Curricula of B.E. Degree for 3rd – 8th Semesters in Applied Electronics and Instrumentation Engineering (AEIE)

Semester-III

Sl. No	Paper Code	Paper Name	Periods/Week			Credits	Full Marks
			L	T	P		
Theoretical Papers							
1	AEIE 301	Electrical Measurements	3	1	0	3	100
2	AEIE 302	Circuit Theory & Networks	3	1	0	3	100
3	M 301	Engineering Mathematics-III	3	1	0	3	100
4	ECE 321	Analog Electronics and Circuits	3	1	0	3	100
5	IT 321	Object Oriented Programming	3	0	0	2	100
6	ME 301	Basic Engineering Thermodynamics & Fluid Mechanics	3	0	0	2	100
7	HS 301	Values and Ethics (Non-credit paper)*	3	0	0	0	100
Practical/Sessional Papers							
8	AEIE 351	Electrical Measurements Laboratory	0	0	3	2	100
9	AEIE 352	Circuit Theory & Networks Laboratory	0	0	3	2	100
10	ECE 371	Analog Electronics and Circuits Laboratory	0	0	3	2	100
11	HS 381	Group Discussion & Personality Development	0	0	3	2	100
		Sub-total	**21**	**4**	**12**	**24**	**1000**
		Total	**37**			**24**	**1000**

Marks for this paper will not be reflected in total marks for the semester

Semester-IV

Sl. No	Paper Code	Paper Name	Periods/Week			Credits	Full Marks
			L	T	P		
Theoretical Papers							
1	AEIE 401	Sensors & Transducers	3	1	0	3	100
2	AEIE 402	Electronic Measurements & Measuring Instruments	3	1	0	3	100
3	M 402	Numerical Methods and Optimization Techniques	3	1	0	3	100
4	ECE 421	Digital Electronics and Circuits	3	1	0	3	100
5	PH 401	Physics of Solid State Devices	3	0	0	2	100
6	EE 423	Electrical Machines	3	0	0	2	100
Practical/Sessional Papers							
7	AEIE 451	Sensors & Transducers Laboratory	0	0	3	2	100
8	AEIE 452	Electronic Measurement & Measuring Instruments Laboratory	0	0	3	2	100
9	M 452	Numerical Methods and Optimization Techniques Laboratory	0	0	3	2	100
10	ECE 471	Digital Electronics and Circuits Laboratory	0	0	3	2	100
		Sub-total	**18**	**4**	**12**	**24**	**1000**
		Total	**34**			**24**	**1000**

Semester-V

Sl. No	Paper Code	Paper Name	Periods/Week			Credits	Full Marks
			L	T	P		
Theoretical Papers							
1	AEIE 501	Industrial Instrumentation	3	1	0	3	100
2	AEIE 502	Power & Industrial Electronics	3	1	0	3	100
3	AEIE 503	Microprocessor Theory & Applications	3	1	0	3	100
4	AEIE 504	Linear Control Theory	3	1	0	3	100
5	ECE 523	Analog & Digital Communication Techniques	3	1	0	3	100
6	HS 501	Industrial Management & Entrepreneurship	3	0	0	2	100
Practical/Sessional Papers							
7	AEIE 551	Industrial Instrumentation Laboratory	0	0	3	2	100
8	AEIE 552	Power & Industrial Electronics Laboratory	0	0	3	2	100
9	AEIE 553	Microprocessor Laboratory	0	0	3	2	100
10	AEIE 554	Control System Laboratory	0	0	3	2	100
		Sub-total	**18**	**5**	**12**	**25**	**1000**
		Total	**35**			**25**	**1000**

Semester-VI

Sl. No	Paper Code	Paper Name	Periods/Week			Credits	Full Marks
			L	T	P		
Theoretical Papers							
1	AEIE 601	Process Control	3	1	0	3	100
2	AEIE 602	Microcontrollers & Embedded Systems	3	1	0	3	100
3	AEIE 603	Telemetry & Remote Control	3	1	0	3	100
4	AEIE 604	Digital Signal Processing	3	1	0	3	100
5	AEIE 605	Optical Instrumentation	3	1	0	3	100
6	CSE 622	Computer Architecture and Organization	3	0	0	2	100
Practical/Sessional Papers							
7	AEIE 651	Process Control Laboratory	0	0	3	2	100
8	AEIE 652	Microcontrollers & Embedded Systems Laboratory	0	0	3	2	100
9	AEIE 653	Telemetry & Remote Control Laboratory	0	0	3	2	100
10	AEIE 654	Digital Signal Processing Laboratory	0	0	3	2	100
		Sub-total	**18**	**5**	**12**	**25**	**1000**
		Total	**35**			**25**	**1000**

Semester-VII

Sl. No	Paper Code	Paper Name	Periods/Week			Credits	Full Marks
			L	T	P		
Theoretical Papers							
1	AEIE 701	Advanced Control Theory	3	1	0	3	100
2	AEIE 702	Analytical Instrumentation	3	1	0	3	100
3	AEIE 703	Biomedical Instrumentation	3	1	0	3	100
4	ECE 721	VLSI Technology	3	0	0	2	100
5	**Refer Appendix-I**	Elective-I	3	0	0	2	100
6	**Refer Appendix-II**	Elective-II	3	0	0	2	100
Practical/Sessional Papers							
7	AEIE 751	Advanced Control Laboratory	0	0	3	2	100
8	AEIE 752	Analytical Instrumentation Laboratory	0	0	3	2	100
9	AEIE 791	Project I	0	0	6	5	100
10	AEIE 792	Seminar I	0	0	3	2	100
		Sub-total	**18**	**3**	**15**	**26**	**1000**
		Total	**36**			**26**	**1000**

Semester-VIII

Sl. No	Paper Code	Paper Name	Periods/Week			Credits	Full Marks
			L	T	P		
Theoretical Papers							
1	AEIE 801	Soft Computing & Control	3	1	0	3	100
2	AEIE 802	Power Plant Instrumentation	3	1	0	3	100
3	**Refer Appendix-III**	Elective-III	3	1	0	3	100
4	**Refer Appendix-IV**	Elective-IV	3	1	0	3	100
Practical/Sessional Papers							
5	AEIE 851	Soft Computing Simulation Laboratory	0	0	3	2	100
6	AEIE 891	Project II	0	0	6	6	100
7	AEIE 892	Seminar II	0	0	3	2	100
8	AEIE 893	Grand Viva-Voce	0	0	0	3	100
		Sub-total	**12**	**4**	**12**	**25**	**800**
		Total	**28**			**25**	**800**

List of Elective Subjects for BE/AEIE/4th year

Appendix- I
Elective-I (AEIE 7th Semester)

Sl. No	Paper Code	Paper Name
1	AEIE 711(a)	Ultrasonic Instrumentation
2	AEIE 711(b)	Agricultural Instrumentation
3	AEIE 711(c)	Sensor Technology
4	AEIE 711(d)	Environmental Instrumentation
5	AEIE 711(e)	EMI/EMC

Appendix- II
Elective-II (AEIE 7th Semester)

Sl. No	Paper Code	Paper Name
1	AEIE 712(a)	Oil & Gas Plant Instrumentation
2	AEIE 712(b)	Image Processing
3	AEIE 712(c)	AI & Machine Learning
4	AEIE 712(d)	Reliability Engineering
5	AEIE 712(e)	NDT/NCT

Appendix- III
Elective-III (AEIE 8th Semester)

Sl. No	Paper Code	Paper Name
1	AEIE 811(a)	Robotics
2	AEIE 811(b)	Artificial Neural Network
3	ECE 811(d)	Wireless Communication
4	CSE 811(i)	Computer Networks
5	M 811(e)	Mathematical Modelling & Stochastic Processes

Appendix- IV
Elective-IV (AEIE 8th Semester)

Sl. No	Paper Code	Paper Name
1	AEIE 812(a)	Industrial Automation
2	AEIE 812(b)	Information Theory & Coding
3	AEIE 812(c)	Nanotechnology
4	AEIE 812(d)	Pattern Recognition
5	AEIE 812(e)	Internet on Things & Applications

Semester-III

Paper Name : Electrical Measurements
Paper Code : AEIE 301
Weekly Load : L:3, T:1, P:0
Credit Point : 3
Total Marks : 100

Module	Detailed Description	Lecturer/ Tutorial Period
1	**Classification of electrical measuring instruments, general feature of indicating instruments:** controlling, damping, balancing of moving systems. **Measuring Instruments:** dynamics, sensitivity, D'Arsonval galvanometer, Ballistic galvanometer, Vibration Galvanometer, PMMC instrument, temperature compensation, Moving iron instrument, errors and compensations, power measurement, low power factor wattmeter, wattmeter connections and errors,	12L+4T
2	**Static and Dynamic errors**: Standard inputs and system analysis for evaluation of sucherrors. Statistical error analysis, test of normal distribution, chi-squared test curve fitting, method of sequential differences, method of extended differences and method of least squares **DC potentiometer:** Weston normal cell, Vernier type, applications, phantom loading **AC potentiometer:** polar type and co-ordinate type, use of Ballistic Galvanometer in magnetic testing	10L+4T
3	**Extension of instrument range:** shunt, multiplier, current transformer, potential transformer; testing and calibration of measuring instruments. Kelvin double bridge, series and shunt type ohmmeter, megger, Measurement of inductances, capacitance and frequency by A.C. Bridges – Maxwell, Schering, Anderson, De-Sauty, Wien.	10L+3T
4	Localization of cable faults using Murray and Varley loop methods. Measurement of high voltage. A.C. and D.C. energy meters. **Reliability**: definition, Gaussian and normal distribution function, MTTF, Bath Tub curve, operating life and cumulative failure analysis.	10L+3T
	Total	42L+14T
	Total week required	14
	Total week reserved	02

Text/Reference Books:

1. Instrumentation for Engineering Measurements by J.W.Dally, W.F.Riley, K.G.Mcconnell, Wiley Edition
2. Electrical Measurement Analysis : by Ernest Frank
3. Clayton & Hancock," Performance and Design of DC machines" Puschtein & Lloyd, Alternating Current Machines"

Paper Name : Circuit Theory & Networks
Paper Code : AEIE 302
Weekly Load : L: 3 T: 1 P: 0
Credit Point : 3
Total Marks : 100

Module	Detailed Description	Lecture/ Tutorial Period

1	Introduction to Mesh and node method of analysis, dual and inverse Networks, driving point and transfer impedances. Application of Network Theorem in AC circuits. Graph of network: Concept of tree branch, tree link, tie set and cut set. Two Port networks – open circuit and short circuit parameters, transmission Parameters, hybrid parameters, interconnection of networks, characteristics of unsymmetrical networks, Image and iterative impedances, propagation function, characteristics of symmetrical networks, characteristic impedance, propagation function, some typical networks- T, Π, lattice, bridged T, bartlett's bisection theorem - its proof and application	11L+3T
2	Filters: Mechanism of filter action, conditions of pass band and stop band, design of Prototype low pass, high pass, band pass and band stop sections (both T & Π section), m-derived sections, modern filter design concepts. Attenuators and Equalisers: T, Π, Bridged T, Lattice and L type attenuators, ladder Attenuator, amplitude and phase equalizer- Lattice and Bridged T, application of Attenuators and equalizers	11L+4T
3	Impedance Transformation: Reactance L and T sections for impedance transformation, dot convention, coupled circuits use of transformer for the purpose of impedance matching. Signals :Different time limited functions(unit impulse, step etc) , continuous functions, Fourier series & its application Laplace Transform -- Concept of complex frequency, transform of standard periodic and non-periodic waveforms. Independent and dependent sources and equivalence of sources. Circuit elements and their transformed equivalents, treatment of mutual couplings. Transient and steady state response of RL, RC, LC and RLC circuits in transient with or without stored energy – solutions in t & s domains. Concept of natural frequency and damping. Sketching transient response, determination of peak values. Practical applications.	11L+5T
4	Poles and zeroes of network functions- restrictions of pole and zero locations of driving point and transfer functions, time domain behavior from the pole zero plot, compensation network stability of active network. Synthesis of two terminal and four terminal network: Driving point impedance (first foster form), network realization of reactance functions, types of reactance functions, driving point admittance (second foster form), canonical networks, cauer networks, synthesis of four-terminal R-C and R-L networks	9L+2T
	Total	**42L+14T**
	Total Week Required	**14**
	No. of Week Reserved	**2**

Text/Reference Books:

1. Network Analysis, M.E.VanValkenburg (Prentice Hall), 3rd Edition.
2. Engineering Circuit Analysis, W.H.Hayt, J.E.Kenmerly, S.M.Durbin,(TMH), 6th Edition, 2002.
3. Network and Systems, Ashfaq Husain,(Khanna Book Publisher), 2000.
4. Network and Systems, D.Roychowdhury,(New Age International) ,2001.
5. Modern Netwok Analysis, F.M.Reza&S.Seely, McGraw Hill.

Paper Name : Engineering Mathematics-III
Paper Code : M 301
Weekly Load : L: 3 T: 1 P: 0
Credit Unit : 3
Total Marks : 100

Module	Detailed Description	Lecture / Tutorial Period

1	**Complex Analysis:** Complex Variable functions; Limit, Continuity, Differentiability and analyticity of functions of a complex variable, Cauchy-Riemann Equations, Laplace Equation, Harmonic function, Mobius transformation, Cauchy's integral Theorem, Cauchy's integral formula, Power series, Taylor's series, Liouville's Theory, Laurent's series, Zeros and singularities, Calculus of residues, Contour integration.	**15L+5T**
2	**Probability:** Conditional probability, multiplication rule, independence, total probability, Bayes' theorem, applications. Random variables: Definition, Discrete and continuous random variable, probability mass function and probability density function, expectation and variance Some special distributions: Uniform, Exponential, Hypergeometric, Binomial, Poisson and Normal distribution. Joint distribution: Joint, Marginal and conditional distributions, Covariance, Correlation, Independence of random variables.	**12L+4T**
3	**Statistics:** Regression: Least square method, linear fitting, parabolic curve fitting, goodness of fit. Sampling distribution: Central limit theorem, distribution of sample mean and sample variance for a normal population, Chi-square, t and F distribution.	**6L+2T**
4	**Estimation:** Consistent and unbiased estimate, Maximum likelihood estimation, Applications. Confidence intervals: Confidence intervals for the means and variances of different distributions. Testing of Hypotheses: Null and alternative hypotheses, Critical and acceptance region, Type-I and Type-II error, power of the test, Neymann-Pearson lemma, Applications in population.	**9L+3T**
	Total:	**42L+14T**
	Total Week Required:	**14**
	No. Of Week Reserved:	**02**

Text/Reference Books:

1. Probability, Statistics and Random Processes-T.Veerarajan, Tata McGrawHill, 2002
2. Stochastic Processes-J. Medhi, Wiley, 1994
3. Theory of Functions of a complex variable- Shanti Narayan, P.K. Mittal, S.Chand Publishing & Company
4. Complex Variables-Spiegel, McGrawHill

Paper Name : Analog Electronics and Circuits
Paper Code : ECE 321
Weekly Load : L: 3 T: 1 P: 0
Credit Point : 3
Total Marks : 100

Module	Detailed Description	Lecture / Tutorial Period
1	**Introduction:** Overview of analog circuits, application of analog circuits implementation. **BJT:** Characteristics of BJT; Ebers-Moll equations and large signal models; inverse mode of operation, early effect; BJT as an amplifier and switch. Biasing and dc circuits of BJT Small signal models, Small signal analysis of CE, CB, CC amplifiers using r_e models, frequency response of amplifiers. Multistage amplifiers (Cascade, Cascode)	11L+2T

2.	**FET:** JFET types, Device structure and operation , Volt-amp characteristics. **MOSFET** enhancement NMOS, PMOS and CMOS, Device structure and operation of Volt-amp characteristics. Nonlinearities in MOSFET Biasing and dc circuits of JFET, MOS. Current source biasing. Small signal analysis of JFET, MOS amplifiers (CS, CG, Source follower).	8L + 4T
3	**Power Amplifiers:** Class A, Class B, Class AB Class C, Class- D Circuit operation, transfer characteristics, power dissipation, and efficiency. Practical BJT and MOS power transistors; thermal resistance; heat sink design; IC power amplifiers. **Differential and operational amplifiers**: Advantages of differential amplifiers; Ideal operational amplifier(OP-AMP) parameters, Characteristics. Inverting and noninverting configurations; Common OPAMP ICs: Gain-frequency and Slew rate etc. Applications of Op-AMP: Inverting, Non-Inverting amplifiers; Instrumentation Amplifier, Integrators, Differentiators; LOG amplifier, Anti Log Amplifier , Comparators; Schmitt triggers, Active RC filters.	9L + 5T
4	**Feedback and oscillators:** Feedback concept and definition; Four basic feedback topologies with real circuits; Analysis of Series-shunt, series-series, shunt-shunt and shunt-series feedback amplifiers; stability in feedback amplifiers, frequency compensation; Principle of sinusoidal oscillators and Barkhausen criterion; Relaxation oscillation Active-RC and Active-LC sinusoidal oscillators; Wien Bridge; Phase-Shift; Quadrature Oscillators; Crystal Oscillators **Application Specific ICs:** Multivibrators, 555 timer as Astable and Monostable multivibrators , VCO(LM 566) amd PLL (LM 565). **Voltage regulations** : Linear regulators using transistors and opamps. Monolithic regulators. SMPS Concepts.	14L + 3T
	Total	**42L+5T**
	Total Week Required:	**14**
	No. Of Week Reserved:	**02**

Text/Reference Books:

1) Microelectronic Circuits – Sedra and Smith (Fifth Edition) (Oxford)
2) Sergio Franco – Operational Amplifier (TMH)
3) Electronic Devices and Circuit theory – Boylestead and Nashlesky – PHI/Pearson Education
4) Design of Analog CMOS Integrated Ckts- Behzad Razavi-Mc Graw Hill Pub.
5) CMOS Analog Circuit Design-P.E. Allen & D.R.Hollberg –Oxford Pub.
6) Millman and Halkias – Integrated Electronics – TMH Op Amp and Linear Ics.
7) P. Horowitz and W.Hill, The Art of Electronics, 2nd Edition, Cambridge University Press,1989.
8) Foundations of Analog and Digital Electronic Circuits. Agarwal, Anant, and Jeffrey H. Lang. San Mateo, CA: Morgan Kaufmann Publishers, Elsevier
9) R. A. Gayakwad, Op-Amps and Linear Integrated Circuit, Prentice Hall of India,
10) Fundamentals of Microelectronics –Behzad Razavi- John Wiely

