Object Recognition: Patterns and patterns classes, matching, classifiers.

Course Learning Outcomes (CLO):
After the successful completion of the course the students will be able to:
1. Explain the fundamentals of digital image and its processing
2. Perform image enhancement techniques in spatial and frequency domain.
3. Elucidate the mathematical modelling of image restoration and compression
4. Apply the concept of image segmentation.
5. Describe object detection and recognition techniques.

Text Books:
1. *Digital Image Processing, RafealC.Gonzalez, Richard E.Woods, Second Edition, Pearson Education/PHI.*

Reference Books
1. *Image Processing, Analysis, and Machine Vision, Milan Sonka, Vaclav Hlavac and Roger Boyle, Second Edition, Thomson Learning.*
2. *Introduction to Digital Image Processing with Matlab, Alasdair McAndrew, Thomson Course Technology*
3. *Computer Vision and Image Processing, Adrian Low, Second Edition, B.S.Publications*
4. *Digital Image Processing using Matlab, RafealC.Gonzalez, Richard E.Woods, Steven L. Eddins, Pearson Education.*

Evaluation Scheme:

S.NO.	Evaluation Elements	Weightage (%)
1	MST	20
2	EST	40
3	Sessional (May include Assignments//Quizzes/Lab Evaluations)	40

UEIXXX: ANALYTICAL INSTRUMENTATION

L	T	P	Cr
3	1	2	4.5

Course objectives: To introduce the concept of analytical Instrumentation, methods, techniques and applications

Introduction: Introduction to instrumental analysis-classification and its advantages, Sampling systems for gas analysis and liquid analysis.

Spectrometry: Introduction to atomic absorption spectrometer, emission spectrometer UV-visual spectrometer, infrared spectrometer, excitation sources: arc and spark, Nuclear magnetic resonance spectrometer, Mass spectrometry, biomedical applications of spectrometry.

Chromatography: Introduction to Chromatographic techniques, Liquid chromatography, Gas chromatography, Applications of chromatography. Introduction to optical Techniques and their Working, turbidimetry, Nephelometry, Polarimetry, Refractometry.

X-ray Analytical Methods: Introduction to X-ray spectral analysis, Fluorescence X-ray spectrometer Wavelength dispersive devices, Energy dispersive devices, Detectors, Scanning electron microscope, X-ray diffractometer, X ray absorption spectrometer Applications of X ray analytical methods in biomedical, industrial applications. **Potentiometry :** Potential and standard potential, ion selective electrode, Glass electrode, Gas sensing electrode. Application of potentiometry.

Course Learning Outcomes (CLO):

After the successful completion of the course the students will be able to:

1. explain the concept of spectrometry and optical techniques
2. elucidate the working of chromatography, elemental analyser
3. illustrate the working of X- ray diffractometer and scanning electron microscope
4. explain the concept of potentiometry and its applications

Text Books:

1. *Braun, R.D., Introduction to Instrumental Analysis, Mc-Graw Hill (2008).*
2. *Khandpur, R.S., Handbook of Biomedical Instrumentation, Tata McGraw–Hill (2000)*
3. *Mathur, R.P., Water and Waste Water Testing Laboratory Manual, Nem Chand and Brothers (1982).*
4. *Patranabis D. Principles of Industrial & Instrumentation, Tata McGraw–Hill (1998)*

Evaluation Scheme:

S.NO.	**Evaluation Elements**	**Weightage (%)**
1	MST	30
2	EST	45
3	Sessional (May include Assignments//Quizzes/Lab Evaluations)	25

UEIXXX EMBEDDED CONTROL SYSTEMS

L	T	P	Cr
3	**1**	**2**	**4.5**

Course Objectives: This course is intended to explain the various concepts used in embedded control systems. Students will also familiarize with real time operating systems.

Introduction: Introduction to Embedded Systems, Its Architecture and system Model, Introduction to the HCS12/S12X series Microcontrollers, Embedded Hardware Building Block.

HCS12 System Description and Programming: The HCS12 Hardware System ,Modes of Operation, The B32 Memory System , The HCS12 DP256 Memory System, Exception Processing–Resets and Interrupts, Clock Functions, TIM, RTI, Serial Communications, SPI-Serial Peripheral Interface, I2C, HCS12 Analog-to-Digital Conversion System.

Basic Input /Output Interfacing Concepts: Input Devices, Output Devices and their Programming, Switch Debouncing, Interfacing to Motor, LCDs, Transducer, The RS-232 Interface and their Examples.

Development tools and Programming: Hardware and Software development tools, C language programming, Codewarior tools- Project IDE, Compiler, Assembler and Debugger, JTAG and Hardware Debuggers, Interfacing Real Time Clock and Temperature Sensors with I2C and SPI bus.

Real-time Operating Systems (RTOS): Basic concepts of RTOS and its types, Concurrency, Reentrancy, Intertask communication, Implementation of RTOS with some case studies.

Laboratory Work:
Programming of HCS12 with Code warrior for Interrupts, Clock Functions, TIM, RTI, SPI, LCD interfacing, Use of JTAG and Hardware Debuggers, Interfacing Keypad, ADC, DAC, LCD, Real Time Clock and Temperature Sensors with I2C and SPI bus.

COURSE LEARNING OUTCOME (CLO): The student will be able to

1. Explain the concept of embedded Systems and its architecture
2. Elucidate the concept of programming for different interfacing devices
3. Analyze various software and hardware tools
4. Explain real-time operating systems

Text Books:

1. *Barrett, S.F. and Pack, J.D., Embedded Systems, Pearson Education (2008).*
2. *Haung, H.W., The HCS12 / 9S12: An Introduction to Software and Hardware Interfacing, Delmar Learning (2007).*

Reference Books:

1. *Fredrick, M.C., Assembly and C programming for HCS12 Microcontrollers, Oxford University Press (2005).*
2. *Ray, A.K., Advance Microprocessors and Peripherals – Architecture, Programming and Interfacing, Tata McGraw–Hill (2007).*

Evaluation Scheme:

Sr. No.	Evaluation Elements	Weightage (%)
1	MST	25
2	EST	35
3	Sessionals (May include Assignments/Projects/Tutorials/Quizzes/Lab Evaluations)	40