Dr. BabasahebAmbedkar Technological University Lonere.

ELECTRICAL ENGINEERING DEPARTMENT

Structure and syllabus

Of

Third Year B. Tech.

(Instrumentation Engineering)

With effect from August 2018

V Semester

Course Code	Course Name	Teaching Scheme			Evaluation Scheme					Credits
		L	P	T	Int	MSE	ESE	TW	Pr/OR	
IEL501	Microcontroller Techniques	3	0	0	20	20	60	-	-	3
IEL502	Control System Components	3	0	1	20	20	60	-	-	4
IEL503	Modern Control System	3	0	0	20	20	60	-	-	3
IEL504	Unit Operations	3	0	1	20	20	60	-	-	4
IEL505	Value Education, Human Rights and Legislative Procedures	2	0	0	20	20	60	-	-	2
IEL506	Elective-IV	3	0	0	20	20	60	-	-	3
IEL507	Elective-V	3	0	0	20	20	60	-	-	3
IEP508	Numerical Methods Lab	0	2	0	-	-	-	25	25	1
IEP509	Control System Components Lab	0	2	0	-	-	-	25	25	1
IEP510	Microcontroller Techniques Lab	0	2	0	-	-	-	25	25	1
	TOTAL	20	06	02	140	140	420	75	75	25

Elective- IV: 1.Multi sensor and data fusion 2. Biomedical Instrumentation-I
Elective-V: 1. Measurement data analysis 2.Artificial neural network. 3. Operating Systems

VI semester

Course Code	Course Name	Teaching Scheme			Evaluation Scheme					Credits
		L	P	T	Int	MSE	ESE	TW	Pr/OR	
IEL601	Industrial Automation and Process Control	3	0	1	20	20	60	-	-	4
IEL602	Digital Signal Processing	3	0	1	20	20	60	-	-	4
IEL603	Power Electronics	3	0	0	20	20	60	-	-	3
IEL604	Elective-VI	3	0	0	20	20	60	-	-	3
IEL605	Elective-VII	3	0	0	20	20	60	-	-	3
IEL606	Elective-VIII (MOOC Course)	3	0	0	20	20	60	-	-	3
IEP607	Introduction to Virtual Lab	0	2	0	-	-	-	25	25	1
IEP608	Digital Signal Processing Lab	0	2	0	-	-	-	25	25	1
IEP609	Industrial automation and process Control Lab	0	2	0	-	-	-	25	25	1
IEP610	Intellectual Property Rights	0	-	-	-	-	-	-	-	0
IET611	Industrial Training *	0	-	-	-	-	-	-	-	0
	TOTAL	18	06	02	120	120	360	75	75	23

Elective-VI 1.Project Engineering and management2.Research Methodology 3. Entrepreneur development
Elective-VII 1..Instrument System Design 2. Biomedical Instrumentation-II 3. Network Protocols
Elective- VIII.

*Industrial Training of 30 days to be assessed in 7 semester

SEMESTER V

IEL 501.Microcontroller Techniques

Teaching scheme:

Theory: 3 hrs

Total credit: 3

Examination Scheme:

Mid-term test: 20 Marks

Internal Assessment: 20 Marks

End semester exam: 60 Marks

Pre requisite	Digital Electronics.	
Course Objective	To understand the basic principles of Microcontroller based design and development. To design and build a functional prototype for real world applications. To select appropriate Micro controllers to solve and design simple engineering problems	
Course Outcome	Understanding the basic principles of Microcontroller based design and development. Ability to design and build a functional prototype for real world applications. Ability to undertake problem identification, formulation and selection of appropriate Microcontrollers. Apply Microcontrollers, programming and interfacing technology to solve and design simple engineering problems	
Unit	Contents	Contact Hrs
1	**Microcontroller Basics:** Difference between microprocessor and microcontroller, architectural considerations, CPU, memory sub system, I/O sub system, control logic. Architecture of MCS-51 microcontroller. Memory structure, different registers (SFR's), addressing modes. Timing Diagram.	7
2	**Programming:** Concept of assembler directives, editor, linker, loader, debugger, simulator, emulator. Instruction set, basic programming using 8051 instructions. Introduction to embedded-C, Integrated Development Environment (IDE), cross compiler, ISP, simple program for delay generation.	7
3	**I/O Programming:** I/O programming, interfacing with simple switch, LED. Seven segment interfacing techniques. Programming with alphanumeric LCD and matrix keypad	6
4	**On-Chip Peripheral Interfaces:** Programming with on-chip Timers, Counters, UART, RS485 transceiver. I2C and SPI protocols. Interrupts, interrupt execution sequence, programming with software and hardware interrupts.	7
5	**External Interfaces:** Analog to digital convertor, interfacing with external serial and parallel ADC's, Digital to analog convertor (DAC), interfacing with DAC, Interfacing with stepper motor and DC motor.	7
6	RISC Microcontrollers, introduction to AVR series microcontrollers. Introduction to ARM7 microcontroller (LPC2148).	6
	Ref Books: 1. Mohammad Ali Mazidi, "The 8051 Microcontroller and Embedded System: Using Assembly and C", Pearson education, Second ed., 2006. 2. Kenneth J. Ayala, "8051 Microcontroller: Programming, Architecture and Interfacing", Thomas Delmar Learning, Third ed., 2007. 3. INTEL Manual: MCS-51 Architecture. 4. Philips Data Handbook, "I2C Peripherals". 5. IEEE Standards, "Low Rate Wireless Personal Area Networks", 2003.	

IEL 502 Control System Components

Teaching scheme:
Theory: 3 hrs
Tutorial:1 hr
Total credit: 4

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Prerequisite	Network analysis and synthesis, numerical methods and C programming	
Course outcome	To know different basic concepts and components of a control system. To derive transfer functions of basic control system components. To perform stability analysis using time domain and frequency domain response on a given system	
Unit	Contents	Contact Hrs.
1	Introduction: Concept of open & closed loop control system, Servomechanism, Multivariable control system, Applications in non-engineering field.	8
2	Physical Systems and Transfer Function: a) Concept of system: physical system, Physical model, Linear and nonlinear systems, Time variant and invariant system. b) Equations of physical systems (Mass-Spring-Dashpot system, R-L-C series & parallel circuit) transfer function, Procedure of obtaining transfer function.	6
3	Block diagrams and Signal flow graphs: a) Block diagram algebra, Diagram reduction, and Numerical examples. b) Signal flow graph; Masons gain formula for deriving overall transfer function of systems. Feedback characteristics of control system: Concept of negative and positive feedback, Sensitivity of the system to parameter variation, using negative and positive feedback	6
4	Control system components: Derivation of transfer functions of following components a)DC servomotors (Armature and field control) b) AC servomotors, c) Synchros d) DC and AC tachogenerators , e) Potentiometer error detectors	6
5	Time domain analysis: Typical test signals, Time domain specifications, Steady state response, Types of system, Steady state error constants and steady state error, (With different input), Numerical examples, transient response, Numericals, Concept of stability, Determination of stability by Routh - Hurwitz criterion.	6
6	Frequency domain analysis: Introduction to frequency response, Advantages of frequency domain analysis, Polar plots, Numericals, Bode plots, Principle of argument, Nyquist criterion, Relative stability from Nyquist criterion, Numericals. Definition of Root Locus, Construction of root locus, and Stability from root locus plots, Root counters, Effect of addition of poles & zeros on root locus plots.	7
	Ref Books: 1 Ogata – Modern Control Engineering (Prentice Hall Of India). 2. Kuo .B. C– Automatic Control System.(Prentice Hall Of India). 3.Nagarath & Gopal – Control System(Willey Earstern) 4. Gopal .M. – Control System.(Prentice Hall Of India).	