Paper Name: Object Oriented Programming
Paper Code: IT 321
Weekly Load: L: 3 T: 0 P: 0
Credit Point: 2
Total Marks: 100

Module	Detailed Description	Lecture / Tutorial Period

1	**Introduction:** Concepts of structural program development, Fundamental Principles of Object Oriented Programming, Paradigms and Metaphors, (classes, objects, messages, encapsulation, information hiding, inheritance, polymorphism, exception handling, and object-oriented containers). Benefits of OOP, Object-oriented languages, Java Virtual Machine (JVM), Bytecode, Platform independency, ahead-of-time (AOT) compiler, dynamic recompilation, HotSpot. **Development of programming Language (C++ and Java):** Data types- Variables. The Primitive Types, String, Variables, Type Conversion and Casting, Arrays, Arithmetic, Bitwise, Relational, Boolean Logical, Assignment. "?" operators, Operator Precedence. Loops, Decisions, Structures -Relational Operators-Loops – for, while & do, Decisions – if, if …. Else, switch Statements, Logical Operators, Control Statements – break, continue, Structured & Enumerated variables, array, Storage Classes, Functions-call by value, call by reference parameters, Inline functions, Default arguments, const arguments, Function overloading, Friend Function	**10L**
2	**Classes and objects:** Class fundamentals, Access Specifier, Declaring objects, new operator, Constructor, Assigning Object Reference Variables, Methods, Constructors, this keyword, Garbage Collection/Destructor, Overloading, Using Objects as Parameters, Returning Objects, Static members, final, nested & inner classes, String class, Using Command –line Arguments, Varargs: Variable-Length Arguments **Inheritance:** Superclass Variable Referencing Subclass Object, Use of super, Dynamic Method Dispatch, Overriding, Abstract Classes, Virtual base classes, The Object Class **Operator Overloading and Virtual Function for C++:** Unary operator overloading (prefix and postfix cases), Binary operator overloading-using member function and friend function, Difference between Assignment operator overloading and copy constructor, Manipulation of strings using operators, Type conversation. Pointer to object, this pointer, Compile time, run time polymorphism, virtual function, Virtual table, VPTR, pure virtual function.	**10L**
3	**Packages & Interfaces:** Defining a Package, Accessing a package, Adding a class to a package, Defining an interface, Implementing Interfaces, Applying Interfaces, Variables in Interfaces, Interfaces can be extended. **Exception handling: T**ypes of errors, Exception Types, Uncaught Exception, Using try-catch-throw, throws, finally, creating own exception subclasses **Threading:** Java thread model, Creating single & multiple thread, Thread priorities, Thread synchronization, Inter thread Communication, Suspending Resuming and stopping threads.	**10L**
4	**Enumerations, Autoboxing and Annotations:** Enumeration Fundamentals, Type Wrappers, Autoboxing and Methods, Annotation, Closures **Generics and Java Structures:** General Form, Bounded Types, Wildcard Arguments, Generic Method, Generic Interfaces, Erasure, Generic Restrictions**,** Iterator, Bit Set, Array List, Looping through Data Structures, Map, Hash Map **Input/ Output:** I/O Basics-Streams, Byte Streams, Character Streams, Reading and writing console Input/Output, Reading and writing files, Object serialization. **Abstract Window Toolkit (AWT):** AWT Classes. Window Fundamentals: Component, container, Panel, Window, Frame, Canvas, Working with Graphics: Lines, Rectangles, llipses and Circles, Arcs, Polygons, Sizing Graphics, Working with Color: Methods, Setting Color, Working with Fonts: Determining the Available Fonts, Creating and Selecting a Font, Obtaining Font Information. Control Fundamentals, Labels, Buttons, Check Boxes, Lists, Scroll Bars, TextField, TextArea, Layout Managers, Menu Bars and Menus, Dialog Boxes. ..	**12L**

	TOTAL:	**42L**
	Total Week Required:	**14**
	No. Of Week Reserved:	**02**

Books: Text and/or **Reference:**

1. H. Schildt, Java: The Complete Reference, McGraw Hill Education
2. H. Schildt, C++: The Complete Reference, McGraw Hill Education
3. B. Stroustrup, The Design and Evolution of C++, Addison-Wesley.
4. H. M. Deitel and P. J. Deitel, Java How To Program, Prentice Hall
5. H. M. Deitel and P. J. Deitel, C++ How To Program, Prentice Hall
6. E. Balagurusamy, Object Oriented Programming with C++, McGraw Hill Education
7. E. Balagurusamy, Programming with Java: A Primer, McGraw Hill Education
8. R. Lafore, Object Oriented Programming in Turbo C++, Galgotia Publications Pvt Ltd
9. D. T. Editorial Service, Java 8 Programming Black Book, Dreamtech Press
10. Y. Daniel Liang, Introduction to Java programming, Pearson education.
11. C. S. Horstmann and G. Cornell, Core Java, Volume I : Fundamentals, Pearson Education.
12. C. S. Horstmann and G. Cornell, Core Java(TM) 2, Volume II--Advanced Features, Pearson Education.

Paper Name: Basic Engineering Thermodynamics & Fluid Mechanics.
Paper Code: ME 301
Weekly Load: L: 3, T: 0, P:0
Credit Point: 2
Total Marks: 100

Module	**Detailed Description**	Lecture / Tutorial Period
1	**Basic Concepts of Thermodynamics**: Definition, Scope and Application of Thermodynamics, Macroscopic and Microscopic Approach, Thermodynamic systems, Working Substance, Pure Substance, Thermodynamic Equilibrium, Properties of Systems, Process, Cycle, Point and Path Function, Heat, Specific Heat, Heat Capacity, Thermodynamic and Mechanical Work, Pressure, Energy. **Zeroth law and Temperature**: Concept of Temperature, Zeroth Law of Thermodynamics, Measurement of Temperature, Thermometers and thermometric property, Temperature measuring scales. **Properties and Thermodynamic Processes of gas**: Introduction, General gas Equation, Equation of state and Characteristic Equation of gas, Universal Gas Constant, Specific heats of Gas, Relation between C_p and C_v, Enthalpy of a Gas, Classification of Thermodynamics Process, Heating and Expansion of gases in Non Flow Process, Real gas.	8L
2	**First Law of Thermodynamics**: Introduction, First law for a closed system undergoing a cycle and undergoing a change of state, Energy- a property of system,PMM-1,Energy of an Isolated System, Limitation of First Law, Application of First law to non-Flow Process, First law of Thermodynamics for Flow Process, Mass balance and energy Balance Equation, Engineering application of Steady Flow Energy Equation(SFEE) **Second Law of Thermodynamics**: Introduction, Heat Engine, Heat Reservoirs ,Refrigerator, Heat Pump, Statement of Second Law of Thermodynamics- Clausius statement, Kelvin Plank statement, Equivalence of Kelvin Plank and Clausius statements, PMM-2,Thermodynamic Temperature, Carnot Cycle, Carnots theorem, Entropy, Clausius Inequality, Temperature- Entropy diagram, Change of entropy for various thermodynamic processes, Irreversibility, Reynold's Transport Theorem. **Air Standard Cycles:** Otto Cycle , Diesel Cycle and their efficiency Properties of Pure substances and Steam Power Cycle	16L

3	**Basics of Heat Transfer Modes:** Conduction, Convection, Radiation **Heat Transfer by Conduction**: Fourier's law, Thermal conductivity of materials, Thermal Resistance, Heat conduction through plane and composite walls, overall heat transfer co-efficient, Heat conduction through hollow and composite cylinders, Heat conduction through hollow composite sphere, Critical thickness of Insulation **Heat Transfer by Convection:** Principle of Free and Forced Convection, Convection heat transfer Co-efficient. **Heat Transfer by Radiation:** Introduction, Surface emission properties, Absorptivity, Reflectivity and Transmissivity, Concept of a black body, Stefan-Boltzmann law, Kirchhoff's law, Plank's law, Wiens displacement law, Intensity of radiation and lamberts cosine law.	7L
4	**Basics of Fluid Mechanics:** Types and properties of fluids, Viscosity, Surface tension, Capillarity. **Fluid Statics:** Fluid Pressure and its measurement, Pascal's law, Total pressure and centre of pressure, Hydrostatic forces on surfaces, Buoyancy, Centre of buoyancy, Metacentre, Metacentric height, Stability of submerged and floating body. **Fluid Kinematics:** Fluid motion, Types of fluid flow, Discharge, Continuity equation, Velocity & acceleration, Velocity potential function and stream function **Fluid Dynamics:** Euler's equation of motion along a stream line, Bernoulli's equation, assumptions, Physical significance of different heads, Application of Bernoulli's equation in flow measurement devices – Venturimeter, Orifice meter, Pitot tube.	11L
	TOTAL:	**42L**
	Total Week Required:	**14**
	No. Of Week Reserved:	**02**

Text / Reference Books:

1. P K Nag – Engineering Themodyamics – TMH Pub.
2 P K Nag – Power Plant Engineering. – TMH Pub.
3 P S Ballaney – Thermal Engineering – Khanna Pub.
4 Domkundwar & Arora – Power Plant Engineering – Dhanpat Rai & Co.
5 R S Khurmi & J K Gupta – Thermal Engineering – S Chand Pub.
6 Kothandaraman, Domkundwar - A Course in Thermodynamics (Thermal Engg): Dhanpat Rai & Co
7 R K Bansal – Fluid Mechanics & Hydraulics Machines- Laxmi Pub.
8 A R Basu – Fluid Mechanics & Hydraulics Machines – Dhanpat Rai & Co.
9 R K Rajput - Fluid Mechanics & Hydraulics Machines – S Chand Pub.
10 Som, Biswas - Fluid Mechanics & Hydraulic Machines – TMH Pub

Paper Name: Values and Ethics
Paper Code: HS 301
Weekly Load: L: 3, T: 0, P:0
Credit Point: 0
Total Marks: 100

Module	Detailed Description	Lecture / Tutorial Period
1	**Nature of professional ethics**:-Introduction, definition, morals &ethics sources of ethics, sources of ethics, relationship between ethics and management. Nature of professional ethics, importance of ethics in profession, nature and objectives of ethics, need for ethics. **Ethical decision making:-** Values, morals, standards, corporate social responsibility, attitude and beliefs, ethical values and dimensions dilemmas-decision making, organization and power politics.	11L
2	**Effects of technological growth:-** Energy Crisis, Rapid technological growth, environmental degradation and pollution, human operator in Engineering	8L

	projects and industries, problems of man, machine, interaction. Impact of assembly line and automation.	
3	**Ethics in profession:-**Engineering profession, ethical issues in engineering practice, conflicts between business demands and professional ideals, social and ethical responsibilities of technologists, code of professional Ethics, Whistleblowing and beyond, effects of globalization in modern organization, case study. **Managing ethics**:- Building a value system, role of law enforcement, training in ethics, ethics in commercial and operational profession, ethics in finance, ethics in HRM, ethics in Global Business, ethics and IT.	8L
4	**Engineering Ethics:** Senses of 'Engineering Ethics' - variety of moral issued - types of inquiry - moral dilemmas - moral autonomy - Kohlberg's theory - Gilligan's theory - consensus and controversy – Models of Professional Roles - theories about right action - Self-interest - customs and religion - uses of ethical theories. Valuing Time – Co-operation – Commitment – Nature of Engineering Ethics, Profession and Professionalism, Professional Ethics, Code of Ethics, Sample Codes – IEEE, ASCE, ASME and CSI.	8L
	TOTAL:	42L
	Total Week Required:	**14**
	No. Of Week Reserved:	**02**

Text and/or **Reference Books:**

1.Blending the best of the East & West, Dr. SubirChowdhury, EXCEL
2.Ethics& Mgmt. & Indian Ethos, Ghosh, VIKAS
3.BusinessEthics,Pherwani,EPH
4.Ethics,Indian Ethos & Mgmt., Balachandran, Raja,Nair, Shroff Publishers
5.Business Ethics: concept and cases, Velasquez, Pearson
6. Engineering Ethics: Charles D, Fleddermann, Pearson / PHI, New Jersey 2004 (Indian Reprint)
7. Engineering Ethics – Concepts and Cases: Charles E Harris, Michael S. Protchard and Michael J Rabins, Wadsworth Thompson Leatning, United States, 2000 (Indian Reprint now available)
8. Ethics and the Conduct of Business: John R Boatright, Pearson Education, New Delhi, 2003.
9. Fundamentals of Ethics for Scientists and Engineers: Edmund G Seebauer and Robert L Barry, Oxford University Press, Oxford, 2001.

Paper Name : Electrical Measurements Laboratory
Paper Code : AEIE 351
Weekly Load : L : 0 T : 0 P : 3
Credit Point : 2
Total Marks : 100

List of Experiments:

1. Instrument workshop- observe the construction of PMMC, Dynamometer, Electro thermal and Rectifier type instrument, Oscilloscope and digital multimeter.
2. Measurement of low resistance by Kelvin Double Bridge.
3. Calibrate A.C. energy meter.
4. Measurement of loss-angle by Schering Bridge.
5. Calibration of wattmeter with D.C. potentiometer.
6. Measurement of inductance by Owen's Bridge/ Anderson Bridge.
7. Measurement of Capacitance by De Sauty Bridge
8. Measurement of power and power factor by 3 voltmeters and one ammeter.
9. Measurement of power and power factor by 3 ammeters and one voltmeter.
10. Measurement of Power using Instrument transformer
11. Calibrate moving iron and electrodynamometer type ammeter/voltmeter by potentiometer

12. Calibrate dynamometer type Wattmeter by potentiometer
13. Measurement of 3-phase power by 2-wattmeter method.

Paper Name : Circuit Theory & Networks Laboratory
Paper Code : AEIE 352
Weekly Load : L : 0 T : 0 P : 3
Credit Point : 2
Total Marks : 100

List of Experiments:

1. Study of Open Circuit (Z) and Short Circuit(Y) Parameters of a Two Port Network.
2. Study of Transmission (ABCD) Parameters of a Two Port Network.
3. Study of different types of Impedances of a Two Port Network:
    a. Image Impedance, b) Characteristic Impedance, c) Iterative Impedance.
4. Conversion from T & ∏ Network to Lattice Network using Bisection Theorem.
5. Design of different Attenuator Circuits.
6. Study of First Order Low Pass R-C Filter & determination of Cut- Off Frequency from its Frequency Response.
7. Study of First Order High Pass R-C Filter & determination of Cut-Off Frequency from its Frequency Response.
8. Design of LC Low Pass Filter Circuit and determination of Cut-Off Frequency from its Frequency Response.
9. Design of LC High Pass Filter Circuit and determination of Cut-Off Frequency from its Frequency Response.
10. Design of LC Band Pass Filter Circuit and determination of Cut-Off Frequency from its Frequency Response.
11. 11.Design of LC Band Reject Filter Circuit and determination of Cut-Off Frequency from its Frequency Response
12. Study of Transformer Coupled Circuit used for Impedance Matching.
13. Study of DC transient Response of R-L-C series circuit.

Paper Name : Analog Electronics and Circuits Laboratory
Paper Code : ECE 371
Weekly Load : L : 0 T : 0 P : 3
Credit Point : 3
Total Marks : 100

List of Experiments:

1) Study of Clipping circuits.
2) Study of Clamping circuits.
3) Study of CE Amplifier.
4) Study of frequency response single stage R – C coupled voltage amplifier.
5) Study of Power Amplifier.
6) Study of OP-AMP characteristics.
7) Study of Integrator and Differentiator circuits.
8) Study of Transistor Phase – Shift Oscillator.
9) Study of series voltage regulator using Transistor and Zener diode.
10) Study of 555 timer as Astable, Monostable multivibrators
11) Study of Active filters using OP-AMP.

Paper Name : Group Discussion and Personality Development
Paper Code : HS 382
Weekly Load : L: 0 T: 0 P: 3
Credit Point : 2
Total Marks : 100

1. **Group Discussion:**
   Students must be made aware of the difference between conversation and group discussion. UGC produced video cassettes could be used to teach them the strategies to be followed in group discussion. Students must also be given practice on contemporary social , economic, political and educational topics.
2. **Mock Interview**
   Students are to be taught the strategies of facing an interview. Mock Interviews Must be arranged for them.
3. **Presentation**
   Students will be taught how to make lab presentations by usuing different audiovisual aids.
4. **Language tests**
   Students will be prepared for facing language tests like T.O.E.F.L

Text/Reference Books:

1. Group discussion and interview (With audio cassette) by Prasad, Published by TMH.
2. Communication at work by Alder and Elmhorst, By MHI

Semester-IV

Paper Name : Sensors & Transducers
Paper Code : AEIE 401
Weekly Load : L : 3 T : 1 P : 0
Credit Point : 3
Total Marks : 100

Module	Detailed Description	Lecture/ Tutorial Period
1.	I**ntroduction of Transducer:** Definition of sensor and transducer; transducers-classification; discussion of functional elements of transducer: primary sensing elements signal conditioning units, signal manipulating units, signal executing units and output elements **Resistive type Transducers:** Potentiometer, Strain Gauge, Load Cell, RTD, Thermocouple, Thermister and Semiconductor temperature sensors and its applications	**10L+4T**
2	**Inductive type Transducers** Principle of operation, sensitivity & efficiency calculation ; Linear Variable Differential Transformer (LVDT), RVDT, variable reluctance type, eddy current type, position displacement type, tachometer & tachogenerator, push pull arrangement , Synchro, E-pick-off. **Capacitive type Transducers**: Principle of operation, sensitivity, efficiency calculation. Variable area type, Variable dielectric constant type ; Applications: microphones, diaphragm type capacitive pressure measurement, hygrometer, moisture measurement, level measurement , thickness measurement, displacement measurements, velocity measurement, acceleration measurement, force measurement	**10L+4T**

3	**Seismic Transducers**: Principle of operation, and its application in velocity, acceleration, force, torque, vibration measurement **Piezo-electric Transducers**: Materials, principle of operation, and application in force, pressure, torque, velocity, acceleration. **Magnetostrictive Transducers:** Materials , principle of operation and its application in various field of measurements like dynamic force, acceleration	**10L+3T**
4	**Ultrasonic Transducer:** Principle of operation, ultrasonic test method: pulse echo, transit time, resonance, ultrasonic transducers for flaw detection, thickness, depth, flow measurement **Optical Transducers:** Introduction, optical spectrum, radiometry and photometry, optical sources and detectors, optical transducers: photo emissive cells, photo conductive cells, photo diode, photo transistor, photovoltaic cells; Introduction to fibre optics , Light Modulation methods **Smart Sensors And Transducers:** Introduction to smart sensors, description of each elementary units of smart transducers, application of smart transducers, thin film & Thick film sensors & MEMS	**12L+4T**
	Total	**42L +14T**
	Total Week Required	14
	No. of Week Reserved	02

Text/Reference Books:

1. Neubert H.K.P – Instrument Transducers – An introduction to their performance & design Oxford University Press
2. Murthy D V S – Transducers and Instrumentation , PHR
3. Patranabis D – Sensors and Transducers, Wheeler
4. Doebelin E O – Measurement Systems; Application and Design; MGH
5. Norton – Handbook of Instrumentation Design.
6. A.K.Sawhney: A Course in Electrical and Electronic Measurements and Instrumentation ,Dhanpat Rai.
7. H S Kalsi, Electronic Instrumentation, TMH.
8. Krauthsamer J and Krauthsamer H,Ultrasonic Testing Of Materials, Springer Verlag, Berlin.N.Y.

Paper Name : Electronic Measurements & Measuring Instruments
Paper Code : AEIE 402
Weekly Load : L: 3 T : 1 P : 0
Credit Point : 3
Total Marks : 100

Module	Detailed Description	Lecture/ Tutorial Period
1.	**Introduction:** Units, dimension of physical quantities, Standards and its classification, functional block diagram of instrumentation systems; performance characteristics of instrumentation systems: static and dynamic, amplitude and frequency response of different order systems for different inputs.	10L+3T
2.	**Errors & Noise:** Errors in measurement, classifications of errors; classification of noise and their reduction; Introduction to reliability. **Statistical Analysis**: Histogram, Mean, Median, Mode, Standard Deviation, Mean Deviation, Autocorrelation. Calculation of Uncertainty. Probability Distribution **Linearization Techniques:** Hardware and Software Techniques.	10L+5T
3.	**Electronic Instruments:** Instrumentation Amplifier, ADC and DAC, RMS, peak and average value detector, Digital Voltmeter, Digital Multimeter, Function Generator (Sine wave, Triangular, Square Wave), Frequency Meter, phase meter, Q meter, Measurement of RF and VHF.	11L+3T

4	**Oscilloscope:** Construction and principle of operation, measurement of frequency, voltage, current and phase; brief discussion of associated circuits. Basic features of analog and digital storage oscilloscope. **Wave and spectrum analyzer**: Discussion of functional element of wave and spectrum analyzer, different types of wave and spectrum analyzer and their details. **Data acquisition systems:** Block diagram, details of each block, analog and digital data acquisition system and its application.	11L+3T
	Total	**42L+14T**
	Total Week Required	14
	No. of Week Reserved	02

Text/Reference Books:

1. David A. Bell, Electronic Instrumentation and Measurements, PHI.
2. A.D.Helfric, W.D.Cooper,Modern Electronic Instrumentation And Measuring Technique, PHI
3. Neubert H.K.P - Instrument Transducers – An introduction to their performance & design Oxford University Press.
4. Doebelin E O- Measurement Systems; Application and Design; MGH
5. Norton – Handbook of Instrumentation Design.
6. A.K.Sawhney: A Course in Electrical and Electronic Measurements and Instrumentation, Dhanpat Rai.
7. H S Kalsi, Electronic Instrumentation, TMH.

Paper Name : Numerical Methods and Optimization Techniques
Paper Code : M 402
Weekly Load : L: 3 T: 1 P: 0
Credit Unit : 3
Total Marks : 100

Module	Detailed Description	Lecture / Tutorial Period
1	**Numerical Methods:** Error Formulation Numerical Interpolation: Finite differences, Newton's forward and backward interpolation formulae, Lagrange's interpolation, error analysis. Numerical Differentiation and Integration: Numerical differentiation using interpolating polynomial, Trapezoidal rule, Simpson's 1/3 rd rule of integration, error analysis.	**10L+4T**
2	Numerical solution of polynomial and transcendental equations: Bisection method, Regula-Falsi method, Fixed point iteration, Newton-Raphson method, Gauss-Jacobi iteration and Gauss-Seidel iteration for solving a system of linear equations. Numerical solution of ODE: Numerical solution of first order ODE with initial condition by Picard's, Euler's and Taylor's series method, Runge-Kutta method, Predictor-Corrector methods (Milne and Adams-Bashforth); Boundary value problems, Shifting and finite difference method.	**10L+3T**

3	I. Introduction: Historical Development, Engineering application of Optimization, Formulation of design problems as mathematical programming problems, classification of optimization problems. II. Linear Programming: Graphical method, Simplex method, Big-M Method, Revised simplex method, Duality in linear programming (LP), Sensitivity analysis, Transportation, assignment and other applications. III. Game theory and its applications: Maximin,Minimax Principle, Two-person-zero-sum game, Dominance principle, Graphical Method.	**12L+4T**
4	IV. Non Linear Programming: Unconstrained optimization techniques, Direct search methods, Constrained optimization, Direct and indirect methods, Optimization with calculus, Kuhn-Tucker conditions. V.PERT and CPM	**10L+3T**
	Total:	**42L+14T**
	Total Week Required:	**14**
	No. Of Week Reserved:	**02**

Text/Reference Books:

1. S.S. Rao, "Engineering Optimization: Theory and Practice", New Age International (P) Ltd., New Delhi, 2000.
2. J.K.Sharma "Operations Research", National Publishing House
3. H.A. Taha, "Operations Research: An Introduction", 5th Edition, Macmillan, New York, 1992.
4. K. Deb, "Optimization for Engineering Design – Algorithms and Examples", Prentice-Hall of India Pvt. Ltd., New Delhi, 1995.
5. An Introduction to Numerical Analysis (2nd edn.)-Atkinson, John Wiley and sons
6. Numerical Analysis-James Blaine Scarborough, Oxford University Press
7. Numerical Methods-S.A. Mollah, Books and Allied Publishers

Paper Name : Digital Electronics and Circuits
Paper Code : ECE 421
Weekly load : L: 3 T: 1 P: 0
Credit Point : 3
Total Marks : 100

Module	Detailed Description	Lecture/ Tutorial Period
1.	**Number system and binary codes:** Digital Circuits, Definition of Analog &Digital Signals. Characteristics of Digital Circuits, Advantages and Disadvantages of Digital systems over Analog system. Brief overview of decimal, binary, octal and hexadecimal number systems and their arithmetic operations. Conversion of one number system to another. Complement methods of different number systems and their arithmetic operation. Signed and floating point representations of binary numbers. Arithmetic operation using signed binary numbers. Definition and signification of binary codes, classification of binary codes-weighted, non-weighted, error detecting and correcting codes, sequential, reflective, self-complementing and cyclic codes, alphanumeric codes. Arithmetic operation of BCD and Excess-3 code. Conversion of binary to gray code and vice versa. Error detecting and correcting code using Hamming and parity code. ASCII code.	11L+4T

2. .	**Logic gates and logic expressions:** Basic logic gates (NOT, AND, OR, NAND, NOR, XOR and XNOR) –operations, truth tables and Venn diagram representations. Universal gates and representation of basic logic gates using universal gates i.e. 7400 & 4000 series IC's. Different postulates and laws of Boolean algebra, De Morgan's theorem; Canonical forms representation of Boolean expressions-SOP and POS forms. Simplification and minimization of logic expressions using Boolean algebra, K-maps, and Quinn McClusky methods, simplification using don't care terms.	6L+6T
3.	**Digital circuits** **Combinational Logic Circuits:** Introduction, Design procedure of combinational logic circuits, Analysis and synthesis of different combinational logic circuits - Adder, Subtractor, Multiplexer, Demultiplexer, Decoder, Encoder, decoder driver, Parity generator/checker, Priority encoder, Code-converter etc. **Sequential Logic Circuits:** Introduction, Latch and Flip-flops, Analysis and synthesis of different types of Flip-flops- S-R, J-K, D and T type flip-flops. Triggering of a flip-flops, Master-slave F/F, Race Around condition of an F/F. Conversions of flip-flops. Application of flip-flops. Shift registers-Introduction, serial, parallel and universal shift register, applications. Counters-Introduction, Classification of counters, synchronous and asynchronous counters; binary, design and analysis of modulo-N and arbitrary sequence counters. Shift register counters (Ring and Johnson).	10L +2L
4.	**Analysis and synthesis of synchronous sequential circuits and Interface Circuits:** Introduction, Basic models of sequential machine (Moore, Mealy), Use of Algorithmic State Machine, Analysis of Synchronous and Asynchronous Sequential Circuits: Design of fundamental mode and pulse mode circuits Design procedure of different synchronous sequential circuits, Synthesis of completely and incompletely specified synchronous sequential machines, Problems in Asynchronous Circuits, Design of Hazard Free Switching circuits. Design of Combinational and Sequential circuits using VHDL. Different parameters definitions such as resolution, accuracy etc. Analog to Digital converter (ADC) - flash type, counter type, tracking type, single and dual-slope type, successive approximation method. Digital to Analog converter (DAC) - weighted resistor method, R-2R ladder method.	15L+2T
	Total:	**42L+14T**
	Total Week Required:	**14**
	No. Of Week Reserved:	**02**

Text/Reference Books:

1. Digital design by Morris Mano (PHI).
2. Fundamental of digital circuits by A.Anand Kumar (PHI).
3. Digital Circuit & Design by S.Salivhanan, S.Aribazhagan-Vikas Publishing House.
4. Digital Fundamentals by T.L.Floyd, R.P.Jain (Pearson)
5. Digital design principles and applications (6/e) by D.P.Leach, A.P.Malvino, G.Saha (TMH)
6. Comer- Digital Logic & State Machine Design, OUP.

Paper Name : Physics of Solid State Devices
Paper Code : PH 401
Weekly Load : L : 3 T :0 P : 0
Credit Point : 2
Total Marks : 100

Module	Detailed Description	Lecture/ Tutorial Period
1	**BAND THEORY & CARRIER STATISTICS:** Energy bands, E-K diagram of semiconductors, direct and indirect band-gap semiconductors, electron & holes, their effective mass and carrier lifetimes, Compound semiconductor, variation of energy band with alloy composition. Fermi-Dirac distribution statistics, the density of states. Electron and hole concentrations at equilibrium, Einstein equation. Effects of temperature on carrier concentrations. **CARRIER TRANSPORT PHENOMENA:** Mobility and conductivity, drift and diffusion current expressions and velocity. Effects of temperature and doping on mobility. High field effects, Calculation of Hall coefficient, Carrier Concentration and Mobility Carriers in semiconductor.	**9L**
2	**JUNCTION CHARACTERISTICS :** Step junction P-N Junction: Contact Potential, Band diagram of unbiased, forward biased and reversed biased P-N Junction, I-V Curve. Static and dynamic resistances. Silicon versus Germanium, Junction Breakdown. Metal-Semiconductor Junction: Rectifying Contacts, Ohmic Contacts, Schottky Barrier Diode. Graded P-N junction: Varactor Diode,	**10L**
3	**QUALITATIVE ANALYSIS OF BJT, FET, MOSFET, CCD**: Fundamentals of Bipolar Junction Transistors, structure, fabrication, operation principle, Amplification. Junction Field Effect Transistors (JFET), structure, fabrication, operation, I-V characteristics, Metal Oxide Semiconductor Field Effect Transistor (MOSFET), principle of operation, MOS capacitor, Charge Coupled Devices (CCD),	**10L**
4	**OPTOELECTRONIC DEVICES:** Electroluminescent process , generation of light, quantum efficiencies, light-emitting diodes, OLED, semiconductor lasers , population inversion at a junction, emission spectra for P-N junction lasers , the basic semiconductor laser, heterojunction lasers , laser materials, applications of laser, principle of optical detection, LDR and PIN photo diode and other photo diodes , Solar cell: principle of operation, characteristics and applications, LCDs. TFT. **BASIC CONCEPTS OF MICROWAVE DEVICES:** Gunn Diode, IMPATT Diode and Tunnel Diode. **EMERGING DEVICES(Discussions):** Basic concepts of quantum and Nano devices: Quantum wells, Quantum Dots, HEMT, SED and Spintronic Devices. Insulated Gate Bipolar Transistor (IGBT) Basics, operation modes	**13L**
	Total	**42L**
	Total Week Required	**14**
	No. of Week Reserved	**02**

Text/Reference Books:

1. Solid State Electronic ***Devices*** by Ben G ***Streetman*** and Sanjay ***Banerjee--PHI***
2. Semiconductor Physics and Devices by Donald A. Neamen—TMH
3. Physics of Semiconductor Devices by S. M. Sze—John Willy
4. Fundamentals of Semiconductor Devices by Betty Lise Anderson, Richard L. Anderson McGraw-Hill Professional, 2005
5. Fundamentals of Semiconductor Physics and Devices by Rolf Enderlein & Norman J Horing.
6. Principle of Semiconductor Devices by B. Van Zeghbroeck
7. Electronic Devices and Circuits by J J Cathey (Schaum series) –TMH

8. Solid State Physics, Solid State Devices and Electronics by C. M. Kachhava—New Age
9. Semiconductor optoelectronic devices by Pallab Bhattacharya,
Prentice Hall, 1994 - Technology & Engineering

Paper Name : Electrical Machines
Paper Code : EE 423
Weekly Load : L : 3 T : 0 P= 0
Credit Point : 2
Total Marks : 100

Module	Detailed Description	Lecture/ Tutorial Period
1	**Single-Phase Transformer** Construction and basic principle of operation, Core type and shell type. Materials used for core. Winding and insulation, (E.M.F. equivalent circuit ;) Equivalent circuit referred to primary -- phasor diagram, Polarity test, O.C and S.C. test Regulation. Efficiency. All day efficiency.	7L
2	**Induction Motor** Three phase balanced excitation system. Development of rotating magnetic field. Frequency of the induced emf and relationship to number of poles. Construction and basic principle of operation of 3 phase induction motor, Slip, Slip speed and slip frequency, Per-phase equivalent circuit, Phasor diagram, Types of windings, Squirrel cage and slip-ring motor construction, Equations for torque, Torque-speed characteristics, Effect of change in rotor resistance in slip-ring machine, Methods of starting and speed control, Losses & efficiency.	9L
3	**D.C. Machines** Construction and operating principle, Function of commutator and brush system, Armature reaction and their effects, Commutation. **D.C. Generators** EMF equation, Characteristics with different excitation systems. **D.C. Motors** Equation for torque, Characteristics with different excitation systems. Method of starting. Speed control, Speed-torque characteristics	14L
4	**Synchronous Machines** Alternator: Construction, EMF equation, Armature reaction with different power factor of loads, Phasor diagram, Methods of determination of voltage regulation. Parallel operation of alternators and synchronization **Synchronous Motors** Principle of operation, Hunting, Starting method, application.	12L
	Total	**42L**
	Total Week Required:	**14**
	No. of Week Reserved:	**02**

Text/Reference Books:

1. H. Cotton," Advanced Electrical Technology"
2. Clayton & Hancock," Performance and Design of DC machines"
3. Puschtein & Lloyd,"Alternating Current Machines"
4. M.G.Say,"The Performance and design of alternating Current Machines"

Paper Name : Sensors & Transducers Laboratory
Paper Code : AEIE 451
Weekly Load : L : 0 T : 0 P : 3
Credit Point : 2
Total Marks : 100

List of Experiments

1	Measurement of Temperature using Temperature Sensor(preferably optical and any other temp sensors)
2	Water Level Measurement Using Capacitive Transducer
3	Study of Inductive Transducer and measurement of displacement using LVDT
4	Study of Load Cell characteristics using Load Cell trainer kit
5	Torque Measurement using Strain Gauge Transducers
6	Measurement of Angular Speed using Stroboscope
7	Study the characteristics of Phototransistors, Photodiodes ,Photoconductive Cell And Photovoltaic Cell
8	Measurement of Force using Magnetostrictive Transducer
9	Study of the application of Ultrasonic Transducers
10	Study the characteristics of Piezoelectric Microphone and Capacitive Microphone with their associate circuits.

Paper Name : Electronic Measurement & Measuring Instruments Laboratory
Paper Code : AEIE 452
Weekly Load : L : 0 T : 0 P : 3
Credit Points : 2
Total Marks : 100

List of the Experiments:

1. Study of static characteristics of an instrument: Accuracy, Precision, Hysteresis.
2. Study of dynamic characteristics (fidelity, speed of response), amplitude and frequency response of 1st and 2nd order systems for different input signals: impulse, steps & sinusoidal signals.
3. Calibration of voltmeter using standard potentiometer.
4. Study and design of D/A converter circuits.
5. Study and design of A/D converter using Dual Slope and Successive Approximation type.
6. Design and study of Instrumentation Amplifier using Op-amps.
7. Study and implementation of Data Acquisition System (DAS) with computers interfacing using more than one sensor.
8. Demonstration of construction and different fault detection of Oscilloscope.
9. Demonstration of Digital Storage Oscilloscope (DSO).
10. Demonstration and application of Spectrum Analyser.
11. Wave Spectrum analysis of signals of different frequency in RLC Circuits using Q- meter.
12. Measurement of RF and VHF signals.
13. Study of the characteristics and design of the higher order systems using software simulators.