IEL 503 . Modern Control System

Teaching scheme:
Theory: 3 hrs
Total credit: 3

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Prerequisite	Control system Components	
Course outcome	To understand the behavior of nonlinear control system. To design and analyze PID controller. To understand and analyze state variable technique. To design and analyze suitable control system for engineering application.	
Unit	Contents	Contact Hrs
1	Non-linear Control Systems: Peculiar behavior of non-linear systems such as sub harmonics, jump resonance, limit cycle, Different types of non-linearities, Phase plane method, Singular Points, Methods of isoclines, Limit Lines & dividing lines on phase plane, Construction of phase plane, Obtaining time domain response from phase plane plots, merits & demerits. Describing function (DF) method, definition & assumptions, Derivation for describing function for different non- linearities, Stability analysis using DF method.	8
2	PID controllers: Introduction to Proportional (P), Integral (I) & Derivative (D) controller, individual effect on overall system performance, P-PI & PID control and effect on overall system performance, Numerical examples.	6
3	State Variable Technique: Concept of state & state variable, General form of state equations, formulation of state equations for the physical system, (RLC network, Armature controlled & Field controlled DC servo motor, mechanical systems).	6
4	State Variable Analysis: Different forms of state variable representations (Phase, physical & canonical form), Concept of diagonalization, Obtaining state equations from transfer function representation and vice versa, solution of state equations, State transition matrix (STM), Methods of finding STM, Power series method, Laplace transform method, Calay Hamilton method, Controllability & observability of linear system, Kalman's test.	6
5	Discrete Data Control System: Methods of representation, Z-transform, Inverse Z-transforms, Pulse transfer function of closed loop system, Response between sampling instants, Concept of stability of discrete time systems, Stability by Jury's test.	6
6	Introduction to control system design, Compensation technique-Cascade & Feedback, Compensation network (lag, lead & lag-lead), Design by reshaping of Bode plots & Root locus technique.	7
	References: 1.Ogata K., 'Modem control Engineering', Prentice Hall 2.Kuo B. C., 'Automatic Control System' Prentice Hall 3. Nagarath I. J., Gopal M., 'Control System Engineering' Willey Eastern.	

IEL 504. Unitoperations.

Teaching scheme:
Theory: 3 hrs
Tutorial: 1 hr
Total credit: 4

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Prerequisite		
Course Objective	• To know the fundamental concepts of fluid mechanics, heat and mass transfer. • To solve the engineering problems related to fluid flow, heat and mass transfer. • To understand the design concepts of fluid and particulate technology. • To design and operate the heat exchange equipment	
Course outcome	• State and describe the nature and properties of the fluids. • Study the different flow measuring instruments. • Study and understand the principles of various size reduction, conveying equipment, sedimentation and mixing tanks. • Comprehend the laws governing the heat and mass transfer operations to solve the problems.	
Unit		Contact Hrs.
1	**FLUID MECHANICS CONCEPTS** Fluid definition and classification, Rheological behavior of fluids & Newton's Law of viscosity. Fluid statics-Pascal's law, Hydrostatic equilibrium, Barometric equation and pressure measurement(problems),Basic equations of fluid flow – Continuity equation, Euler's equation and Bernoulli equation; Types of flow – laminar and turbulent; Reynolds experiment; Flow through circular and non circular conduits – Hagen Poiseuille equation (no derivation).Flow past immersed bodies – drag and drag co-efficients, application of KozneyKarmen & Burke Plummer equation; Flow through stagnant fluids – theory of Settling and Sedimentation – Equipments (cyclones, thickners)	8
2	**FLOW MEASUREMENTS &**: Different types of flow measuring devices, flow measurements – Orifice meter, Venturimeter, Rotameter. Pumps – types of pumps (Centrifugal & Reciprocating pumps), application of Bernoulli's equation for Energy calculations in pumps.	6
3	**MECHANICAL OPERATIONS:** Properties and handling of particulate solids – characterization of solid particles, average particle size, screen analysis- Conceptual numericals of differential and cumulative analysis. Size reduction –characteristics of comminuted products, crushing laws, working principle of ball mill., Mixing – types of mixers (ribbon and muller mixer), power number and power number calculation; Filtration & types, filtration equipments (plate and frame, rotary drum).	6
4	**CONDUCTIVE & CONVECTIVE HEAT TRANSFER**: Modes of heat transfer; Conduction – steady state heat conduction through unilayer and multilayer walls, cylinders; Insulation, critical thickness of insulation. Convection- Forced and Natural convection, principles of heat transfer co-efficents, log mean temperature difference, individual and overall heat transfer co-efficients, fouling factor; Condensation – film wise and drop wise	6
5	**HEAT TRANSFER EQUIPMENTS** Heat transfer equipments – double pipe heat exchanger, shell and tube heat exchanger. Diffusion – Fick's law of diffusion. Types of diffusion. Steady state molecular diffusion in fluids at rest and laminar flow (stagnant / unidirection and bi direction).	6
6	**BASICS OF MASS TRANSFER** Mass, heat and momentum transfer analogies. Measurement of diffusivity, Mass transfer coefficients and their correlations. Interphase mass transfer- equilibrium, diffusion between phases.	7

	Ref Books: 1. Unit operations in Chemical Engineering by Warren L. McCabe , Julian C. Smith & Peter Harriot, McGraw-Hill Education (India) Edition 2014. 2. Transport Process Principles and Unit Operations by Christie Geankoplis, Prentice Hall of India. 3. Fluid Mechanics by K L Kumar, S Chand & Company Ltd. 4. Introduction to Chemical Engineering by Badger W.I. and Banchero, J.T., Tata McGraw Hill New York, 1997. 5. Mass Transfer Operations by Robert E. Treybal. McGraw-Hill Education 6. Principles of Unit Operations by Alan S Foust, L.A. Wenzel, C.W. Clump, L. Maus, and L.B. Anderson , John Wiley & Sons. 7. Engineering Fluid Mechanics by Kumar K.L. Eurasia Publishing House (P) Ltd., New Delhi, 1984.	

IEL 505 Value Education, Human Rights and Legislative Procedures

Teaching scheme:
Theory: 2hrs
Total credit: 2

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Prerequisite	Human Values and engineering ethics	
Course outcome	To understand value of education and self-development To develop good values and character To know Human right and legislative procedure	
Unit	Contents	Contact Hrs.
1	Values and Self Development-Social values and individual attitudes, Work ethics, Indian vision of humanism, Moral and non-moral valuation, Standards and principles, Value judgments.	8
2	Importance of cultivation of values, Sense of duty, Devotion, Self-reliance, Confidence, Concentration, Truthfulness, Cleanliness, Honesty, Humanity, Power of faith, National unity, Patriotism, Love for nature, Discipline.	6
3	Personality and Behavior Development- Soul and scientific attitude, God and scientific attitude, Positive thinking, Integrity and discipline, Punctuality, Love and kindness, Avoiding fault finding, Free from anger, Dignity of labor, Universal brotherhood and religious tolerance, True friendship, Happiness vs. suffering love for truth, Aware of self-destructive habits, Association and cooperation, Doing best, Saving nature.	6
4	Character and Competence- Science vs. God, Holy books vs. blind faith, Self-management and good health, Science of reincarnation, Equality, Nonviolence, Humility, Role of women, All religions and same message, Mind your mind, Self-control, Honesty, Studying effectively.	6
5	Human Rights- Jurisprudence of human rights nature and definition, Universal protection of human rights, Regional protection of human rights, National level protection of human rights, Human rights and vulnerable groups.	6
6	Legislative Procedures- Indian constitution, Philosophy, fundamental rights and duties, Legislature, Executive and Judiciary, Constitution and function of parliament, Composition of council of states and house of people, Speaker, Passing of bills, Vigilance, Lokpal and functionaries	7
	Ref Books: 1. Chakraborty, S.K., Values and Ethics for Organizations Theory and Practice, Oxford University Press, New Delhi, 2001. 2. Kapoor, S.K., Human rights under International Law and Indian Law, Prentice Hall of India, New Delhi, 2002. 3. Basu, D.D., Indian Constitution, Oxford University Press, New Delhi, 2002. 4. Frankena, W.K., Ethics, Prentice Hall of India, New Delhi, 1990. 5. Meron Theodor, Human Rights and International Law Legal Policy Issues, Vol. 1 and 2, Oxford University Press, New Delhi, 2000.	

IEL 506.1. Multi-sensor data fusion

Teaching scheme:
Theory: 3 hrs
Total credit: 3

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Pre requisite		
Course Objective	To learn the concepts and techniques used in sensor data fusion	
Course Outcome	To understand the concept of sensor fusion. To apply algorithms for multi-sensor data fusion. Interpret high performance data structures.	
Unit	Contents	Contact Hrs
1	Multi-sensor data fusion: Introduction, sensors and sensor data, Use of multiple sensors, Fusion applications. The interference hierarchy: output data. Data fusion model. Architectural concepts and issues.	3
2	Benefits of data fusion, mathematical tools used: Algorithms, Co-ordinate transformations, rigid body motion. Dependability and Markov chains. Meta – heuristics	5
3	Taxonomy of algorithms for multisensory data fusion. Data association. Identify declaration.	7
4	Estimation: Kalman filtering, practical aspects of Kalman filtering, extended Kalman filters. Decision level identify fusion. Knowledge based approaches.	8
5	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.	7
6	High performance data structures: Tessellated, trees, graphs and function. Representing ranges and uncertainly in data structures. Designing optimal sensor system with in dependability bounds. Implementing data fusion system.	7
	Ref Books: 1. David L. hall, Mathematical techniques in multisensory data fusion, Artech House, Boston. 2. R. R. Brooks and S. S. Iyengar, Multisensor Fusion: Fundamentals and applications with Software, Prentice Hall Inc., New Jersey. 3. Arthur Gelb, Applied Optimal Estimation, M.I.T. press 4. James V. Candy, Signal Processing: The Model Based Approach, Mc Graw Hill	

IEL 506.2. Biomedical Instrumentation

Teaching scheme:
Theory: 3 hrs
Total credit: 3

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Prerequisite	Electrical measurement and instrumentation, physics, basic electrical engineering	
Course outcome	To know the elements body cell structure. To understand the bioelectric signal and their recording. To review different principle of construction and operation of different transducer used in biomedical applications. To understand the construction and operation principle of bidielectric signal recording systems, bais X ray components and safety assepts. the	
Unit	Contents	Contact Hrs
1	Anatomy and Physiology : Elementary ideas of cell structure, heart and circulatory system, control nervous system, Musclo-skeletal system, Respiratory system Body temperature and reproduction system. Classification of Biomedical Equipment, Diagnostic, therapeutic and clinical laboratory equipment	8
2	Bioelectric signals and their recording : Bioelectric signals (ECG, EMG, ECG, EOG & ERG) and their characteristics, Bioelectrodes, electrodes tissue interface, contact impedance, effects of high contact impedance, types of electrodes, electrodes for ECG, EEG and EMG.	6
3	Transducers for Biomedical Application : Resistive transducers - Muscle force and Stress (Strain guge), Spirometry (Potentiont), humidity, (Gamstrers), Respiration (Thermistor) Inductive Transducers - Flow measurements, muscle movement (LVDT) Capacitive Transducers - Heart sound measurement, Pulse pick up Photoelectric Transducers - Pulse transducers, Blood pressure, oxygen Analyses Piezoelectric Transducers - Pulse pickup, ultrasonic blood flowmeter Chemcial Transducer - Ag-Agfallas (Electrodes, PH electrode)	6
4	Bioldectric Signal recording machines : Physiological pre-amplifier and specialized amplifiers, ECG lead systems details of ECG, EMG, and EEG machines, Patient Monitoring system, Heart rate measurement pulse rate measurement, respiration, rate measurement, blood pressure measurement, microprocessor applications in patient monitoring, X- Ray Machine	6
5	Basic X-Ray components and circuits, types of X-ray machines e.g. general purpose, dental image intensifier system, table shooting and maintenance of X- Ray machine	6
6	Safety Aspect of Medical : Gross current, Micro Current shock, safety standards rays and considerations, safety testing instruments, biological effects of X-rays and precautions	7
	Ref Books: 1. NPTEL courses	