Paper Name : Numerical Methods and Optimization Techniques Laboratory
Paper Code : M 452
Weekly Load : L: 0 T: 0 P: 3
Credit Unit : 2
Total Marks : 100

List of experiments:

1	Forward and backward difference table
2	**Numerical Differentiation:** Use of Newton's forward and backward interpolation formula only.
3	**Numerical Integration:** Trapezoidal formula (composite), Simpson's $1/3^{rd}$ formula (composite),Problems. Numerical Solution of System of linear Equations: Gauss-Jordan method, Gauss-Siedel method, Sufficient condition of convergence.
4	**Numerical Solution of Algebraic and Transcendental Equations**: Iteration method, Bisection method, Secant method, Regula-Falsi method, Newton- Raphson method.
5	**Numerical solution of Initial value problems of First order ODE:** Taylor's series method, Euler's method, Runge-Kutta method (4^{th} order), Modified Euler's method.
6	**Optimization Techniques:** Linear Programming (Transportation , Assignment , Duality , Simplex)
7	**PERT/CPM** :Critical Path Calculation

Text/Reference Books:

1. Numerical Methods with programming in C -T. Veerarajan, Tata McGrawHill, 2004
2. Numerical Methods in Science and Engineering- S.Rajasekaran, S Chand Publishing
3. Numerical Methods for Engineering and Science –Guha & Srivastava, Oxford University Press

Paper Name : Digital Electronics and Circuits Laboratory
Paper Code : ECE 471
Weekly load : L: 0 T: 0 P: 3
Credit Point : 2
Total Marks : 100

List of Experiments:

1. To Study and Verify the Truth Table of Different Basic Logic Gates (NOT, AND, OR, NAND, NOR, EX-OR).
2. To Study and Implementation of Different Basic Logic Gates using Universal Gates (NAND, NOR) and verification of De-Morgan's theorem.
3. Design and Verify the logic circuit of Half Adder and Full Adder Using Basic Logic Gates.
4. Design and Verify the logic circuit of Half Subtractor and Full Subtractor Using Basic Logic Gates.
5. Design and Verify of Binary to Octal Decoder Using Basic Logic Gates and Study of Decoder IC 74138.
6. Design of 4:1 Multiplexer Using Basic Logic Gates and Study of Multiplexer IC 74153.
7. Study of BCD to Decimal Decoder Driver by Using Decoder Driver IC 7447 and Seven Segment LED Display Device LTS-542.
8. Design and Verify of S-R, J-K, D and T type Flip Flop Using Basic Logic Gates.
9. Design and Study of four bit Shift Resistor using IC 7474 in different Modes: a) Serial in-Serial out; b) Serial in-Parallel out; c) Parallel in-Serial out; d) Parallel in-Parallel out.

10. Design and Study of Asynchronous (Ripple) Counter of given modulus by using IC 7476.
11. Study Decimal to BCD Priority Encoder & Encoder IC 74147.
12. Design of 8 bit Parity Generator/Checker circuit using IC 74180.
13. Design and Study of 8 bit A/D Converters.
14. Design and Study of 8 bit D/A Converters.

Semester-V

Paper Name: Industrial Instrumentation
Paper Code: AEIE 501
Weekly Load: L:3 T:1 P:0
Credit Point: 3
Total Marks: 100

Module	Detailed Description	Lecture / Tutorial Period
1.	**INTRODUCTION TO PROCESS AND PROCESS PARAMETER**: Description of process, process instrumentation, introduction of process parameters, process signal and universal standard range, unit, elementary diagram of different process like open loop, close loop process. Manufacturing specifications and standards. **PRESSURE MEASUREMENT:** International standard, unit & dimension, simple block diagram of pressure measurement and transfer functions. Pneumatic instruments: introduction to flapper-nozzle systems, bellows, diaphragm, membrane, different type of bourdon tube, different type of manometers, low pressure measurements: pirani, McLeod gauge, force balance mechanism, characteristics, and industrial applications. Electrical instruments: different types of DP Transmitters. **TEMPERATURE MEASUREMENT:** Construction, working principle, static and dynamic characteristics of thermometer, thermocouple, RTD, Thermistor, optical and IR pyrometer, bimetallic thermometers, thermal switches, block diagram of temperature measurement of heat exchanger, boiler, furnace.	11L+4T
2	**FLOW MEASUREMENT :** Bernoulli theorem, Reynolds number, laminar , turbulent ,coriolis flow ,mass flow rate , flow velocity, cross sectional view of different fluid tapping, block diagram of flow measurements; Pneumatic instruments: working principle , construction, characteristics ,advantages, limitation. Primary flow measuring instruments, secondary flow meter like orifice meter, venturi meter, pitot tube, nozzle meter, rotameter; Electrical instruments: electromagnetic , turbine flowmeters, ultrasonic flowmeters, coriolis flowmeter.	11L+4T
3	**LEVEL MEASUREMENT :** working principle, construction, application, advantage, disadvantage of displacer type, float type, weight balance type flowmeters, and manometric type level measurements. electrical type: dp transmitter, ultrasonic, gamma radiation, microwave and their applications in industrial instrumentations. **MEASUREMENT OF OTHER PARAMETERS :** Moisture, humidity, angular speed using stroboscope, viscosity, density, thickness, nuclear radiation measurements.	10L+4T
4	**RECORDER:** Construction, working principle, and applications of different Analog Recorders, Digital Recorder and its different recording methods. **DISPLAY:** Description of LED, LCD and Plasma Intrinsic safety, hazardous environment, alarm monitoring	10L+2T
	TOTAL:	**42L+14T**
	Total Week Required:	**14**
	No. Of Week Reserved:	**02**

Text and/or **Reference Books:**

1. Jone B.E.- Instrumentation, Measurement and Feedback ,TMH, 1983
2. Doeblin E.O. - Measurement System: Application & Design, MGH Tokyo
3. H S Kalsi, Electronic Instrumentation, TMH
4. D. Patranabis,-Industrial Instrumentation, TMH
5. Liptak- Hand Book On Process Instrumentation**,**
6. DVS Murthy – Transducers and Instrumentation, PHI
7. Shawney A.K—A course in Electrical & Electronic Measurements, Dhanpat Rai & Sons

Paper name: Power & Industrial Electronics
Paper Code: AEIE 502
Weekly Load: L: 3 T: 1 P: 0
Credit Point: 3
Total Marks: 100

Module	**Detailed Description**	**Lecture/ Tutorial Period**
1	Power semiconductor devices, Rectifier devices, series and parallel operation of rectifiers, power rectification half wave and full wave with high-current diodes from single & three phase a.c. supplies – different circuit arrangements, their analysis, ratings of rectifiers, rectifier transforms, regulation efficiency. SCR, DIAC, TRIAC, UJT, PUT, GTO and other power electronic devices – construction, characteristics and operating principles,	11L+3T
2	Series and parallel operation of thyristors, Thryristor turn-on & turn-off mechanisms, switching characteristics, triggering modes, different triggering circuits, cosine firing scheme, pulse transformer triggering, UJT triggering, TRIAC firing circuit etc., protection circuits – dv/dt protection, snubber circuits, di/dt protection, over voltage & over current protection, gate protection, heat sink.	11L+4T
3	A.C. power control – phase control & other techniques-Full-wave, half controlled, bridge circuits, Thyristor converters-controlled rectification, use of free-wheeling diodes, ON-OFF control, natural and forced commutation. a.c. & d.c. choppers.	9L+2T
4	Inverters – configurations – series & parallel, bridge, single and poly phase, self-commutation; inverter control circuits-sequential and d.c. coding; voltage source inverter, current source inverter; cyclo-converters. SMPS, magnetic amplifiers, induction and dielectric heating, induction cooking, electric welding. Use of power electronic devices in dc motor control and ac motor.	11L+5T
	TOTAL:	**42L+14T**
	Total Week Required:	**14**
	No. Of Week Reserved:	**02**

Text/Reference Books:

1. Power Electronics by P. C. Sen.
2. Power Electronics by Mohan, Undeland and Robbins.
3. Power Electronics-circuits, devices and applications by Mohammad H. Rashid
4. An Introduction to Thyristors and their Application by M. Ramamoorty.
5. Power Electronics, Thyristor Controlled Power for Electric Motors b R.S. Ramshaw
6. Power Electronics by K. Hari Babu, Scitech Publications Pvt. Ltd.
7. Power Electronics by Harish C Rai, Galgotia publications.
8. Power Electronics and its applications by Alok Jain, Penram publisher

Paper Name: Microprocessor Theory & Applications
Paper Code: AEIE 503
Weekly Load: L: 3 T:1 P:0
Credit Points: 3
Total Marks: 100

Module	Detailed Description	Lecture / Tutorial Period
1	**Introduction:** Generic-8-bit microprocessor and its architecture, 8085 functional block diagram, functions of different sections, Memory mapping, Memory interfacing, addressing modes, instruction cycle, timing diagram, different machine cycles-fetch and execute operations. **Interrupts:** Different types of Interrupts, Interrupt service routine. Design of programs using interrupts.	8L+2T
2.	**Programming the 8085:** Introduction to microprocessor programming paradigm, Assemblers, and Cross-compilers. Assembly language Programming - Instruction format, Instruction set, delay programs, flowcharts, Stack and subroutine.	10L+5T
3	**Data Transfer Schemes & Interfacing:** Programmable peripheral interface (8255A), programmable interval timer(8254), programmable interrupt controller (8259), Direct memory access(DMA), programmable keyboard display interface (8279), serial I/O and data communication-8251 USART-Interfacing A/D and D/A converters.	12L+3T
4	**Introduction to 8086**: Architecture of 8086 Microprocessor-functions of general purpose registers-flags and flag register, addressing modes, 8086-minimum and maximum mode of operation, Memory segmentation and memory organization concepts, Timing diagram, Instruction set, Assembly language programming concepts, Memory interfacing to 8086 (Static RAM & EPROM). **Applications of Microprocessors**: Typical application of microprocessors: stepper motor control, dc motor control. temperature control, traffic light control etc.	12L+4T
	TOTAL:	42L+14T
	Total Weeks Required:	**14**
	No. of Weeks Reserved:	**02**

Text/Reference Books:

1. Microprocessor Architecture Programming & Applications with 8085 /8080: Ramesh S Gaonkar.
2. Digital Computer Electronics An Introduction to Microcomputers : Malvino.
3. Digital Systems From Gates to Microprocessor : Sanjay K. Bose.
4. Assembly Language Programming : Lance A. Lventahl.
5. Microprocessors Theory & Applications : M Rafiquizzaman.
6. Microcomputer Systems The 8086 / 8088 family Architecture, Programming & Design : Liu & Gibson
7. Microprocessor & Interfacing Programming & Hardware: Douglas V. Hall
8. The Intel Microprocessors : Barry B. Brey.
9. Introduction to Microprocessors for Engineers and Scientist: P. K. Ghosh & P.R. Sridhar.

Paper Name: Linear Control Theory
Paper Code: AEIE 504
Weekly Load: L:3 T: 1 P:0
Credit Points: 3
Total Marks: 100

Module	**Detailed Description**	**Lecture / Tutorial Period**
1.	Elementary control concepts. Open loop and close loop control. Mathematical Model of Physical Systems: Introduction, Differential equation representation of physical systems. Electrical analogy of physical systems. Transfer function concepts, Block diagram algebra, Signal flow graphs. Feedback Characteristics of Control Systems: Introduction, Reduction of parameter variation by use of feedback, Control of system dynamics by use of feedback, Control of effects of disturbance signals by use of feedback, Regenerative feedback, Illustrative examples.	9L+4T
2	Control System Components: Introduction, DC servomotors, AC servomotors, Tachometer, DC tacho-generators, AC tacho-generators, Stepper motors, Synchro error detectors, Areas of Application. Time Response Analysis: Introduction, Standard test signals, Performance indices, Time response of first order system, Time response of second order systems.	10L+4T
3	Stability Analysis in Time Domain: The concept of stability, Assessment of stability from pole positions, Necessary conditions for stability, Routh-Hurwitz stability criterion, Relative stability analysis, Illustrative examples. Root Locus Technique : Introduction, The root locus concept, root locus construction rules, root contours. Control Actions: P, PD, PI & PID Control.	11L+3T
4.	Frequency Response Analysis: Introduction, Performance indices, Frequency response of second order systems, Polar plots, Bode plots, All pass systems, Minimum-phase and Non-minimum-phase systems, Illustrative examples. Series compensation – lag, lead and lead-lag compensation using Bode plots. Stability Analysis in Frequency Domain: Introduction, A brief review of Principle of Argument, Nyquist stability criterion, Assessment of relative stability – Gain Margin and Phase Margin, Illustrative examples. Introduction to SISO, MIMO systems, state space model.	12L+4T
	TOTAL:	42L +14T
	Total Weeks Required:	**14**
	No. of Weeks Reserved:	**02**

Text and/or **Reference Books:**

1. Madan Gopal - Control Systems , Principles & Application , TMH
2. NagrathI. J. and Gopal M. - Control Systems Engineering, New Age International (P) Ltd.
3. Ogata K - Modern Control Systems, Prentice Hall.
4. Benjamin C. Kuo - Automatic Control Systems, PHI
5. Chandna - Control System, CyberTech
6. M. Gopal- Modern Control System, New Age International
7. Mahapatra- Industrial Control & Instrumentation, Universities Press
8. Automatic Control Systems(with MATLAB programs)- Syed Hasan Saeed, S.K.Kataria & Sons.

Paper Name: Analog & Digital Communication Techniques
Paper Code: ECE 523
Weekly Load: L: 3 T: 1 P: 0
Credit Point: 3
Total Marks: 100

Module	Detailed Description	Lecture / Tutorial Period
1	**Introduction:** Introduction to fundamental elements of communication systems. Concepts of signals and spectrum, spectrum allocation for different communication systems. Baseband and Bandpass transmission of signals. Discussions about communication channels and propagation characteristics. **Fourier series and Fourier Transform:** Introduction, brief discussions of Fourier series and Fourier transformations, properties of Fourier transformation with application.	12L+4T
2	**CW Modulation:** Basic concepts and necessity of Modulation. Classifications of CW modulation. Amplitude Modulation**:** Definition, time and frequency analysis for AM, basic concepts of DSB-SC, SSB-SC and VSB-SC modulation. Different types of modulator and demodulator circuits of Amplitude Modulation (e.g. Square law modulator, balanced modulator, ring modulator, envelope detector etc.) Angle Modulation: Principles and definitions, relationship between frequency and phase modulations, narrow and wide band FM. Different types of modulator and demodulator circuits of Frequency Modulation (e.g. Direct and Indirect modulator, Slope detector, PLL etc.)	10L+4T
3	**Pulse Modulation:** Sampling theorem, Nyquist criterion, Interpolation. Definitions and overview of PAM, PPM, PWM. Concepts of PCM, DM. **Pass Band Data Transmission:** Concept of digital carrier modulation, generation and detection of ASK, FSK, PSK, basic concepts of BPSK & QPSK.	13L+3T
4	**Information Theory and Coding:** Definition of information, entropy, channel capacity, different channel codlings i.e. Shannon fano, Huffman coding, linear block code, cyclic code etc.	7L+3T
	TOTAL:	**42L+14T**
	Total Week Required:	**14**
	No. Of Week Reserved:	**02**

Text/ References Books :

1 Electronic Communications – Dennis Roddy and John Coolean , 4th Edition, PEA, 2004
2 Modern Analog and Digital Communication – B.P.Lathi, Oxford reprint, 3rd edition, 2004
3 Analog and Digital Communications – Simon Haykin, John Wiley, 2005.
4 Electronics & Communication System – George Kennedy and Bernard Davis, TMH 2004.
5 B.Carlson, Introduction to Communication Systems (4/e), McGraw-Hill
6 Principles of Communication Systems – H. Taub & D. Schilling , TMH, 2nd Edition, 2003

Paper Name : Industrial Management & Entrepreneurship
Paper Code : HS 501
Weekly Load : L: 3 T:0 P: 0
Credit Point : 2
Total Marks : 100

Module	Detailed Description	Lecture/ Tutorial Period
1	**Introduction:** Management: Its Nature, Purpose and Importance, Management process: Planning, Organizing, Staffing, Directing and Controlling, Management Function: Marketing, HR and OB, Operation and Financial Management. Analytical and statistical Tools and techniques used in management: Forecasting based on cross sectional and longitudinal data as a part of managerial planning. Quantitative tools for Decision making. PERT and CPM as efficient controlling techniques.	10L
2	**Motivation, Leadership and HRM in Organization:** Maslow's Hierarchy' of Needs theory, Herzberg's Two factor theory, Broom's Expectancy Theory, Leadership: Trait approaches-Leadership Behavior and Styles(overview), Brief overview of HRM with emphasis on HR process. **Marketing Management:** Concept of customer centric marketing management, Basic Idea of Segmentation Targeting and Positioning. Understanding Marketing Mix.	10L
3	**Financial Management:** Importance and Scope of Financial Management. Overview of Working Capital management, CVP analysis and Capital Budgeting. Indian Financial Market emphasizing on Sensex Calculation. **Operations Management:** Basic Idea on Plant location and facility layout, Tools and Techniques for measuring productivity. Measurement of Quality for Product and Service. Basic understanding on Inventory Management. Overview of TQM and JIT.	10L
4	**Business Environment and Strategic Management:** Business Mission, Vision, Formulation of objectives, Assessment of the external environment with the help of SWOT, EAD including Portor's Industry Analysis, Assessment of Internal competences, Strategic alternatives, Portfolio Analysis. **Innovation and Entrepreneurship:** **Enterpreneurship**: Opportunity identification, Market Potential Estimation, Business plan development and feasibility analysis. **Managing new innovation:** new product development, intellectual property management. Brief idea about different types of venture capitalist and investors including financial organisation	12L
	Total	**42L**
	Total week required	**14**
	No. of week reserved	**02**

Text/Reference Books:

1. Industrial Management By S C jain, W S Bawa, Dhanpat Rai & Co (P) Ltd
2 Discourses of Strategic Management , Dilip Roy,Asian Book Private Limited
3 Strategic Management & Business Policy , Azhar Kazmi, McGraw Hill Education
4 Industrial & Business Management , Martand T. Telsang, S Chand Pub.
5 Management Theory & Practices , C B Gupta, S Chand Pub
6 Fundamentals of Entrepreneurship Development & Business Communication ,

Pranam Dhar, ABS Pub House.
7 Production & Operation Management , S Anil Kumar & N Suresh, New Age International pub.
8 Marketting Management , Kotler & Keller, Perason Pub.
9 Human Resource Management , Gary Dessler & Biju Varkkey, Pearson Pub.
10 Business Organization & Management , Tulsian, Pearson Education Asia Pub.