IEL 507. 1. Measurement Data Analysis

Teaching scheme:
Theory: 3 hrs
Total credit: 3

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Prerequisite	Electrical and electronics measurement	
Course outcome	To understand and analyze different methods of data measurement and data processing. To calculate errors in measurement.	
Unit	Contents	Contact Hrs
1	General Information about Measurement: basic concept and terms, metrology and the basic metrology problems, classification of measurements, classification of measurement errors, Presentation of results of measurements, rules for rounding off. Measuring Instruments and their Properties: Types of measuring instruments, the concept of an ideal instrument: Metrological Characteristics of measuring instruments, standardization of the metrological characteristics of measuring instruments, Dynamic characteristics of measuring instruments and their Standardization. Statistical Analysis of the errors of measuring instruments based on data provided by calibration laboratories.	8
2	Statistical methods for experimental data processing: Requirements of statistical estimations, Estimation of the parameters of the normal distribution, Construction of confidence intervals, Methods for testing Hypotheses about the form of the distribution function of a random quantity, Methods for testing sample homogeneity, Trends in applied statistics and experimental data processing.	6
3	Direct measurements: Relation between single and multiple measurements, Identification and elimination of systematic errors, method for calculating the errors and uncertainties of single measurements, Method for calculating the uncertainty in multiple measurements, Comparison of different methods for combining systematic and random errors. Indirect measurements: Basic terms and classification, correlation coefficient and its calculation, the method of reduction, the method of transformation, Errors and uncertainty of indirect measurement results.	6
4	Examples of Measurements and measurement data processing: An indirect measurement of the electrical resistance of a resistor, The measurement of the density of a solid body, the measurement of ionization current by the compensation method. The measurement of power at high frequency, the measurement of voltage with the help of a potentiometer and a voltage divider, calculation of the uncertainty of the value of compound resistor.	6
5	Combined Measurement: General remarks about the method of least squares, Measurements with linear equally accurate conditional equations, Reduction of linear unequally accurate conditional equations to equally accurate conditional equations, Linearization of nonlinear conditional equations, Examples of the application of Least squares, determination of the parameters in formulas from empirical data and construction of calibration curves. Combing the results of measurements: Introductory remarks, Theoretical principles, Effect of the error of the weighted mean, combining the results of measurements in which the random errors predominate, combining the results of measurements containing both systematic and random errors, Example: Measurement of the activity of the nuclides in a source.	6
6	Calculation of the Errors of Measuring Instruments: The problems of calculating measuring instrument errors, Methods for calculating measuring instrument errors, calculation of the error of electrical balances (unique instrument), Calculation of error of voltmeters (mass-produced instrument), Calculation of the error of digital thermometers (mass-produced instrument).	7
	Ref Books: 1. Semyon G. Rabinovich, Measurement Errors and uncertainties- theory and practice	

	2. S. V. Gupta, Measurement Uncertainties: Physical Parameters and Calibration of Instriuments 3. Ifan Hughes and Thomas Hase, Measurements and their Uncertainties: A practical Guide to Modern Error Analysis, Oxford University Press 4. Michael, Grabe, Measurement Uncertainties in Science and Technology.	

IEL 507.2. Artificial Neural Network

Teaching scheme:
Theory: 3 hrs
Total credit: 3

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Prerequisite		
Course outcome	To review basic principles of neuron structure. To understand building blocks artificial neural network. To understand different networks of ANN To develop different algorithm for learning. To study and understand Fuzzy neural networks.	
Unit	Contents	Contact Hrs
1	Introduction and ANN Structure: Biological neurons and artificial neurons. Model of an ANN. Activation functions used in ANNs. Typical classes of network architectures. Mathematical Foundations and Learning mechanisms: Re-visiting vector and matrix algebra. State-space concepts. Concepts of optimization. Error-correction learning. Memory-based learning. Hebbian learning. Competitive learning.	8
2	Single layer perceptron: Structure and learning of perceptron. Pattern classifier - introduction and Bayes' classifiers. Perceptron as a pattern classifier. Perceptron convergence. Limitations of a perceptron.	6
3	Feedforward ANN: Structures of Multi-layer feedforward networks. Back propagation algorithm. Back propagation - training and convergence. Functional approximation with back propagation. Practical and design issues of back propagation learning.	6
4	Radial Basis Function Networks: Pattern reparability and interpolation. Regularization Theory. Regularization and RBF networks. RBF network design and training. Approximation properties of RBF	6
5	Competitive Learning and Self organizing ANN: General clustering procedures. Learning Vector Quantization (LVQ). Competitive learning algorithms and architectures. Self-organizing feature maps. Properties of feature maps.	6
6	Fuzzy Neural Networks: Neuro-fuzzy systems. Background of fuzzy sets and logic. Design of fuzzy stems. Design of fuzzy ANNs	7
	References NPTEL course	

IEL 507.3. Operating systems

Teaching scheme:
Theory: 3 hrs
Total credit: 3

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Prerequisite		
Course objective	1. Study the basic concepts and functions of operating systems 2. Learn about Processes, Threads and Scheduling algorithms 3. Learn various memory management schemes 4. Study I/O management and File systems 5. Learn the basics of Linux system and perform administrative tasks on Linux Servers	
Course outcome	1. Design various Scheduling algorithms 2. Apply the principles of concurrency 3. Design deadlock, prevention and avoidance algorithms. 4. Compare and contrast various memory management schemes 5. Design and Implement a prototype file systems 6. Perform administrative tasks on Linux Servers	
Unit		Contact Hrs
1	**OPERATING SYSTEMS OVERVIEW** Computer System Overview-Basic Elements, Instruction Execution, Interrupts, Memory Hierarchy,Cache Memory, Direct Memory Access, Multiprocessor and Multicore Organization. Operating systemoverview-objectives and functions, Evolution of Operating System.- Computer System Organization-Operating System Structure and Operations- System Calls, System Programs, OS Generation andSystem Boot.	8
2	**PROCESS MANAGEMENT** Processes-Process Concept, Process Scheduling, Operations on Processes, Interprocess Communication; Threads- Overview, Multicore Programming, Multithreading Models; Windows 7 -Thread and SMP Management. Process Synchronization - Critical Section Problem, Mutex Locks,Semophores, Monitors; CPU Scheduling and Deadlocks.	8
3	**STORAGE MANAGEMENT** Main Memory-Contiguous Memory Allocation, Segmentation, Paging, 32 and 64 bit architectureExamples; Virtual Memory- Demand Paging, Page Replacement, Allocation, Thrashing; AllocatingKernel Memory, OS Examples.	8
4	**I/O SYSTEMS** Mass Storage Structure- Overview, Disk Scheduling and Management; File System Storage-FileConcepts, Directory and Disk Structure, Sharing and Protection; File System Implementation- FileSystem Structure, Directory Structure, Allocation Methods, Free Space Management; I/O Systems.	7
5	**CASE STUDIES:** Linux System- Basic Concepts;System Administration-Requirements for Linux System Administrator,Setting up a LINUX Multifunction Server, Domain Name System, Setting Up Local Network Services;	6
6	**VIRTUALIZATION-** Basic Concepts, Setting Up Xen.VMware on Linux Host and Adding Guest OS.	6
	References 1.William Stallings, "Operating Systems - Internals and Design Principles", 7th Edition, Prentice Hall,2011. 2.Andrew S. Tanenbaum, "Modern Operating Systems", Second Edition, Addison Wesley, 2001. 3.Charles Crowley, "Operating Systems: A Design-Oriented Approach", Tata McGraw Hill Education", 1996. 4.D M Dhamdhere, "Operating Systems: A Concept-Based Approach", Second Edition, Tata McGraw-Hill Education, 2007. NPTEL course	

IEP508. Numerical computational Lab

Teaching scheme:
Lab work : 2hrs
Total credit: 1

Examination Scheme:
Continuous Assessment (T/W): 25 Marks
Pr/oral: 25 Marks

WRITE DOWN AND EXECUTE THE FOLLOWING PROGRAMS USINGC/C++/MATLAB.

Pre requisite	Basic electrical engineering, control system I	
Course Objective		
Course Outcome		
Expt No	Title of Expt	
1	Roots of Non-Linear Equations-To find the roots of non-linear equations using Bisection method.	
2	Roots of Non-Linear Equations -To find the roots of non-linear equations using Newton-Raphson method.	
3	Interpolation- Using Linear or Quadratic interpolation, finds intermediate data points from given set of data.	
4	Interpolation- Using Lagrange interpolation, find intermediate data point form given set of data and compare the result with linear or quadratic interpolation	
5	Curve Fitting- For a give data set; find best fit curve using linear regression	
6	Curve Fitting- For a give data set; find best fit curve using polynomial regression	
7	Linear Solver-To solve system of linear equations using Gauss Elimination method.	
8	Linear Solver-To solve system of linear equations using Gauss Jordan method.	
9	Integration-To integrate numerically using Trapezoidal Rule	
10	Integration-To integrate numerically using Simpson's Rule	
11	Matrix Eigen values-To find Eigen values of matrix by power method	
12	Differential Equation-To find numerical solution of ordinary differential equations by Euler's method	
13	Differential Equation-To find numerical solution of ordinary differential equations	

IEP 509 Control System-I Lab

Teaching scheme:
Lab work : 2hrs
Total credit: 1

Examination Scheme:
Continuous Assessment (T/W): 25 Marks
Pr/oral: 25 Marks

Pre requisite	Basic electrical engineering	
Course Objective		
Course Outcome		
Expt No	Title of Expt	
1	Study of various pneumatic and hydraulic system components.	
2	Development, implementation and testing of pneumatic circuits.	
3	Development, implementation and testing of hydraulic circuits.	
4	Study of operation and calibration of 2-wire DP transmitter for flow and level control.	
5	Design of a two-wire temperature transmitter.	
6	Study of cut-view section of pneumatically operated control valve.	
7	Calibration of I to P and P to I converters.	
8	Study of control valve Flow characteristics.	
9	Study of valve positioner.	
10	Study of different types of control valve actuator.	
11	Study of pressure/temperature/level/flow switches.	
12	Study of square root extractor.	
13	Study of different types of control relay.	

IEP 510Microcontroller Techniques Lab

Teaching scheme:
Lab work : 2hrs
Total credit: 1

Examination Scheme:
Continuous Assessment (T/W): 25 Marks
Pr/oral: 25 Marks

Pre requisite	Basic electrical engineering	
Course Objective		
Course Outcome		
Expt No	Title of Expt	
1	Programming exercises to programmable peripheral interface.	
2	Programming exercises using interrupts.	
3	Programming exercises to use the timer.	
4	Familiarization with 8051 micro-controller board and its assembler.	
5	Programming exercises using 8051 micro-controller.	
6	Basic I/O operations and ADC Interfacing using KEIL software.	
7	Counting Pulses using Interrupt and Serial Data Transmission.	
8	Interfacing 8051 with DAC.	
9	Interfacing 8051 with stepper motor.	
10	Real time clock and memory interfacing with 8051.	
11	Programming exercise using ARM processor	
12		

SEMESTER VI

IEL 601. INDUSTRIAL AUTOMATION AND CONTROL

Teaching scheme:
Theory: 3 hrs
Tutorial: 1 hr
Total credit: 4

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Prerequisite	Control system I, industrial automation	
Course outcome	To understand construction and working principle of different industrial measurement systems. To understand new trends in industrial process control.	
Unit	Contents	Contact Hrs
1	Introduction to Industrial Automation and Control: Architecture of Industrial Automation Systems. Introduction to sensors and measurement systems.	8
2	measurement: Temperature measurement, Pressure and Force measurements, Displacement and speed measurement, Flow measurement techniques, Measurement of level, humidity, pH etc, Signal Conditioning and Processing, Estimation of errors and Calibration	6
3	Process Control: Introduction to Process Control P I D Control, Controller Tuning. Implementation of PID Controllers. Special Control Structures: Feed forward and Ratio Control. Predictive Control, Control of Systems with Inverse Response, Cascade Control, Overriding Control, Selective Control, Split Range Control.	6
4	Sequence Control: Introduction to Sequence Control PLCs and Relay Ladder Logic Sequence Control, Scan Cycle, RLL Syntax Sequence Control, Structured Design Approach Sequence Control, Advanced RLL Programming Sequence Control : The Hardware environment	6
5	Control of Machine tools: Introduction to CNC Machines Control of Machine Tools, Analysis of a control loop, Introduction to Actuators, Flow Control Valves. Hydraulic Actuator Systems: Principles, Components and Symbols, Hydraulic Actuator Systems: Pumps and Motors, Proportional and Servo Valves.	6
6	Pneumatic Control Systems: System Components Pneumatic Control Systems, Controllers and Integrated Control Systems. Networking of Sensors, Actuators and Controllers: The Fieldbus, The Fieldbus Communication Protocol, Introduction to Production Control Systems	7
	References NPTEL course	

IEL 602. Digital Signal Processing

Teaching scheme:
Theory: 3 hrs
Tutorial: 1 hr
Total credit: 4

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Pre requisite	Signals and systems network analysis and synthesis.	
Course Outcome	To study different signals, systems, design procedure for filters. To understand time domain and frequency domain of systems. To analyses system signals and digital filter structure. To design digital filter for engineering application.	
Unit	Contents	Contact Hrs
1	Introduction to signals and systems Discrete time signals and systems, Z-transforms, structures for digital filters, design procedures for FIR and IIR filters. Frequency transformations: linear phase design; DFT. Methods for computing FFT. Noise analysis of digital filters, power spectrum estimation. Signals and signal Processing: characterization & classification of signals, typical Signal Processing operations, example of typical Signals, typical Signal Processing applications.	8
2	Time Domain Representation of Signals & Systems- Discrete Time Signals, Operations on Sequences, the sampling process, Discrete-Time systems, Time-Domain characterization of LTI Discrete-Time systems, state-space representation of LTI Discrete-Time systems, random signals	6
3	Transform-Domain Representation of Signals-The Discrete-Time Fourier Transform, Discrete Fourier Transform, DFT properties, computation of the DFT of real sequences, Linear Convolution using the DFT. Z-transforms, Inverse z transform, properties of z-transform, transform domain r epresentations of random signals. Transform-Domain Representation of LTI Systems: the frequency response, the transfer function, types of transfer function, minimum-phase and maximum-Phase transfer functions, complementary transfer functions, Discrete-Time processing of random signals	6
4	Digital Processing of Continuous-Time Signals - sampling of Continuous Signals, Analog Filter Design, Anti-aliasing Filter Design, Sample-and Hold circuits, A/D & D/A converter, Reconstruction Filter Design.	6
5	Digital Filter Structure - Block Diagram representation, Signal Flow Graph Representation, Equivalent Structures, bone FIR Digital Filter Structures, IIR Filter Structures, State-space structure, all pass filters, tunable IIR Digital filters. cascaded Lattice realization of IIR and FIR filters, Parallel all pass realization of IIR transfer function, Digital Sine-Cosine generator.	6
6	Digital Filter Design: Impulse invariance method of IIR filter design, Bilinear Transform method of IIR Filter Design, Design of Digital IIR notch filters, FIR filter Design based on truncated fonnersens, FIR filter design based on Frequency Sampling approach	7
	Ref Books: 1. Proakis J.G., and Manolakis, Introduction to DSP, PHI, 2007 2. Sanjit K. Mitra, “Applications DSP a Computer based approach”, TMH, 2006	