Paper Name: Industrial Instrumentation Laboratory.
Paper Code: AEIE 551
Weekly Load: L: 0 T: 0 P: 3
Credit Point: 2
Total Marks: 100

List of experiments:

1.	Real time moisture measurements using proper moisture meter and computer with proper simulation s/w.
2.	Measurements of Volume flow rate using orifice meter,venturimeter,pitot tube , rotameter.
3.	Measurements of the parameter change and study the behaviors of process connecting two or more transducers (Thermocouple, Strain Gauge etc) with Data Acquisition System interfacing with computer.
4.	Calibration of bourdon pressure gauge with respect to mercury column manometer.
5	Measurement of speed by tachometer, tachogenerator and stroboscope.
6	Calibration of a bimetallic dial thermometer.
7	Measurement of viscosity of liquids.
8	Study of solar energy to electrical energy (as Non-conventional energy) conversion using solar cell.
9	Measurements a prototype furnace temperature using various type (J/K/S/E etc) thermocouple and resistance temperature detector .
10	Study of Dead Weight Tester.
11	Study of coriolis flowmeter/electromagnetic flowmeter.

Text/Reference Books:

1. D.V.S Murty : Sensors And Transducers
2. Patranabis D – Principles of Industrial Instruments, THM.
3. Liptak: Handbook of Process Instrumentation and control.

Paper name: Power & Industrial Electronics Laboratory
Paper Code: AEIE 552
Weekly Load: L: 0 T: 0 P: 3
Credit Point: 2
Total Marks: 100

List Of Experiments:

1. Study of V-I Characteristics of an SCR
2. Study of V-I Characteristics of a TRIAC
3. Study of different Triggering Circuits for Thyristor
4. Study of Uni Junction Transistor (UJT) Triggering Circuit
5. Study of a firing Circuit suitable for single phase half controlled Converter
6. Study UJT relaxation oscillator.
7. Universal motor speed control using thyristor
8. Studies on SMPS
9. Studies on Inverter.
10. PSPICE Simulation of DC to DC step down chopper
11. PSPICE Simulation of single phase controller with R-L Load

Paper Name: Microprocessor Laboratory
Paper Code: AEIE 553
Weekly Load: L: 0 T: 0 P: 3
Credit Points: 2
Total Marks: 100

List of Experiments:

01	Familiarization with 8085/8086 register level architecture and trainer kit components and 8085/8086 simulator on PC.
02	Assembly language programming using 8085/8086 microprocessor – I a) Addition of two numbers or block of numbers b) Subtraction of two numbers/ difference calculation of two numbers c) Storing of data blocks (ascending/descending) d) Searching maximum and minimum number from a block of data
03	Assembly language programming using 8085/8086 microprocessor – II a) Multiplication and division of 8 bit data b) Shifting a block of memory c) Series calculation d) String Matching c) Code conversion (BCD to binary or reverse) d) Square, square root and factorial calculation of a given number.
04	Writing of a short subroutine and testing.
05	Program using subroutine calls and IN/OUT instructions using 8255 PPI on the trainer kit.
06	Program writing to interface ADC with 8086 microprocessor.
08	Static and scrolling display using 8279 on the trainer kit.
09	Temperature measurement using a microprocessor.
10	Position control of a stepper motor.
11	Measurement and control of speed of a d.c. motor using a microprocessor.
12	Development of a digital clock.
13	Development of a over-voltage/current protective system.
14	Familiarization with EPROM programming and Erasing.

Paper Name: Control System Laboratory
Paper Code: AEIE 554
Weekly Load: L: 0 T:0 P: 3
Credit Points: 2
Total Marks: 100

List of Experiments

1. Determination of step response for 1st & 2nd order System with unity feedback on Oscilloscope.
2. Familiarization with MATLAB- Control system toolbox, MATLAB-Simulink toolbox / PSPICE.
3. Simulation of step response for First order & Second order System with unity feedback using MATLAB / PSPICE.
4. Determination of performance indices from step response of second order system.
5. Determination of root-locus, Bode-plot, Nyquist plot, using MATLAB-Control system toolbox for a given 2nd/higher order transfer function
6. Determination of different control system specifications Gain Margin, Phase Margin, Gain Crossover frequency & Phase Crossover frequency from 2nd/higher order transfer function
7. Determination of PI, PD, PID controller action on 1st order simulated process.
8. Study the characteristics of ac servomotor and determine its transfer function.
9. Synchro and stepper motor studies.

10. Performance characteristics of a dc motor angular position control system.
11. Design of different types closed- loop system and its controllers (PI,PD,PID etc).

Semester-VI

Paper Name: Process Control
Paper Code: AEIE 601
Weekly Load: L: 3 T: 1 P: 0
Credit Points: 3
Total Marks: 100

Module	Detailed Description	Lecture/ Tutorial Period
1	The basic process control loop- different blocks in the loop. Open loop vs. closed loop systems. Generation of Control Action in pneumatic, electric/ electronic, hydraulic. Construction of different controllers. Digital controller, components and working of direct digital control (DDC), benefits of DDC, digital controller realization. Tuning of Controller – open loop & closed loop methods.	11L + 5T
2	Schemes and analysis of Feedback control, Cascade control – Definitions, primary & secondary loop, instability analysis and cascade loop saturation, Feedforward control – Load balancing, steady state model, dynamic model, feedforward-feedback control configuration, Ratio control – Flow ratio control, ratio stations, remote sensing of ratio, Selective control: Override control, Auctioneering control, Valve-position control, Split-range control; batch and continuous process control, multi variable control schemes, adaptive control.	10L + 4T
3	Final control elements – Actuators pneumatic spring & springless piston motor, pneumatic, hydraulic, and electrical actuators. Control valves – types, valve sizing, characteristics, body materials, trim of control action, single & double seated valve, special type of control valves – Flow, Pressure, Directional control valve. Selection criteria for control valve. Valve positioners – Performance, application & advantages. P-I and I-P converters.	10L +2T
4	Control schemes in industrial processes- distillation columns, heat exchanger, furnaces, reactors, boiler, evaporator, combustion. Programmable Logic Controller: Architecture, basic symbols used in PLC realization, relay logic and ladder logic, PLC ladder diagram realization, Application case study. Distributed Control System and SCADA system : DCS structure, DCS hardware and software, networks, gateways and connectivity, case study: SCADA hardware and software.	11L+3T
	TOTAL:	42L +14T
	Total Weeks Required:	**14**
	No. of Weeks Reserved:	**02**

Text and/or **Reference Books:**

1. Harriot – Process zcontrol, MGH
2. Conghanowr D.R. – Process System Analysis & Control. MGH, 2nd Ed
3. Curtis D Johnson – Process Control Instrumentation Technology, - Pearson Education/PHI
4. Luyben W. L – Simulation & Control for Chemical Engg.
5. George Stephanopoulos – Chemical Process Control – An Introduction to theory & Practice, PHI
6. Considine Doglas M – Process /Industrial Instruments and Control Handbook,MH
7. Bequette – Process Control – Modeling, Design and Simulation,PHI
8. D Patranabis – Principles of Process Control, TMH
9. K Krishnaswamy – Process Control, New Age International

10. S K Singh - Industrial Instrumentation and Control, TMH
11. Surekha Bhanot – Process Control, OXFORD

Paper Name: Microcontrollers & Embedded Systems
Paper Code: AEIE 602
Weekly load: L: 3 T: 1 P: 0
Credit Point: 3
Total Marks: 100

Module	**Detailed Description**	**Lecture/ Tutorial Period**
1	Introduction to microcontroller, constructional block diagram, comparison with microprocessor, elementary block diagram of embedded systems and embedded processor, examples of embedded systems. introduction to 8-bit microcontrollers of Intel, Atmel etc Schematic diagram of intel-8051,microcontroller-registers,oscillators,ports, memory, timers/counters, special function registers Addressing modes.	10L +3T
2	Special Mnemonics Like DA, ACALL, LCALL, unconditional & conditional jump, multiplication division, addition and subtraction, sign and unsigned number operation, explanation with examples of programming related to topic. Introduction to the Timer/Counter And It Special Registers**:** programming for delay generation and square wave generation with different frequency and time period, method of loading the count value in timer; i/o port programming;	10L+4T
3	Serial Communication: basics of serial :simplex, half duplex, duplex; UART&USART; programming for transmit and received data: connection to RS232 Interrupts**:** interrupts of 8051 microcontroller; programming on timer interrupt, programming on external hardware interrupts, programming on serial communication interrupts Interfacing with Peripheral Input/Output Devices: ADC ,DAC, Display ; Designing And Coding Interfacing With Appropriate Sensors For Measurements Of Temperature.	11L+3T
4	Speed Control Of Stepper Motor Using 8051 Microcontroller, Key Board Interfacing**,** Introduction and programming model of AVR and PIC micro-controllers Software Development for process control ,distributed control systems, temperature, pressure, flow, speed, rms meters	11L+4T
	TOTAL:	**42L+ 14T**
	Total Week Required:	**14**
	No. Of Week Reserved:	**02**

Text and/or **Reference Books:**
1. Mazidi & Mazidi ; The 8051 Microcontrollers And Embedded Systems;Pearson Education
2. D.Calcutt, F Cowan, H Parchizadeh; 8051 Microcontrollers; ELSEVIER
3. Lyoid: Microcontroller 8051 Family;
4. Microprocessor Interfacing – Hall D. V. MGH

Paper Name: Telemetry & Remote Control
Paper Code: AEIE 603
Weekly Load: L: 3 T: 1 P: 0
Credit Point: 3
Total Marks: 100

Module	Detailed Description	Lecture / Tutorial Period
1.	**Basic Concept:** Telemetry- its purpose and applications. Basic schemes-voltage, current, frequency and pneumatic telemetry systems and limitations. Wired and wireless telemetry systems and their applications, PLCC **Multiplexing (Time Division Multiplexing & Frequency Division Multiplexing systems):** Basic concept and block schematic for TDM & FDM system, de-multiplexing schemes, comparisons, applications and limitations. IRIG standards in FDM system. of TDM and FDM.	10L+4T
2	**Modem:** Introduction, QAM, modem protocols, synchronous protocols. **Satellite Communication and Telemetry:** Introduction, TT&C services and subsystems, the earth station. Kepler's laws.	9L+4T
3	**Fibre Optic Telemetry:** Optical fibre as a transmission medium, interconnections, repeater, Sources and Detectors; Receivers, wave-length division multiplexing **Industrial Communication System:** Introduction, OSI network model and details architecture, Token Buses and Rings, HART and HART Protocol, Fieldbus and Device Networks; Foundation Fieldbus, Profi-bus Networks, Industrial Ethernet and TCP/IP based systems, Niche Fieldbus networks	11L+3T
4	**Data Acquisition System:** Fundamental concept, analog and digital signal transmission in processes; Protocols and standards, Data Acquisition: Buses, Networks, Software and Data Handling, Data Reconciliation and Software method for bias detection P&ID diagram and single line diagram-introduction, interpretation of it, applications; Annunciator-basic concept, working principle and applications in industries, hooter, buzzer and bell systems **Remote Control:** Concept, schemes and industrial applications with examples	12L+3T
	Total:	**42L+14T**
	Total Weeks Required:	**14**
	No. Of Week Reserved:	**02**

Text and/or **Reference Books:**

1. Patranabis D., Telemetry Principles; TMH
2. Anand MMS, Electronic Instruments and Instrumentation Technology, PHI
3. Béla G. Lipták, Process Software and Digital Networks, CRC Press
4. Dr. Frank Carden, Dr. Robert Henry, Dr. Russ Jedlicka; Telemetry Systems Engineering Artech House USA
5. Pandiyan Jagadeesh, Introduction to SmartPlant P&ID: The Piping & Instrumentation Diagrams (P&ID) Handbook, APJBooks

Paper Name: Digital Signal Processing
Paper Code: AEIE 604
Weekly Load: L:3 T: 1 P:0
Credit Point: 3
Total Marks:100

Module	Detailed Description	Lecture / Tutorial Period

1.	Introduction: Difference between analog , discrete time and digital signals, overview of digital signal processing, application areas. Discrete-time signals: Representation of discrete-time signal, basic idea of sampling and reconstruction of signal, sampling theorem, sequences – periodic, energy, power, unit-sample, unit-step, unit-ramp, real & complex exponentials, arithmetic operations on sequences. Discrete time system: Definition, representation of linear time invariant systems(LTI), impulse response, derivation for the output sequence, concept of convolution, graphical, analytical methods to compute convolution , stability and causality conditions, recursive and non-recursive systems.	11L+2T
2.	Z-Transform: Definition, mapping between s-plane and z-plane, unit circle, convergence and ROC, properties of Z-transform, Z-transform on sequences, characteristic families of signals along with ROCs, convolution, correlation and multiplication using Z transform. Inverse Z-transform by contour integration, power series & partial-fraction expansions	10L+3T
3.	DTFT, DFT and FFT: Definition, Characteristics of DTFT sequence, DTFT of different sequences, Derivation of DFT/IDFT from DTFT sequence, basic properties of DFT, Twiddle factor, linear transformation, circular convolution, multiplication of DFT. Fast Fourier transform (FFT), FFT algorithms, Radix 2 algorithm- Decimation-in-time and decimation-in- frequency algorithm, signal flow graph, butterfly diagram, Chirp z-transform algorithm.	11L+3T
4	Digital filter: Introduction of digital filters, FIR, IIR filters, their representation advantages and disadvantages. Design of FIR filter- Linear phase filter, rectangular window technique, Gibbs phenomenon, different windows- Bartlett, Hamming, Hanning, Kaiser etc. Design of IIR filter from analog filter, Bilinear Transformation method, Impulse invariant method, Butterworth, Chebyshev. Elliptic IIR filters. Realization of IIR and FIR filters-structures, Direct form-I and II structures, cascade and parallel structures. DSP Processor Architecture: Typical DSP Processor Architecture: Texas instruments family of DSP processors, fixed point, floating point. TMS 320 C54X Board, Architecture. Application in Filter Design, speech processing, DTMF generation and detection, FPGA: Architecture, different sub-systems, design flow for DSP system design, mapping of DSP algorithms onto FPGA.	10L+6T
	TOTAL:	**42L+14T**
	Total Week Required:	**14**
	No. Of Week Reserved:	**02**

Books recommended:

1. J.G. Proakis & D.G. Manolakis, Digital Signal Processing, Principles, Algorithms and Applications, *Pearson/PHI*
2. R. Babu, Digital Signal Processing, *Scitech*
3. S.K.Mitra, Digital Signal Processing - A Computer based approach, *TMH.*
4. S. Salivahanan et al, Digital Signal Processing, *TMH*
5. E.C. Ifeachor et.al., Digital Signal Processing : A Practical approach, *Pearson Education.*
6. Hammimg R.W, Digital Filters, *Pearson/ PHI*
7. A. Oppenheim, R.Schafer , Digital Signal Processing, *Pearson/PHI.*
8. Roman Kuc, Introduction to DSP, *BS Publication.*
9. L.R. Rabiner & B.Gold, Theory and Application of Digital Signal Processing, *Pearson/PHI*
10. K.Padmanabhan, S.Ananthi & R.Vijayarajeswaran, A Practical Approach to Digital Signal Processing- *New Age.*

Paper Name: Optical Instrumentation
Paper Code: AEIE 605
Weekly Load : L: 3 T :1 P : 0
Credit Points: 3
Total Marks: 100

Module	Detailed Description	Lecture/ Tutorial Period
1.	**Introduction to Radiometry& Photometry:** EM spectrum, Wave Particle Duality. Laws related to black body radiation Plank's Law, Wien Displacement Law, Stefan's Law, Beer Lambert Law, Wave front, Group Index, Group velocity, Phase velocity, **Reflection, Refraction, Interference, Diffraction, Polarization**: Devices for measuring Interference, Diffraction & Polarization. Lloyd's experiment, Newton's Experiment, Fresnel's experiment, Fraunhofer's Experiment, Michelson's Experiment, Fabry Perot's Experiment.	9L+3T
2.	**LASER:**Laser Sources, Lasing Mechanism, Basic Properties, Spontaneous emission, Stimulated emission, Absorption, Einstein's Assumptions, Population Inversion, 3 – level, 4 – level, Metastable state, Laser pumping, Semiconductor based lasers - Double heterojunction broad area laser, Stripe geometry DH laser, Q – switching, Mode locking, Holography – Generation & Reconstruction. Ruby Laser, CO2 Laser, Ga As Laser, Modes, Resonant Cavity Types. **LED:** Characteristics, Principle, Basic Structure, Electro luminescence, pn junction principles, LED materials, Power & efficiency, Fermi level, Compensation doping, Energy Band diagram, Heterojunction high intensity LED.	10L+3T
3.	**Photodetectors:** LDR, Principle of pn junction photodiode, PIN photodiode, Avalanche photodiode, Silicon APD, InGaAs APD, Phtotransistor, Heterojunction PD, Schottky PD, Noise in PD, Noise Equivalent Power, SNR of PDs. Optoisolators, Optocouplers, **Fibre Optics:** Materials, Construction, Operational Modes, Step Index, Graded Index, Numerical Aperture, Ray propagation, Dispersion, Attenuations, Scattering, Fibre Loses. Joint loss, Splices, connectors, Fibre Manufacturing, Fibre Coupling, Encoding based position sensor.	11L+4T
4.	**Optical Measurements:** Temperature, Displacement, Pressure; Liquid-level; Optical Time Domain Refractometer, Charge Coupled Devices. Optical Gyroscopes, Velocity meter, **Optical Modulators:** Kerr Effect; Pockel Effect; Phase & Polarization Modulator; Mach Zehnder Modulator, Coupled Waveguide Modulator, Acoustic Optic Molulator, **Optical Instruments Applications:** Optical Coherence Tomography; Optics in Endoscopy; Lithographic System; Spectral Imaging System, Human Eyes, Microscopy, Telescopy. Speckle-pattern instruments.	12L+4T
	TOTAL:	42L+14T
	Total Weeks Required:	**14**
	No. of Weeks Reserved:	**02**

Books: Textand/or**Reference:**

1. P. Bhattacharjee, Semiconductor Optoelectronic Devices, Pearson
2. W. Hawkes, Optoelectronics- An Introduction, PHI
3. C. K. Sarkar, Optoelectronics and Fiberoptics communication, New Age International
3. Kasap, Optoelectronics and Photonics: Principles and practices, Allied Publishers Limited,Chennai, 2001.
4. Optical Semiconductor Devices, Allied Publishers Limited, Chennai, 1999.
5. Fukuda Culshaw B and Dakin J (Eds.), Optical FibreSensorsI, Vols. I, II and III, Artech House, 1989.