IEL 603 Power Electronics

Teaching scheme:
Theory: 3 hrs
Total credit: 3

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Prerequisite	Electronic Devices And Circuits	
Course outcome	To review principle of construction, operation and characteristics of basic semiconductor devices. To understand and analyze performance of controlled and uncontrolled converters. To understand and analyze performance of DC to DC converters. Dc to AC converters. To understand and analyze performance of AC voltage controllers.	
Unit	Contents	Contact Hrs
1	Power semiconductor devices & their characteristics : Characteristics and operation of power diodes, Thyristors, power transistors (BJTs, MOSFETs, IGBTs, SITs), Ratings of power semiconductor devices, typical applications of power semiconductor devices, Introduction to types of power electronic circuits: diode rectifiers, AC-DC converters, AC-AC converters, DC-DC converters, DC-AC converters	8
2	Turn on and Turn off circuits for power semiconductor devices; BJT base drive requirements and drive circuit, MOSFET & IGBT gate drive circuits, Isolation of gate/base drives: Pulse transformers, optocouplersThyristor firing schemes, Gate drive ICs	6
3	Diode Rectifiers and AC-DC converters : Diode Rectifiers: Single phase half wave, full wave rectifiers with R and RL load, Three phase bridge rectifier with R and RL load, Effect of source inductance Controlled Rectifiers : Principle of phase controlled rectification, single phase semi and full converter with R and RL load, power factor improvement in controlled rectifiers, three phase semi and full converter with R and RL load.	6
4	AC voltage controllers (AC-AC converters) : Principle of on-off control, principle of phase control in single phase and three phase circuits, Cycloconverters: single phase cycloconverter operation, three phase cycloconverter operation.	6
5	DC-DC converters : Classification of DC-DC converters, Buck converter, Boost converter, Buck-Boost converter, Cuk converter	6
6	DC-AC converters : Principle of operation and performance parameters, single phase bridge inverter, Three phase inverters: 180 degree and 120 degree conduction modes of operation	7
	References: 1.RashidM. H – Power Electronics circuits, devices and applications-(New Delhi Pearson Education). 2.Murthi.V. R- Power Electonics Devices, circuits and Industrial Applications.(Oxford). 3. Bimbhra.P. S- Power Electronics.(Khanna Publication).	

IEL 604.1. Project Engineering and Management

Teaching scheme:
Theory: 3 hrs
Total credit: 3

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Prerequisite	Communication skills.	
Course outcome	To understand concepts of project management. To develop a project plan. To understand the project implementation strategy. To analyze post project affects.	
Unit	Contents	Contact Hrs
1	Introduction to Project management: Characteristics of projects, Definition and objectives of Project Management, Stages of Project Management, Project Planning Process, Establishing Project organization.	8
2	Work definition: Defining work content, Time Estimation Method, Project Cost Estimation and budgeting, Project Risk Management,	6
3	Project scheduling and Planning Tools: Work Breakdown structure, LRC, Gantt charts, CPM/PERT Networks	6
4	Developing Project Plan (Baseline), Project cash flow analysis, Project scheduling with resource constraints: Resource Levelling and Resource Allocation. Time Cost Trade off: Crashing Heuristic.	6
5	Project Implementation: Project Monitoring and Control with PERT/Cost, Computers applications in Project Management, Contract Management, Project Procurement Management	6
6	Post-Project Analysis	7
	Text/Reference Books: 1. Shtub, Bard and Globerson, Project Management: Engineering, Technology, and Implementation, Prentice Hall, India 2. Lock, Gower, Project Management Handbook. 3. Cleland and King, VNR Project Management Handbook. 4. Wiest and Levy, Management guide to PERT/CPM, Prentice Hall. Ibdia 5. HoraldKerzner, Project Management: A Systemic Approach to Planning, Scheduling and Controlling, CBS Publishers, 2002. 6. S. Choudhury, Project Scheduling and Monitoring in Practice. 7. P. K. Joy, Total Project Management: The Indian Context, Macmillan India Ltd.	

IEL 604.2. Research Methodology

Teaching scheme:
Theory: 3 hrs
Total credit: 3

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Prerequisite	Communication skills.	
Course objective	To Understand the research meaning apply the same for doing the research work To Identify and formulate the research problem To Design the research work in the proper structured manner using sample techniques	
Unit	Contents	Contact Hrs
1	**Foundations of Research** Meaning, Objectives, Motivation, Utility. Concept of theory, empiricism, deductive and inductivetheory. Characteristics of scientific method – Understanding the language of research – Concept,Construct, Definition, Variable. Research Process	7
2	**Problem Identification & Formulation** Research Question – Investigation Question – Measurement Issues – Hypothesis – Qualities of agood Hypothesis –Null Hypothesis & Alternative Hypothesis. Hypothesis Testing – Logic &Importance.	6
3	**Research Design** Concept and Importance in Research – Features of a good research design – Exploratory ResearchDesign – concept, types and uses, Descriptive Research Designs – concept, types and uses.Experimental Design: Concept of Independent & Dependent variables.	6
4	**Qualitative and Quantitative Research** Qualitative research – Quantitative research – Concept of measurement, causality, generalization,replication. Merging the two approaches	6
5	**Sampling** Concepts of Statistical Population, Sample, Sampling Frame, Sampling Error, Sample Size, NonResponse. Characteristics of a good sample. Probability Sample – Simple Random Sample,Systematic Sample, Stratified Random Sample & Multi-stage sampling. Determining size of thesample – Practical considerations in sampling and sample size	6
6	**Data Analysis** Data Preparation – Univariate analysis (frequency tables, bar charts, pie charts, percentages),Bivariate analysis – Cross tabulations and Chi-square test including testing hypothesis ofassociation.	7
	Reference Books: 1) Business Research Methods – Donald Cooper & Pamela Schindler, TMGH, 9th edition 2) Business Research Methods – Alan Bryman& Emma Bell, Oxford University Press.	