Paper Name: Computer Architecture and Organization
Paper Code: CSE 622
Weekly Load: L: 3 T: 0 P: 0
Credit Point: 2
Total Marks: 100

Module	Detailed Description	Lecture / Tutorial Period
1.	**Introduction:** Computer Architecture and Organization, Von-Neumann Architecture **Computer Arithmetic:** Booth's Multiplication Algorithm, Restoring & Non-Restoring Division Algorithms **Memory Hierarchy**: Main memory Organization, RAM/ROM, Memory Address Mapping, Cache Memory	**10L**
2.	**General Processor Organization & Instructions sets**: Instruction Types and Formats, Fixed and Variable Length Instructions; Addressing Modes: Various Types of Addressing Modes, Displacement Addressing- Indexing; Instruction interpretation: Micro Operations and their RTL level specifications, Instruction Phases, Instruction Cycle	**10L**
3.	**Control Unit Design**: Hardwired Control Unit, Micro Programmed Control Unit **I/O Transfer**: Program controlled, Interrupt controlled and Direct Memory Access Uni-programming and Multi-programming Architectural support. RISC versus CISC Architectures: Concepts of Register Windows used in RISC **Measure of computer performance:** Benchmarking, MIPS, FLOPS	**10L**
4.	**Pipelined processors**: Pipeline Stalls, Hazards, Techniques for eliminating /reducing hazards, Instruction Flow Charts **Flynn's Classification**: SIMD: Array Processors, Loosely Coupled, Tightly Coupled machines, ICNs; MIMD: Multiprocessors, Shared Memory, Cache Coherence	**12L**
	TOTAL:	**42L**
	Total Week Required:	**14**
	No. Of Week Reserved:	**02**

Text and/or **Reference Books:**

1. J.P.Hayes, Computer Architecture and Organization, Mc Graw Hill.
2. William Stallings, Computer Organization and Architecture, Pearson
3. K.Hwang, F.Briggs, Parallel processing and Computers Architecture,Tata McGraw Hill
4. Hennessey, Patterson, Computer Architecture, Elsevier.
5. Kai Hwang Advanced Computer Architecture, Mc Graw Hill International.
6. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Naraig Manjikian, Computer Organization and Embedded Systems, Mc Graw Hill International.

Paper Name: Process Control Laboratory
Paper Code: AEIE 651
Weekly Load: L:0 T: 0 P:3
Credit Points: 2
Total Marks: 100

List of Experiments

1. Study of level, flow, temperature, pressure control loop.

2. Study of ON/OFF controller in a real-time process.
3. Study of the performance of the level control loop using local PID controller.
4. Study of the performance of the flow control loop using local PID controller.
5. Study of the performance of the temperature control loop using local PID controller.
6. Study of the performance of the pressure control loop using local PID controller.
7. Study of the performance of the level control loop using PLC.
8. Study of the performance of the flow control loop using PLC.
9. Study of the performance of the temperature control loop using PLC.
10. Study of the performance of the pressure control loop using PLC.
11. Study of the performance of the level control loop using DCS.
12. Study of the performance of the flow control loop using DCS.
13. Study of the performance of the temperature control loop using DCS.
14. Study of the performance of the pressure control loop using DCS.
15. Study and Characteristics of control valves (with and without positioners).
16. Study of zener barrier / isolating interface and their use for the construction of an intrinsically safe measurement system.
17. Study of the performance of the wireless temperature transmitter.
18. Study of profibus/fieldbus system.

Paper name: Microcontrollers & Embedded Systems Laboratory
Paper Code: AEIE 652
Weekly Load: L:0 T:0 P:3
Credit point: 2
Total marks: 100

Lists of the Experiments:

1 Write a program in assemble language of microcontroller.
i) To add any two unsigned number, signed number, one unsigned and one signed number.
ii) To do subtraction between any two unsigned /signed numbers/ one unsigned and one signed number.

2 Write a program in assemble language of microcontroller 8051
i) To multiply any two unsigned number, signed number, one unsigned and one signed number.
ii) To divide a number (signed, unsigned) by other number (signed/unsigned)

3 Develop a stable oscillator for 100hz and 1khz frequency using microcontroller.

4 Develop an Up-counter using a microcontroller to count the pulses generated by a variable frequency generator within 10 minute and display the binary count on other port continuously.

5 Write a program in assemble language of microcontroller 8051 using interrupts to get data serially and send it to another port when timer is turning a LED connected to third port on and off every second.

6 Design an interfacing among display devices, microcontroller, and keyboard.

7 Write a microcontroller program to send your first name and last name to a particular Port. Use ROM code space.

8 Design an arrangement with a switch and microcontroller and develop a code to monitor the switch to perform if switch is on condition, send ‘hello’ to serial port or send ‘goodbye’ to serial port.

9 Write microcontroller program to transfer serially the letter ‘z’ continuously at 1200 baud rate.

10 Write a program to generate a saw tooth waveform and triangular waveform using microcontroller and DAC.

11 Develop a code to interface ADC with microcontroller and measure the analog voltage with help of proper interfacing circuit design.

12 Stepper motor and DC motor interfacing

13 Interface a process parameter sensor (temperature) with microcontroller trough ADC to continuous measure the value whether it reaches the set point. When it crosses the set point, Microcontroller stops the source of heat energy by additional circuit connected to other port.

Books:

1. Mazidi M A ,Mazidi J G, McKinlay R D, Tthe Microcontroller and Embedded Systems ,Pearson Edu.
2. David Calcutt, Frederick Cowan, Hassan Parchizadeh,8051 Microcontrollers, Hardware, Software and Applications.

Paper Name: Telemetry & Remote Control Laboratory
Paper Code: AEIE 653
Weekly Load: L: 0 T: 0 P: 3
Credit Point: 2
Total Marks: 100

List of experiments:

1 Study of characteristics of Amplitude Modulation
2 Study of characteristics of Amplitude Demodulation
3 Study of characteristics of Frequency Modulation
4 Study of characteristics of Frequency Demodulation
5 Study of Pulse Amplitude Modulation and Demodulation(PAM)
6 Study of Pulse Width Modulation(PWM) and demodulation
7 Study of Pulse Position Modulation and demodulation
8 Study of Pulse Code Modulation(PCM) system
9 Study of characteristics of ASK
10 Study of characteristics of FSK
11 Study of characteristics of PSK
12 Study of Time Division Multiplexing System(TDM)
13 Study of Frequency Division Multiplexing System(FDM)
14 Study of characteristics of a simple remote control system
15 Familiarization of Software Bases Data Acquisition System
16 Study of Transmitter and Receiver System

Paper Name: Digital Signal Processing Laboratory
Paper Code: AEIE 654
Weekly Load: L:0 T:0 P:3
Credit Point: 2
Total Marks: 100

List of Experiments:

Using Matlab:

1. Generation of Signals
2. Linear and circular convolution of two sequences
3. DFT and FFT on sequences

4. Design of FIR filters
5. Design of IIR filters

Using Hardware Kits

1. Study of various addressing modes of DSP hardware using simple programming examples
2. Sampling of input signal and display
3. Implementation of FIR filters
4. Calculation of FFT

Semester-VII

Paper Name: Advanced Control Theory
Paper Code: AEIE 701
Weekly Load: L:3 T: 1 P:0
Credit Points: 3
Total Marks: 100

Module	Detailed Description	Lecture / Tutorial Period
1.	Introduction, State variable analysis of dynamical systems: canonical forms, stability, controllability and observability – continuous and discrete systems. Linear system design by state variable feedback.	11L+2T
2.	Analysis of SISO process control loop by z-transform technique, z-and s-domain relationship, stability analysis of discrete systems in z-plane, stability analysis by using Bilinear transformation, Jury's stability test, steady-state error analysis of sampled-data control systems,	12L+4T
3.	Digital implementation of PID controller, Digital control algorithms - controller design by transformation from s-domain to z-domain, deadbeat control, Dahlin's technique, Kalman's algorithm. Introduction to optimal control-quadratic performance index and regulator problems.	9L+5T
4.	Nonlinear elements and systems – phase plane and describing function methods. Stability analysis and Liapunov's method. Adaptive and Self-tuning control: Need for adaptive control, adaptive control by preset compensation, adaptive control by pattern recognition, adaptive control by discrete parameter estimation. Dead time compensation - Smith predictor and Dahlin controller.	10L+3T
	TOTAL:	**42L+14T**
	Total Weeks Required:	**14**
	No. of Weeks Reserved:	**02**

Textand/or**Reference Books:**

1. MadanGopal- Modern Control theory, PHI
2. NagrathI. J. and Gopal M.- Control Systems Engineering, New Age International (P) Ltd.
3. Ogata K - Modern Control Systems, Prentice Hall,
4. Benjamin C. Kuo - Automatic Control Systems., PHI
5. M. Gopal: Modern Control System, New Age International
6. Automatic Control Systems (with MATLAB programs)- Syed Hasan Saeed, S.K.Kataria& Sons.

Paper name: Analytical Instrumentation
Paper Code: AEIE 702
Weekly Load: L: 3 T: 1 P:0
Credit Point: 3
Total marks: **100**

Module	Detailed Description	Lecture / Tutorial Period
1.	**Introduction of analytical instrumentation:** Difference between analytical and monitoring instruments, block diagrams; classification of analytical instruments; **Chromatography**: Classification, Working principle, Gas Chromatography Instrumentation, Carrier gases, Modes of separation, Injectors, Columns, Detectors e.g. TCD, FID, ECD, AID etc. Applications. Liquid Chromatography; High Pressure LC; **Mass Spectrometry**: Basic components, Working principle, Ionization methods, Ion detectors, Inductively Coupled Plasma, Mass Analysers, Applications Types - Magnetic Deflection MS; ToF MS; Radiofrequency MS; Quadrupole MS; Fourier Transform Ion Cyclotron Resonance MS	11L+2T
2	**Spectrophotometer, Flame Photometry/Colorimeter**: Beer law, Lambert law, Beer Lambert law, Single beam photometer, Double beam photometer, UV – Vis **Spectrometry:** Absorption, Emission, Scattering, UV -VIS range, IR Spectroscopy, FT- IR spectroscopy; Nuclear Magnetic Resonance Spectroscopy; Atomic Fluorescence Spectroscopy; Raman Spectroscopy.	11L+5T
3	**pH Meter**: Nernst equation, construction of electrodes, metal electrode, hydrogen electrode, membrane electrode, Ion selective electrode, working principle, glass electrode, reference electrode, calomel electrode, Ag/AgCl electrode, combination electrode, working principle, calibration of pH meter applications of pH meter. **Conductivity Meter**: Working principle; specification, construction; applications, advantages and drawbacks, different types of conductivity meters; Polarography.	9L+4T
4	**Gas Analyser**: IR Gas Analyser, Thermal Conductivity Analyser; NOx, SOx, COx monitor, H2S analyser, Oxygen Analysers: Working principle, application, Zirconia, Pauling cell, Mackerth type galvanic analyser, **Radiation Detector:** Ionization Chamber, Proportional Counter, Geiger Muller Counter, Scintillation Counter, **Electron Microscope**: Scanning (SEM); Transmission (TEM); Their principle of operation, construction, applications, advantages and drawbacks. Sample preparation.	11L+3T
	TOTAL:	42L+14T
	Total Week Required:	14
	No. Of Week Reserved:	02

Reference Books:

1 R S Khandpur -Handbook Of Analytical Instruments, ,Tmh
2 Liptak B G (Ed) – Instrument Engineer's Handbook, Chilton Book Co, Philadelphia
3 Jones E B – Instrument Technology, Vol-II, Analysis Instruments Butterworths Scientiif Publication, London.

Paper name: Biomedical Instrumentation
Paper Code: AEIE 703
Weekly Load: L: 3 T: 1 P: 0
Credit Point: 3
Total Marks: 100

Module	Detailed Description	Lecture / Tutorial Period

1.	**Introduction to Biomedical Instrumentation:** Components of Man – Instrument system. Challenges in bio medical instrumentation; Artifacts of Biomedical instrumentation; Biomedical transducers; In vivo and In vitro processes, **Introduction to Human Physiology:** Physiological Systems in Human body; Cardio vascular system, Respiratory system, Muscular system, Nervous system. **Bio electrodes, Bio potential** – resting and action; Propagation of action potential, Electrode – tissue interface; Selection criteria of electrodes.	12L+4T
2	ECG, EMG, EEG, ERG – Principle, procedure, interpretation, electronic circuits, lead system, recording methods, typical waveforms, **Blood, Heart & Lungs:** Blood pressure, Blood flow rate, heart sound and cardiac output measurement, respiratory system measurement, lung volume, Plethysmography, Spirometry, Pace maker, Defibrillator, Blood gas analyzers, Oximeters. Blood cell counter.	11L+3T
3.	**Imaging Techniques:** X – ray, Ultrasound, Computer Tomography, Magnetic Resonance Imaging, Positron Emission Tomography, and Radionuclide Imaging. Their working principle, block diagram, image artifacts, image intensifiers, Drawbacks. Application areas.	9L+2T
4	**Assisting and therapeutic device:** Ventilator, Anesthesia machine, Nerve and muscle simulator, Audiometers, Diathermy, Endoscopes, Kidney machine – Dialysis. Lithotripsy. **Laser application in Medicine:** Thermal and Non – thermal, Ophthalmology, Retinopathy, Glaucoma, Dermatology, **Biotelemetry:** Transmission & Reception aspects of biological signals, **Safety and precautions of biomedical equipment:** Care and Feeding of battery-operated medical equipment. **Bioinformatics:** basics of molecular biology, computational bioinformatics, matching algorithms, BLAST.	10L+5T
	TOTAL:	42L+14T
	Total Weeks Required:	**14**
	No. of Weeks Reserved:	**02**

Text Books/ References:

1 L. Cromwell, “Biomedical Instrumentation and Measurements”, Pearson Education.

2. J.J. Carr, “Introduction to Biomedical Equipment Technology”, Pearson Education.

3. R.S.Khandpur,”Handbook of Biomedical Instrumentation”, TMH, New Delhi.

4.N.Pandey, “Bio-Medical Electronics and Instrumentation”, Katson books, New Delhi.

5. Cremer- Bioinformatics

Paper Name: VLSI Technology
Paper Code : ECE 721
Weekly Load: L: 3 T: 0 P: 0
Credit Point: 2
Total Marks: 100

Module	**Detailed Description**	**Lecture / Tutorial Period**
1.	**Introduction to VLSI**: Design Flow & Methodologies, Concepts of Regularity, Modularity and Locality, Testability, Reliability, Yield & other process Parameters. **MOS inverters and Transmission Gates:** Static Load MOS inverters with Resistive load, n-MOS(Enhanced & Depletion type) load , Pseudo –nMOS, Saturated Load, More Saturated Load. Calculation of Noise Margin.	18 L

2	**Analog VLSI:** CMOS Current Sources and sinks, CMOS Voltage and Current references CMOS Differential Amplifier, Operational Amplifier, Comparator **CMOS inverters and Transmission Gates:** **Static Load MOS inverters** with Resistive load, n-MOS(Enhanced & Depletion type) load , Pseudo –nMOS, Saturated Load, More Saturated Load. Calculation of Noise Margin. **Dynamic Load MOS inverter:** CMOS inverter, VTC, Switching Characteristics (Rise Fall & Delay time), Calculations of V_{IL} ,V_{IH}, V_{OH} , V_{th} ,Noise Margin, Power Dissipation (Static, Dynamic & Short circuit), Effect of aspect ratio change **in** CMOS circuit. **Transmission gates:** nMOS, pMOS & CMOS transmission gates and logic transfer characteristics.	10 L
3	**Digital VLSI:** **Combinational MOS Logic Circuits:** nMOS & Pseudo nMOS logic and CMOS logic gates: Realization of NAND, NOR, XOR, half and full adders & other Boolean Logic functions. AND-OR-INVERT (AOI) & OR - AND –INVERT (OAI) gates. **Sequential Logic Circuits:** The SR latch circuit, clocked latch and flip-flop, CMOS D-latch and edge-triggered circuits, Schmitt trigger circuit **Dynamic Logic Circuits:** Basic concept, capacitive feed through, charge sharing & other source of charge loss. Pass transistor logic, synchronous dynamic circuit techniques, Dynamic CMOS Logic, Clocked CMOS Logic (C^2MOS), CMOS Domino Logic, NP Domino Logic (Zipper/ NORA CMOS). Ratioed logic & Ratio less Logic	6L
4	**VLSI Physical Design:** Partitioning, Floor planning, Placement & Routing Algorithms**.** **Low-Power VLSI Design Issues:** Overview of power consumption, Various ways for power reduction, delay and power optimization, Activity Capacitances and power supply adjustment for power reduction, sleeping mode, Introduction of double threshold voltage. Introduction to FPGA, CPLD, ASIC and FPGA based combinational and sequential circuit design.	6L
	TOTAL:	42L
	Total Week Required:	**14**
	No. Of Week Reserved:	**02**

Reference/Text Book:

1. Ken Martin, Digital Integrated Circuit Design, OUP
2. CMOS Digital Integrated Circuits - S.M. Kang and Y. Leblebici, TMH
3. Digital Integrated Circuits - J.M. Rabaey, PHI.
4. Neil H.E Weste, Kim Haase, David Harris, A.Banerjee, "CMOS VLSI Design : A circuits & Systems Perspective", Pearson Education
5. Wayne Wolf," Modern VLSI Design – System-on-chip Design", Prentice Hall India/Pearson Education
6. Philips E. Allen & Douglas R. Holberg, " CMOS Analog Circuit Design" , Oxford University Press
7. David Hodges, Horace G Jackson, & Resve A Saleh, " Analysis & Design of Digital Integrated Circuits", Tata McGraw-Hill
8. R. L. Geiger, P.E.Allen, Noel R. Strader," VLSI Design techniques for Analog and Digital Circuits", McGraw-Hill International.

Paper Name: Advanced Control Laboratory
Paper Code: AEIE 751
Weekly Load: L:0 T: 0 P:3
Credit Points: 2
Total Marks: 100

List of experiments:

1. Simulation of complex control systems using MATLAB/other equivalent software package.
2. Simulation of first order and second order system with and without dead time
3. Design of different controllers (P, PI, PID) for SISO system and study their responses.
4. PC based data acquisition report generation.
5. Logic gates operations, Timing Operations, counter operations and math operations using PLC.
6. Design of Discrete PID controller and Deadbeat controller for a first order system.
7. State feedback control of a process by pole placement.
8. State estimation of a process using full order and reduced order observers.
9. Model-free controller design.
10. Identification of dynamic models of plants.