IEL 604.3. Entrepreneur Development

Teaching scheme:
Theory: 3 hrs
Total credit: 3

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Prerequisite		
Course outcome	1. To select right entrepreneurship filed. 2. To write feasible report. 3. To understand organization setups and behaviors. 4. To understand different financial sources for entrepreneurship.	
Unit		Contact Hrs
1	**Entrepreneurship**: Aim, alternative to seeking jobs, promote self employment and accelerate industrialization, EDP in India & Maharashtra (An over view), Institutions promoting entrepreneurship, their objective and mode of functioning.	8
2	**Motivation:** Requirements and constraints: Affiliation, power achievement, goal setting, financial and carrier risks and rewards, sources of information, where to go? for what? Entrepreneurship, personality, creativity and other qualities.	6
3	**Selecting the right Entrepreneurship field**: Search, and scanning , small scale, medium scale industries, manufacturing / transporting / consultancy for selecting product for development, manufacturing	6
4	**Feasibility report**: Market survey, right infrastructure, location and government subsidies, sources of technology, recruiting right people, identifying customers, finding out competitors, preparation of feasibility report, project report	6
5	**Organizational set- ups**: Advantage and limitations of proprietorship, partner ship co – operatives, private limited and public limited company, management in small scale firms, entrepreneurial skills, advertising, selling and scales promotion, sale forecast	6
6	**Financial:** Seed money, sources of finance, different financing institutions, different taxes and duties from government, certain do's and don'ts for successful entrepreneur	
	References: 1. A Handbook for new entrepreneurship – Entrepreneurship Development Institute of India, Ahmedabad. 2. G. S. Batra, "Entrepreneurship and Small scale Industries", Deep & Deep Publications Pvt. Ltd 3. Banga, Sharma, "Industrial Organization and Management	

IEL 605.1. Instrumentation System Design.

Teaching scheme:
Theory: 3 hrs
Total credit: 3

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Prerequisite		
Course outcome	To select and design diaphragm for different sensing applications. To design strain gauge based torque, force, load and pressure measurement systems. To gain knowledge in design of accelerometer and gyroscope. To know about different chemical sensors and their design criteria.	
Unit	Contents	Contact Hrs
1	Introduction to diaphragm: Diaphragm performance and materials, design of flat diaphragms, flat diaphragms with rigid center, design of convex diaphragms, semiconductor diaphragms and rectangular diaphragms, design of corrugated diaphragms.	8
2	Design of strain gauge based load cells, torque sensors, force sensors and pressure sensors.	6
3	Design of capacitance based displacement, pressure and level sensors, Design of self and mutual inductance transducers for measurement of displacement and other parameters	6
4	Design of capacitive and inductive proximity sensors	6
5	Accelerometer and Gyroscopic design and its applications. Design of Hall effect sensors, Electromagnetic sensors, magneto-elastic sensors.	6
6	Introduction to chemical sensors, characteristics. Design of direct and complex chemical sensors.	
	Text/Reference Books: 1. Karl Hoffman, An introduction to stress analysis and transducer design using strain gauges, HBM 2. James W. Dally, William F. Riley, Kenneth G. McConnell, Instrumentation for Engineering measurements, Wiley 3. Di Giovanni, Flat and corrugated Diaphragm Design Handbook, CRC Press	

IEL 605.2. Biomedical Instrumentation-II

Teaching scheme:
Theory: 3hrs
Total credit: 3

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Pre requisite		
Course Objective	1. To familiarize the learners with the various Imaging techniques in medicine operating principles and quality control aspects of various imaging modalities. 2. To keep the learners abreast with the technological developments in the field of Medical Imaging	
Course Outcome	1. Understand essential physics, concepts of Medical Imaging and how they are employed in diagnosis and therapy. 2. Get familiar with the current techniques of medical Imaging along with their clinical applications. 3. To apprehend the importance of radiation constructive utilization and safety.	
Unit	Contents	Contact Hrs
1	Introduction to image processing in medical applications, X-ray tubes, cooling systems, removal of scatters, Fluoroscopy, construction of image Intensifier tubes, angiographic setup, mammography, digital radiology, DSA	4
2	Principle of Computed tomography: Scanner configurations/generations, CT system: Scanning unit(gantry), detectors, data acquisition system, spiral CT, scanner parameters, CT Number Reconstruction techniques, Radon Transform, Filtered Back projection, Fourier Reconstruction Technique, Iterative reconstruction Technique, Image quality and artifacts, Clinical applications of CT.	8
3	Advancements in CT: Multi-detector computed tomography (MDCT), Flat panel detectors CT-Angiography contrast agents in CT, Nuclear Magnetic Resonance: Physics of MRI, Relaxation Parameters and Spin Echoes, Magnetic Field Gradients, Slice selection and Frequency Encoding	7
4	Alpha, Beta, Gamma radiation, Radiation detectors, Radio isotopic imaging equipment, radio nuclides for imaging, Gamma ray camera, scanners, Position Emission tomography, SPECT, PET/CT. Wave propagation and interaction in biological tissues, Acoustic radiation fields, continuous and pulsed excitation. Transducers and imaging systems, Scanning methods, Imaging modes, Principles and theory of image generation.	8
5	Magnetic Resonance Imaging, Hardware: Magnets, Gradient systems, RF coils, Fourier Reconstruction techniques, Image contrast, Resolution and Factors affecting signal-to-noise. Safety Considerations/Biological Effects of MRI. Pulse sequences in MRI, Contrast agents MR Angiography, Perfusion MRI, Clinical applications.	8
6	Magnetic Resonance Spectroscopy (MRS) Basic Principle of MRS and localization techniques, Chemical Shift Imaging, Single voxel and Multi voxel MRS, Water Suppression techniques	5
	Ref Books: 1. D. N. Chesney and M. O. Chesney, Radio graphic Imaging, CBS publications, New Delhi. 2. William R. Hendee, Medical Imaging Physics 3. Christensen, Physics of Diagnostic Radiology 4. W. Peggy, Roger D. Ferimarch, MRI for technologists, McGraw Hill, New York. 5. Steve Webb, The Physics of Medical imaging, Taylor & Francis, New York.	

IEL 605.3. Network Protocols

Teaching scheme:
Theory: 3hrs
Total credit: 3

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Pre requisite		
Course Objective	To familiarize the students with various inter-networking protocols and their functionalities. To learn the new concepts in the computer networks.	
Course Outcome		
Unit		Contact Hrs
1	Review of Networking Technologies and Internetworking Concepts and Architectural Model: Application level and network level interconnection, Properties of the internet, Internet architecture, Interconnection through IP routers.	4
2	Internet Addresses, Mapping Internet Addresses to Physical Addresses (ARP) & Determining an Internet Addresses at Startup (RARP): Universal identifiers, Three primary classes of IP addresses, Network and broadcast addresses, Limited broadcast, Dotted decimal notation, Weakness in internet addressing, Loopback addresses, Address resolution problem, Two types of physical addresses, Resolution through direct mapping, Resolution through dynamic binding, Address resolution cache, ARP to other protocols, Reverse address resolution protocol, Timing RARP transaction, Primary and backup RARP servers	8
3	Internet Protocol: Connectionless Datagram Delivery and Internet Protocol: Routing IP Datagram: The concepts of unreliable delivery, Connectionless delivery system, Purpose of the internet protocol, The internet datagram, Routing in an internet, Direct and indirect delivery, Table driven IP routing, Next hop routing, Default routes, Host specific routes, The IP routing algorithm, Handling incoming datagrams , Establishing routing tables.	7
4	Internet Protocol: Error and Control Message (ICMP) and Subnet and Supernet Address Extension: The internet, Control message protocols, Error reporting versus error detection, ICMP message format, Detecting and reporting various network problems through ICMP, Transparent router, Proxy ARP, Subnet addressing, Implementation of subnets with masks representation, Routing in the presence of subnets, A unified algorithm.	8
5	User Datagram Protocol (UDP): Format of UDP message, UDP pseudo header, UDP encapsulation and protocols layering and the UDP checksum computation, UDP multiplexing, De-multiplexing and ports.	8
6	Reliable Stream Transport Service (TCP): The transmission control protocol, Ports, Connections and endpoint, Passive and active opens, The TCP segment format, TCP implementation issues	5
	Reference 1. Douglas E. Comer, Internetworking with TCP/IP: Principles, Protocols and Architecture, Volume 1, 5th edition, PHI publication, 2006. 2. Behrouz A. Forouzan, TCP-IP Protocol Suite, 3rd edition, Mc-Graw Hill publication, 2005 Comer, Internetworking with TCP-IP Vol. 3, 2nd edition, Pearson publication, 2001. 3. W. Richard Stevens, Unix Network Programming: Interprocess Communications, Volume 2, 2nd edition, PHI publication, 1999. 4. William Stalling, SNMP SNMPv2, SNMPv3, and RMON 1 and 2, 2nd edition, Pearson Education publication, 2001. 5. Hunt Craig, TCP-IP Network Administration, 3rd edition, PHI publication, 2002	

IEL 606. Elective-VIII (MOOC Course)

IEP 607. Introduction to Virtual Laboratory.

Teaching scheme:
Lab work : 2hrs
Total credit: 1

Examination Scheme:
Continuous Assessment (T/W): 25 Marks
Pr/oral: 25 Marks

Pre requisite	Basic electrical engineering	
Course Objective		
Course Outcome		
Expt No	Title of Expt	
1	Architecture of Virtual Instrumentation,	
2	Graphical programming in data flow,	
3	Programming Techniques, VIS & Sub VIS, loops & charts, arrays	
4	ADC, DAC, DIO, Counters & timers	
5	PC Hardware structure, timing, interrupts, DMA,	
6	Common Instrument Interfaces for Current loop, RS 232C/Rs 485, GPIB, System basics, interface basics: USB, PCMCIA, VXI, SCXI, PXI	
7	Networking basics for office & industrial application VISA & IVI, image acquisition & processing, Motion Control	
8	Use of Analysis Tools, Fourier transforms Power spectrum	
9	Use of Analysis Tools for Correlation methods.	
10	Use of Analysis Tools for windowing & flittering.	
11	Application of VI in Process Control Designing of Oscilloscope using Lab view	
12	Application of VI in Process Control Designing of Digital Millimeter using Lab view	
13	Study of Data Acquisition & control using Lab view	
14	Virtual instrumentation for an Innovative Thermal Conductivity Apparatus to measure the Thermal Conductivity	
15	To measure the conductivity of non-Newtonian fluids while they are subjected to sharing force	

IEP 608. Digital signal Processing Laboratory.

Teaching scheme:
Lab work : 2hrs
Total credit: 1

Examination Scheme:
Continuous Assessment (T/W): 25 Marks
Pr/oral: 25 Marks

Pre requisite	Basic electrical engineering	
Course Objective		
Course Outcome	Generate various signals from DSP kit and perform convolution of two signals. Implement and determine DFT, FFT and IDFT of signals. Determine the frequency responses of various signals. Apply the knowledge of various techniques to design FIR and IIR filters using MATLAB	
Expt No	Title of Expt	
1	Discrete Fourier Transform	
2	Fast Fourier transforms	
3	Design and implement FIR filter using windowing method	
4	Design and implement IIR filter using Butter worth approximation	
5	Design and implement IIR filter using Chebeshev approximation	
6	IIR filters design using least square method	
7	Sine/square wave generation	
8	FIR filters implementation	
9	IIR filters implementation	
10	10. FFT implementation	
11	Effect of finite word length calculations	
12	Practical Based real signal acquisition & analysis	

IEP 609. Industrial automation Process Control Laboratory.

Teaching scheme:
Lab work : 2hrs
Total credit: 1

Examination Scheme:
Continuous Assessment (T/W): 25 Marks
Pr/oral: 25 Marks

Pre requisite	Basic electrical engineering	
Course Objective		
Course Outcome		
Expt No	Title of Expt	
1	Characteristics of l/P and P/l converter	
2	Interacting and Non interacting tank system	
3	Control valve characteristics	
4	Control valve characteristics with and without positioner	
5	Pressure process controller	
6	Temperature process controller	
7	Level process controller	
8	Flow process controller	
9	Cascade control system using Multiprocess Trainer	
10	Feed forward control system using Multiprocess Trainer	
11	Ratio control system using Multiprocess Trainer	
12	Cascade control system using MATLAB	
13	Tuning of controllers using MATLAB	
14	Response of different order processes with and without transportation delay using MATLAB	
15	Study of DCS.	

IEL 610. Intellectual Property Rights.

Teaching scheme:
Theory: 2hrs
Total credit: 0

Examination Scheme:
Audit course.
P: Performed
NP: Not Performed

Prerequisite		
Course outcome	To understand the need of awareness and knowledge about IPR. To understand how IPR are regarded as a source of national wealth and mark of an economic leadership in the context of global market scenario.	
Unit	Contents	Contact Hrs
1	Introduction: Nature of Intellectual Property, Patents, Designs, Trademarks and copy rights, Process of patenting and Development-technological research, Innovation, Patenting, development.	8
2	International Scenario: International Cooperation on Intellectual Property, Procedure for grants of Patents, Patenting under PCT.	6
3	Patent Rights: Scope of Patent Rights, Licensing and transfer of technology, Patent information and databases, Geographical Indications.	6
4	New developments in IPR: Administration of patent system, New developments in IPR, IPR Biological systems, Computers, Software etc., Traditional knowledge, Case studies, IPR and IIT's objectives towards learning IPR.	6
5	Trademark and Patenting: Registered and unregistered trademarks, designs, concepts, idea patenting.	6
	Text/Reference Books: 1. Halbert, Resisting Intellectual Property, Taylor & Francis Ltd. 2. Robert P. Merges, Peter S. Meneil, Mark A. Lemley, Intellectual Property in New Technological Age, Aspen Publishers.	