Paper Name: Analytical Instrumentation Laboratory
Paper Code: AEIE 752
Weekly Load: L: 0 T: 0 P: 3
Credit Point:2
Total Marks: 100

List of experiments:

1. Study of pH meter with different buffer solutions and Measurements of pH values of the different Normality Solution of Sodium Chloride.
2. Study ofconductivity-meter with different buffer solutions and Measurements of the values of conductivity of any electrolytic solution with computer interfaced.
   a. with different temperature .
   b. with different concentration.
3. Study of the Gas Chromatography and analysis of any one hydrocarbon gas sample like ethyline, acetyline with proper detector.
4. Study of Thermal Conductivity or Flame Ionization or Electron Capture detector and its experimentation for the detection of the corresponding parameters.
5. Study and analysis of concentration of
   a. Oxygen,
   b. Nitrogen Oxides and
   c. Sulfur Di Oxide

   Using proper Analyzer with proper simulator.
6. Study of Electrode and experimentation with one of them and proper simulation s/w to measure ion concentration of any standard solution
7. Measurements of arsenic, tds of water collected from different places using proper detector.
8. Study and Experimentation with IR spectrophotometer and proper simulator for compositions analysis of sample.

Text and/or **Reference Books:**

1. R S Khandpur -Handbook Of Analytical Instruments, TMH
2. Patranabis D – Principles of Industrial Instruments, THM.

Paper Name: Project I
Paper Code : AEIE 791
Weekly Load: L: 0, T: 0, P: 6
Credit Point : 5
Total Marks: 100

- A project group made up of Students (preferably not more than four in each group) under the guidance of a faculty member need to complete one project during the Final Year (Semester VII & VIII). Project-I is the first part covered in Semester VII.
- Total marks of the project work are 200. Marks and Credits are distributed over the Semester VII & VIII.
- At the beginning of the Semester-VII each project group have to submit their project Synopsis. At the end of Semester VII students have to submit an Intermediate Project Report. Each group should submit at least two extra copy of Intermediate Project Report other than their individual copy, one for their Project guide and one for the departmental record.
- Progress of each project group should be demonstrated and presented in front of Board of Experts and evaluation will be made on that. 50% of total marks will be evaluated by the project guide and rest 50% of total marks will be evaluated by the Board of Experts.

Paper Name: Seminar I
Paper Code : AEIE 792
Weekly Load: L: 0, T: 0, P: 3
Credit Point : 2
Total Marks: 100

- Each student have to give 10 minutes' individual presentation on any topic (advanced technology, research or development, new emerging field etc.) followed by 5 minutes interaction / discussion session.
- The presentation should be in front of teachers and students of the class.
- Evaluation should be based on the following parameters of the students: Presentation skill, delivery of the speech, depth and breadth of the subject matter presented and seminar report.
- The attendance of other students in the seminar will be recorded and their participation should also be assessed for evaluation.
- Each student has to submit technical reports for each presentation they have delivered.
- Marks will be given based on evaluation throughout the year and a final evaluation at the end of Semester.

Appendix- I
Elective-I (AEIE 7th Semester)

Paper Name: Ultrasonic Instrumentation
Paper Code: AEIE 711(a)
Weekly Load: L: 3 T: 0 P: 0
Credit Point: 2
Total Marks: 100

Module	**Detailed Description**	**Lecture / Tutorial Period**

1.	**Ultrasonic waves:** Principle of Wave propagation, modes of sound wave propagation. history & present status of US, future direction. **Properties of Acoustic Plane Wave:** Wavelength and defect detection, sound propagation in elastic materials, attenuation of sound waves, acoustic impedance, reflection and transmission coefficients, refraction and Snell's Law, mode conversion, signal-to-noise ratio, wave interaction or interference, normal beam inspection, angle beams, crack tip diffraction, automated scanning, precision velocity measurements, attenuation measurements, **Spread Spectrum**: Ultrasonic, signal processing techniques, flaw reconstruction techniques.	12L
2.	**Equipment & Transducers:** piezoelectric transducers, characteristics of piezoelectric transducers, radiated fields of US transducers, transducer beam spread, transducer types, transducer testing, transducer modeling, couplant. **Electromagnetic Acoustic Transducers (EMATs):** Lamb wave generation, shear wave generation, velocity measurements using EMATs, texture measurement, stress measurement, composite materials, Pulser-Receivers, tone Burst generators, arbitrary function generators, electrical impedance matching and termination, data presentation, error analysis,	11L
3	**Ultrasonic Test methods:** Basic principle of US testing, echo, transit time, resonance, direct contact and immersion types **Ultrasonic methods of measuring:** Thickness, depth, flow, level etc. Various parameters affecting ultrasonic testing and measurements, their remedy.	10L
4	**Ultrasonic Wave Applications:** US in medical diagnosis, Rail Inspection, Weldments (Welded Joints). **Calibration Methods**: Distance Amplitude Correction (DAC), Thompson-Gray measurement model, Ultrasonic Simulation – UTSIM, grain noise modeling, references & standards, transducer characteristics.	9L
	TOTAL:	**42L**
	Total Week Required:	**14**
	No. Of Week Reserved:	**02**

Text/Reference Books:

1. Krantkramer - Ultrasonic Testing of materials, Springer 2005
2. Krauthsamer J and Krauthsamer H – Ultrasonic Testing of Materials, Springer Verlag, Berlin, New York.
3. Wells N T – Biomedical Ultrasonics, Academic Press, London 1977.

Paper Name: Agricultural Instrumentation
Paper Code: AEIE 711(b)
Weekly Load: L: 3 T: 0 P: 0
Credit Point: 2
Total Marks: 100

Module	**Detailed Description**	**Lecture / Tutorial Period**
1.	**Introduction:** Necessity of instrumentation & control for agriculture, engineering properties of soil; Fundamental definitions & relationships, index properties of soil, permeability & seepage analysis, shear strength, Mohrs circle of stress, active & passive earth pressures, stability & slopes, **Instrumentation in Process industry:** Flow diagram of sugar plant & instrumentation set up for it, flow diagram of fermenter & control(batch process),flow diagram of dairy industry & instrumentation set up for it, juice extraction control process & instrumentation set up for it.	9L

2	**Weather Monitoring Instruments:** Hygrometer, Pryoheliometer, Pan Evaporator, ETgage; Meteorological Display Unit, Pyranometer, Luxmeter, Salinity Refractometer, Psychrometer, soil pH meter, soil moisture/water content meter, tensiometer, hydrometer, soil salinity conductivity meter, sunshine duration meter, Agro meteorological Digital Weather station. Time Domain Reflectometer (TDR)	9L
3	**Instrumentation in Irrigation and Green house System:** Irrigation systems: necessity, irrigation methods: overhead, centre pivot, lateral move, micro irrigation systems, soil moisture measurement methods: resistance based method, voltage based method, thermal based method, details of gypsum block, irrigation scheduling, irrigation efficiencies, Application of SCADA for DAM parameters & control. **Green houses & instrumentation:** ventilation, cooling & heating, Anemoneter for wind speed, temperature & humidity, rain gauge carbon dioxide enrichment measurement & control.	12L
4	**Instruments in Farming:** Automation in earth moving equipment & farm equipment, implementation of hydraulic, pneumatic & electronics control circuits in harvesters cotton pickers, tractor etc. classification of pumps: pump characteristics, pump selection & installation. **Food Processing:** Definition, Food quality measurement , food safety and standards bill 2005, central committee for food standards, Agmark, Bureau of Indian Standards, Codex Standards, recommended international code of hygiene for various products, Design consideration: cold storage, atmospheric controller and preservatives; biosensors. **Automation in Food Industry:** Application of SCADA & PLC in food packing industry, Trends in modern food processing, Equipment for creating and maintaining controlled atmosphere.	12L
	TOTAL:	**42L**
	Total Week Required:	**14**
	No. Of Week Reserved:	**02**

Text/Reference Books:

1. Handbook of Instrumentation -Process control –B.G.Liptak, Chilton.
2. Irrigation : Theory and Practice, Michael. A.M, Vikas Publishing House Pvt Ltd, 2008.
3. Process control and instrumentation technology, "C.D. Johnson", PHI.
4. Mineral Processing Technology, Wills B.A., 4th Ed.,Pergamon Press.
5. Automatic Control for food processing system, R.G.Moreira, T.P.Coulate, 2001.

Paper Name: Sensor Technology
Paper Code: AEIE 711(c)
Weekly Load: L: 3 T: 0 P: 0
Credit Point: 2
Total Marks: 100

Module	Detailed Description	Lecture / Tutorial Period
1.	**Sensors Fundamentals and Characteristics:** Sensors, Signals and Systems; Sensor Classification; Units of Measurements; Sensor Characteristics, Sensor Calibration. **Physical Principles of Sensing:** Electric Charges, Fields, and Potentials; Capacitance; Magnetism; Induction; Resistance; Piezoelectric Effect; Hall Effect; Temperature and Thermal Properties of Material; Heat Transfer; Light; Dynamic Models of Sensor Elements	10L

2.	**Interface Electronic Circuits:** Input Characteristics of Interface Circuits, Amplifiers, Excitation Circuits, Analog to Digital Converters, Direct Digitization and Processing, Bridge Circuits, Data Transmission, Batteries for Low Power Sensors **Sensors in Different Application Area:** Occupancy and Motion Detectors; Position, Displacement, and Level; Velocity and Acceleration; Force, Strain, and Tactile Sensors; Pressure Sensors, Temperature Sensors, Chemical Sensors, Biological Sensors.	11L
3.	**Sensor Materials and Technologies:** Materials, Surface Processing, Nano-Technology. **Sensor Modeling:** Numerical modeling techniques, Model equations, Different effects on modeling (Mechanical, Electrical, Thermal, Magnetic, Optical, Chemical and Biological) and examples of modeling.	11L
4	**Sensor Design and Packaging:** Partitioning, Layout, technology constraints, scaling, compatibility study. **Sensor Technology:** Thick and thin films fabrication process, Micro machining, IOC (Integrated Optical circuit) fabrication process, Ceramic material fabrication process, Wire bonding, and Packaging. **Sensor Applications:** Process Engineering, Medical Diagnostic and Patient monitoring, Environmental monitoring etc.	10L
	TOTAL:	**42L**
	Total Week Required:	**14**
	No. Of Week Reserved:	**02**

Text/Reference Books:

1. J. Fraden, Handbook of Modern Sensors:Physical, Designs, and Applications, AIP Press,Springer
2. D. Patranabis, Sensors and Transducers, PHI Publication, New Delhi
3. Mechatronics- Ganesh S. Hegde, Published by University Science Press (An imprint ofLaxmi Publication Private Limited).

Paper Name: Environmental Instrumentation
Paper Code: AEIE 711(d)
Weekly Load: L: 3 T: 0 P: 0
Credit Point: 2
Total Marks: 100

Module	**Detailed Description**	**Lecture / Tutorial Period**
1.	**Introduction:** Necessity of instrumentation & control for environment, sensor requirement for environment. Instrumentation methodologies: Ultraviolet analyzers, total hydrocarbon analyzers using flame ionization detector, Gas chromatography in environmental analysis, photo ionization, portable &stationary analytical instruments. **Quality of water:** Standards of raw & treated water, sources of water & their natural quality, effects of water quality. Water quality parameters: Thermal conductivity, detectors, Opacity monitors, pH analyzers & their application, conductivity analyzers & their application. Water treatment: Requirement of water treatment facilities, process design.	11L
2.	**Sedimentation & flotation:** General equation for settling or rising of discrete particles, hindered settling, effect of temperature, viscosity, efficiency of an ideal settling basin , reduction in efficiency due to various causes, sludge, storage & removal, design criteria of settling tank, effect of temperature on coagulation. Groundwater monitoring: Level measurement in ground water monitoring wells, laboratory analysis of ground water samples, instrumentation in ground water monitoring, instrumentation in assessment of soil & ground water pollution.	10L

3.	**Waste Water and Flow Monitoring System:** Automatic waste water sampling, optimum waste water sampling locations, and waste water measurement techniques. Instrumentation set up for waste water treatment plant. Latest methods of waste water treatment plants. Flow monitoring: Non-open channel flow measurement, open channel waste water flow measurement. Rain water harvesting: necessity, methods, role of NGOs & municipal corporation.	10L
4.	**Air Pollution and Sound Monitoring Systems:** Definitions, energy environment relationship, importance of air pollution, Air sampling methods &equipment, analytical methods for air pollution studies. Control of air pollution. Sound pollution: basics of sound pollution, its effect to environment. Acoustic noise measurement & monitoring. **Instruments in Weather station:** Instruments in Weather station like Barometer, Rain gauge, Ceilometer etc. Global environmental analysis, Virtual Instruments in Environmental Engineering Laboratory, Rover Environmental Monitoring station (REMS).	11L
	TOTAL:	**42L**
	Total Week Required:	**14**
	No. Of Week Reserved:	**02**

Text/Reference Books:

1. Water treatment technology - Walter J. Weber.
2. Air pollution engineering – M. N. Rao & H. V. N. Rao.
3. Air pollution control technology – Wark& Warner.
5. Environmental Instrumentation & Analysis Handbook,Randy D. Down & Jay H. Lehr, Wiley.
6. Environmental Engineering-Peany Howard S, Donal R Rowe and George TachoBanoylousTeddy.
8. Environmental Engineering and Science, Gilber M Masters, Pearson Education (1997)

Paper Name: EMI /EMC
Paper Code: AEIE 711(e)
Weekly Load: L: 3 T: 0 P: 0
Credit Point: 2
Total Marks: 100

Module	**Detailed Description**	**Lecture / Tutorial Period**
1.	**Introduction:** History and concept of EMI, Definitions of EMI/EMC, Electromagnetic environment, Practical experiences and concerns, frequency spectrum conservations, mechanisms of EMI generation, EMI testing, Methods of elimination of EMI and Biological effects of EMI. **Natural and manmade sources of EMI/EMC:** Sources of Electromagnetic noise, typical noise paths, modes of noise coupling, designing for EM compatibility, lightening discharge, electro static discharge (ESD), electromagnetic pulse (EMP).	10L
2.	**EMI from apparatus / Circuits and open area test sides:** Electromagnetic emissions, noise from relays and switches, non-linearity's in circuits, passive inter modulation, transients in power supply lines, EMI from power electronic equipment, EMI as combination of radiation and conduction. **Open area test sides:** OATS measurements, measurement precautions. **Grounding and Cabling:** Safety and signal grounds, low and high frequency grounding methods, grounding of amplifiers and cable shields, isolation, neutralizing transformers, shield grounding at high frequencies, digital grounding, types of cables, mechanism of EMI emission / coupling in cables.	11 L

3	**Radiated interference measurements**: anechoic chamber, TEM cell, reverberating chamber, GTEM cell, comparison of test facilities, **Conducted interference measurement:** Characterization of conduction currents/ voltages, conducted EM noise and power lines, conducted EMI from equipment, immunity to conducted EMI, characteristics of EMI filters and power line filter design.	10 L
4	**Shielding and Bonding:** effectiveness of shielding, near and far fields / impedances, methods of analysis, total loss due to absorption and reflection effects, composite absorption and reflection losses for electric fields / magnetic fields, magnetic materials as a shield, shield discontinuities, slots and holes, seams and joints, conductive gaskets. Electrical Bonding, Shape and Material for Bond straps, General Characteristics of good bonds. **Components for EMC and EMC Standards:** Choice of capacitors, inductors, transformers and resistors, EMC design components National / International EMC standards, military and civilian standards.	11 L
	TOTAL:	**42L**
	Total Week Required:	**14**
	No. Of Week Reserved:	**02**

Text/Reference Books:

4. Engineering Electromagnetic Compatibility by Dr. V.P. Kodali, IEEE Publication, Printed in India by S. Chand & Co. Ltd., New Delhi, 2000.
5. Electromagnetic Interference and Compatibility IMPACT series, IIT – Delhi, Modules – 9.
6. Introduction to Electromagnetic Compatibility, NY, John Wiley, 1992, by C.R. Pal.
7. Radar hand book by Skolink

Appendix- II
Elective-II (AEIE 7th Semester)

Paper Name: Oil & Gas Plant Instrumentation
Paper Code: AEIE 712(a)
Weekly Load: L:3 T: 0 P: 0
Credit Point: 2
Total Marks: 100

Module	**Detailed Description**	**Lecture / Tutorial Period**
1.	Introduction: Structure of Oil & Gas Industry; World oil supply and demand; Oil desalting: Operation, variables, heater treater design, crude and condensation stabilization, LTX Stabilization.	9L
2	Oil & Gas Treatment: Emulsion treatment, emulsifier, demulsifier, gravity separation, coalescence, coalescing media, electrostatic coalescers. Treating Equipment: Pressure vessels - Vertical, horizontal, Electrostatic. Process heat duty, Sensible heat of natural gas, Water, Heat transfer from fire-tube. Heat exchangers- types, fluid placement, sizing, number of tubes.	10L

3	Natural Gas Dehydration: (a) Glycol Process: operation, effect of variables, dew point depression, stage calculation. NTU - graphical and analytical methods, Absorber sizing. Lean oil absorption. (b) Solid-bed process: design & operation, effect of process variables, Regeneration and cooling calculations. Hydrocarbon recovery. (c) Hydrate formation & inhibition. Natural Gas Sweetening: Acid gases, Toxicity, Pipeline specification. Solid-bed Process: Design, operation & effect of variables. Adsorbent selection. Multistage Separation, Hengsteback's Flash calculation, stabilizer design. Amine and other absorptive process details.	12L
4	Reservoir Management: Data acquisition, analysis and management: Classification of data, acquisition, analysis and application, validation, storing and retrieval Reservoir model: Role of reservoir model in reservoir management, integration of G & G and reservoir model Reservoir performance analysis and prediction: Naturally producing mechanism, reserves and role of various forecasting tools- volumetric method, MBE, Decline curve and mathematical simulation Health & Safety Practices: Oil pollution, stack emission, flaring and fugitive release, drilling waste, rock cutting, oily sludge, HSE regulations for Oil & Gas industry.	11L
	TOTAL:	**42L**
	Total Week Required:	**14**
	No. Of Week Reserved:	**02**

Text/Reference Books:

1. A.L. Waddams, 'Chemicals from Petroleum', Butter and Janner Ltd., 1968.
2. J.G. Balchan. and K.I. Mumme, 'Process Control Structures and Applications', Van Nostrand Reinhold Company, New York, 1988.
3. Austin G.T. Shreeves, 'Chemical Process Industries', McGraw Hill International Student edition, Singapore, 1985.
4. B.G Liptak, 'Instrumentation in Process Industries', Chilton Book Company, 1994

Paper Name: Image Processing
Paper Code: AEIE 712(b)
Weekly Load: L: 3 T: 0 P: 0
Credit Point: 2
Total Marks: 100

Module	Detailed Description	Lecture / Tutorial Period
1.	**Image Fundamentals And Transforms:** Digital image formation model, Sampling and quantization, aliasing Digital Image representation, Basic relationship between pixels-neighborhood, distance, operations etc. Transforms used in electronic image processing and their area of applications-2-D DFT, Walsh transform, Hadamard transform, Harr transform, DCT, KL transform. **Image Enhancement:** Simple mapping modifications, Histogram based methods, Homomorphic processing Adaptive modification of local contrast and luminance.	11 L

2.	Linear filtering, Median filtering, Out of range pixel smoothing, Rank Order Filtering, Definition, Median Filter Frequency domain methods-Smoothing filters(Ideal, Butterworth, Gaussian etc.), Sharpening filters(Ideal, Butterworth, Gaussian etc.). **Image Restoration:** Model of Image Degradation/restoration process, Noise models, Inverse filtering, Least mean square filtering (Weiner filtering), Constrained least mean square filtering, Blind image restoration, Singular value decomposition (SVD) pseudo inverse restoration. Geometric modifications.	11 L
3	**Image Analysis:** Image segmentations- edge, line, point, boundary detection, Hough Transform, thresholding, region based segmentation, Image representations. Morphological image processing-hit and miss transformations, opening and closing, some gray scale morphological processing.	9 L
4	**Coding And Compression:** Lossless compression: Variable length coding, LZW coding, Bit plane coding, predictive coding, DPCM. Lossy Compression- Transform coding, Wavelet coding, Basics of Image compression standards- JPEG, MPEG etc. **Colour Image Processing:** Colour fundamentals, colour models, Pseudo color image processing,	11 L
	TOTAL:	**42 L**
	Total Week Required:	**14**
	No. Of Week Reserved:	**02**

Text/Reference Books:

1. Rafael C Gonzalez, Richard E Woods, Digital Image Processing - Pearson Education.
2. William K Pratt, Digital Image Processing -John Willey.
3. A.R.Weeks, Fundamentals of Electronic Image Processing-PHI/ Pearson Education.
4. Millman Sonka, Vaclav Hlavac, Roger Boyle, Image Processing Analysis and Machine Vision- Brooks/cols (Thompson Learning).
5. A.K. Jain, Fundamentals of Digital Image Processing- PHI
6. Chanda, Dutta Majumdar – Digital Image Processing and Applications- PHI

Paper Name: AI & Machine Learning
Paper Code: AEIE 712(c)
Weekly Load: L: 3 T: 0 P: 0
Credit Points: 2
Total Marks: 100

Module	Detailed Description	Lecture/ Tutorial Period
1.	Introduction to Artificial intelligence-Definition, pros and cons AI techniques Intelligent Agents- Agents & environment, nature of environment, structure of agents, goal based agents, utility based agents, learning agents. Problem Solving-Problems, Problem Space & search: Defining the problem as state space search, production system, problem characteristics, issues in the design of search programs. Solving problems by different search algorithms	10L
2.	Knowledge and Reasoning-Knowledge representation, approaches to knowledge representation, issues in knowledge representation. Representing simple fact in logic, computable functions & predicates, resolution, natural deduction. Representing knowledge using rules, Reasoning approaches	10L
3.	Learning-Forms of learning, inductive learning, learning decision trees, explanation based learning, learning using relevance information, neural net learning & genetic learning. Expert Systems- Representing and using domain knowledge, expert system shells, knowledge acquisition. Basic knowledge of programming language like Prolog & Lisp.	10L

4.	Deep Learning-Introduction to machine learning basics, deep networks, deep models, regularization for deep learning, optimization for deep model, convolution networks, sequence modeling, practical methodology and applications	12L
	TOTAL:	**42L**
	Total Weeks Required:	**14**
	No. Of Week Reserved:	**02**

Textand/or**Reference Books:**

1. Dirankov & Hellemdron – Fuzzy Logic Control, Narosa
2. Timothy J. Ross Fuzzy Logic with Engineering Applications
3. S Haykians – Neural Networks, Pearson
4. Anderson – An Introduction to Neural Network, PHI
5. Goldberg – Genetic Algorithm, Pearson
6. Rajsekaran&Pai – Neural Networks, Fuzzy Logic & Genetic Algorithm: Synthesis and Applications, Pearson
7. Bose – Neural Network Fundamentals and Graphs – Algorithms and Applications, TMH
8. Ian Goodfellow, Yoshua Bengio, Aaron Courville- Deep Learning

Paper Name: Reliability Engineering
Paper Code: AEIE 712(d)
Weekly Load: L: 3 T: 0 P: 0
Credit Point: 2
Total Marks: 100

Module	**Detailed Description**	**Lecture / Tutorial Period**
1	Introduction,Elements of Probability and definition of Reliability. Failure data analysis: Failure Data, Mean Failure Rate, Mean Time to Failure, Mean Time between Failure, Graphical Plots, MTTF in Terms of Failure Density,Reliability in terms of Hazard Rate and Failure Density.	9L
2	Hazard Models: Constant Hazard, Linearly-increasing Hazard, The Weibull Model, Density Function and Distribution Function, Distribution Function and Reliability Analysis. System Reliability: Reliability in Series, Parallel and Mixed Configuration, Application to Specific Hazard Models, Methods of Solving Complex Systems, Markov Models, Markov Graphs, Systems subjected to Probability Laws.	12L
3	Reliability Improvement, Improvement of Components' Reliability, Redundancy, Unit Redundancy, Standby Redundancy, Optimization, Reliability Cost Trade-off. Fault-Tree Analysis, Construction, Calculation of Reliability from Fault Tree, Event Tree Analysis, Use of Boolean Algebra to Reliability Analysis	11L
4	Maintainability, Availability, System Downtime, Reliability and Maintainability Trade-Off. Repairable systems, Instantaneous Repair Rate, Mean Time to Repair(MTTR), Reliability Allocation for Series System. Application of Reliability.	10L
	TOTAL:	**42 L**
	Total Week Required:	**14**
	No. Of Week Reserved:	**02**

Textand/or**Reference Books:**

1. Reliability Engineering and Risk Analysis, A Practical Guide: Mohammad Modarres, Mark P. Kaminskiy, Vasiliy Krivtsov, Third Edition, CRC Press.
2. Reliability Engineering: L.S. Srinath, East-West Press Private Limited.
3. Reliability Engineering, 2nd Edition, Elsayed A. Elsayed, Wiley Publication

Paper Name: NDT/NCT
Paper Code: AEIE 712(e)
Weekly Load: L: 3 T: 0 P: 0
Credit Point: 2
Total Marks: 100

Module	Detailed Description	Lecture / Tutorial Period
1.	**Introduction:** Fundamentals of and introduction to destructive and non-destructivetesting. Scope and limitations of NDT,Visual examination methods, Different visual examination aids. **Dye penetrant Testing/ liquid penetrant testing:** Principle, procedure, characteristics of penetrant, types of penetrants,penetrant testing materials, fluorescent penetrant testing method–sensitivity, application and limitations.	10 L
2	**Magnetic Particle Testing:** Important terminologies related to magnetic properties of material, principle, magnetizing technique, procedure, equipment, fluorescent magnetic particle testing method, sensitivity, application and limitations. **Eddy current testing:** Principle, instrument, techniques, sensitivity, application, limitation. Thermal methods of NDT.	11 L
3	**Ultrasonic Testing:** Basic principles of sound propagation, types of sound waves, Principle of UT, methods of UT, their advantages and limitations, Piezoelectric Material, Various types of transducers/probe, Calibration methods, use of standard blocks, technique for normal beam inspection, flaw characterization technique, defects in welded products by UT, Thickness determination by ultrasonic method, Study of A, B and C scan presentations, advantage, limitations acoustic emission testing – principles of AET and techniques	10 L
4	**Radiographic testing:** X-ray and Gamma-Ray radiography, Their principles, methods of generation, Industrial radiography techniques, inspection techniques, applications, limitations, Types of films, screens and penetrameters. Interpretation of radiographs, Safety in industrial radiography. **Leak and pressure testing:** Definition of leak and types, Principle, Various methods of pressure and leak testing, Application and limitation	11L
	TOTAL:	**42 L**
	Total Week Required:	**14**
	No. Of Week Reserved:	**02**

Text/Reference Books:

1. Practical Non-destructive Testing – Baldev Raj, T. Jayakumar & M. Thavasimuthu, Norosa Publishing House, New Delhi.
2. Treaties on Non-destructive testing, Vol. 1,2 & 3 Edited by Dr. E.G. Krishnadas Nair, NDT Centre, Hal, Bangalore
3. Non-destructive testing, Warren J. Mc Gonnagle, Gordon Breach, Science Publishers Ltd.
4. Ultrasonic Testing of Materials, J. Krautkramer& Herbert Krautkramer, Narosa Publishing House, New Delhi.
5. Non-destructive testing, R. Hatmshaw.
6. Ultrasonic Methods of Testing Materials, LeszekFilipezynski, Zdzislaw Pawlowski & Jerzywehr, Butterworths, London.

Semester-VIII

Paper Name: Soft Computing & Control
Paper Code: AEIE 801
Weekly Load: L:3 T: 1 P:0
Credit Points: 3
Total Marks: 100

Module	Detailed Description	Lecture/ Tutorial Period
1.	Introduction to soft Computing and its constituents. Fuzzy Logic: Introduction, definition of fuzzy set, difference between fuzzy set and crisp set, Operations on fuzzy sets, Basicoperators, T-norm, S-norm, other aggregation operators. Fuzzy Relations, implications, cylindrical extensions, projection and composition.	11L+2T
2	Approximate reasoning, compositional rule of inference, rule based system, term set, Fuzzification, reasoning, defuzzyfication, Different fuzzy models, Fuzzy logic based control systems.	11L+3T
3	Neural Networks: Introduction to artificial neural networks, basic models, multilayer perception, Hopfield networks, and learning vector quantization network. Learning of neural networks, Back propagation training algorithm. Self-organizing features maps , Neural network based control.	11L+6T
4	Basics of genetic algorithm (GA), Different GA Operators, Applications of GA. Some Hybrid Neuro-fuzzy control systems.	9L+3T
	TOTAL:	**42L+14T**
	Total Weeks Required:	**14**
	No. Of Week Reserved:	**02**

Textand/or**Reference Books:**

1. Dirankov&Hellemdron – Fuzzy Logic Control, Narosa
2. Timothy J. Ross Fuzzy Logic with Engineering Applications
3. S Haykians – Neural Networks, Pearson
4. Anderson – An Introduction to Neural Network, PHI
5. Goldberg – Genetic Algorithm, Pearson
6. Rajsekaran&Pai – Neural Networks, Fuzzy Logic & Genetic Algorithm: Synthesis and Applications, Pearson
7. Bose – Neural Network Fundamentals and Graphs – Algorithms and Applications, TMH

Paper Name: Power Plant Instrumentation
Paper Code: AEIE 802
Weekly Load: L: 3 T: 1 P: 0
Credit Point: 3
Total Marks: 100

Module	Detailed Description	Lecture / Tutorial Period
1	**General Concepts:** Power generation; Different types of Power plants; Setups, energy conversions and measurement requirements; examples of Thermal, Hydel, and Nuclear plants; Basic building block for all types of power generation plants. **Instrumentation for:** Turbines; Condensers; Generators; Busbar coupling; Coal handling; Water treatment Feed water, combustion air and flue gases	10L+4T

2	**Boiler Control** - Steam pressure control, combustion control, Furnace Draft control, Steam (Main & Reheat) temperaturecontrol, Feed water control, Attemperator; Deaerator control; Combustion Control-air/fuel ratio control; Drum level control; Super heater control; . **Control loops in boiler:** Data logger and computer control; supervisory control and monitoring system; P&I diagram of boiler; Cogeneration distributed control system in power plants; Interlocks in boiler operation. **Data handling**: Processing, logging, acquisition, accounting, display and storage. Introduction to power plant modeling/simulation	12L+4T
3	**Instrumentation for safety interlocks** - protective gears, emergency measures, Alarm systems and Analysis; Pollution measurement, monitoring and control; Dust monitor **Parameters of power plant and its measurement**: Electrical and non-electrical parameter measurement -correction factor for steamtemperature and steam pressure; drum level measurement; radiations detector; smoke density measurement; speed vibration; shell temperaturemonitoring & control - steam pressure control lubricant temp control of turbines.	10L+3T
4	**Analyzers in power plants:** Flue gas oxygen analyzer - analysis of impurities in feed water and steam - Dissolved oxygen analyzer - chromatography - PH Meter - Fuel analyzer. **Nuclear Power Plant:** Nuclear power plant instrumentation - P&I diagram of different types of nuclear power plant - radiations detection instruments - process sensors for nuclear power plants - Spectrum	10L+3T
	TOTAL:	**42L+14T**
	Total Week Required:	**14**
	No. Of Week Reserved:	**02**

Text/Reference Books:

1. Sam Dukelow. G "The control of Boilers", instrument society of America,1991.
2. Modern power station practice, Vol.6, "Instrumentation Controls and Testing",Pergamon Press, Oxford, 1971. A 153.
3. Elonka. S.M, and Kohan. A.L, "Standard Boilers Operations", McGraw Hill,New Delhi, 1994.
4. Electric Power Engineering Handbook – Edited by L. L. Grigsby.

Paper Name: Soft Computing Simulation Laboratory
Paper Code: AEIE 851
Weekly Load: L:0 T: 0 P:3
Credit Points:2
Total Marks: 100

List of experiments

1. Introduction to MATLAB tools for soft computation.
2. Neural network programmings:
   -Programming for understanding of a single layer neural network.
   -Learning algorithms of Neural Network.
3. Programmings on Fuzzy logic:
   -Programming for generating membership function, Fuzzification, Fuzzy operations, Defuzzification.
4. Neural Network Toolbox:
   -Create and train a neural network using Back Propagation algorithm by neural network toolbox.

5. Fuzzy Logic Toolbox:
   -Understanding FIS Editor,
   -Develop fuzzy membership function, Create fuzzy rules, Obtain the composition of two inputs.
6. Implementation of fuzzy logic controller using MATLAB and 1st order delay process.
7. Implementation of neural controller using MATLAB and 1st order delay process

Paper Name: Project II
Paper Code : AEIE 891
Weekly Load: L: 0, T: 0, P: 6
Credit Point : 6
Total Marks: 100

- This is the continuation of Project-I started at Semester VII.
- Each project group should complete their project in this Semester and finally prepare a comprehensive Project Report. Each group should submit at least three extra copy of Project Report other than their individual copy, one for their Project guide, one for the departmental library and one for Institute's main library.
- Project work and Project report of each project group should be demonstrated and presented in front of Board of Experts and evaluation will be made on that. 50% of total marks will be evaluated by the project guide and rest 50% of total marks will be evaluated by the Board of Experts.

Paper Name: Seminar II
Paper Code : AEIE 892
Weekly Load: L: 0, T: 0, P: 3
Credit Point : 2
Total Marks: 100

- Each student have to give 10 minutes' individual presentation on any topic (advanced technology, research or development, new emerging Field etc.) followed by 5 minutes interaction / discussion session.
- The presentation should be in front of teachers, students of the class.
- Marks will be given based on evaluation throughout the year and a final evaluation at the end of Semester based on a final presentation.
- Evaluation should be based on the following parameters of the students: Presentation skill, delivery of the speech, depth and breadth of the subject matter presented and seminar report.
- The attendance of other students in the seminar will be recorded and their participation should also be assessed for evaluation.
- Each student has to submit a technical report for each presentation they have delivered.

Paper Name: Grand Viva
Paper Code : AEIE 893
Weekly Load: L: 0, T: 0, P: 0
Credit Point : 3
Total Marks: 100

Viva-Voce based on all the theoretical as well as practical papers starting from semester I to semester VIII will be conducted at the end of semester VIII. Board of experts will evaluate the performance of each individual student.

The board should consist at least one External Expert from the same discipline, members from corresponding department and experts for all non-departmental subjects.

Appendix- III
Elective-III (AEIE 8th Semester)

Paper Name: Robotics
Paper Code: AEIE 811(a)
Weekly Load: L:3 T: 1 P:0
Credit Points: 3
Total Marks: 100

Module	Detailed Description	Lecture/ Tutorial Period
1	Introduction of robotics-definition of robot and law of robotics, robotics system and robot anatomy, present application status, safety measure in robotics. Robot kinematics- forward and reverse kinematics of three degree of freedom robot arms : forward and reverse transformation of four degree of freedom manipulator in 3-D,	11L+4T
2	Homogaeneous transformation, D-Alembert equation of motion. Robot in effectors: classification of end effectors ,drive system for grippers, magnetic ,mechanical ,adhesive and vacuum grippers, gripper force analysis, synthesis of element with movavility, constucton and manipulation trajectory planning joint interpolated trajectory control.	10L+3T
3	Robot manipulation – computed torque technique ,sequential and adaptive control ,resolve motion control robots. Artificial intelligence and robotics, need of sensing systems: details description and types of sensors, briefly explanation robot vision system and its classification.	10L+4T
4	Robot programming languages; classification of robot languages, robot level and task level languages robot intelligence-state space search, robot learning, robot task planning, Application of robot:-capabilities of robots, robotics application, obstacle avoidance	11L+3T
	TOTAL:	**42L +14T**
	Total Weeks Required:	**14**
	No. of Weeks Reserved:	**02**

Textand/or**Reference Books:**

1. K S Fu, R C Ganzalez and C S G Lee, Robotics Control, Sensing, Vision and Intelligence, McGraw-Hill, International Edition, 1987.
2. M P Groover, M Weins, R N Nagel and N C Odrey, Industrial Robotics, McGraw Hill, 1986.
3. S Sitharama Iyengar and Albetro Elefes, Autonomous Mobile Robots Control, Planning and Architecture, IEEE Computer Society Press.
4. Niku, Introduction to Robotics, Pearson
5. Craig, Introduction to Robotics, 2/e, Pearson.

Paper Name: Artificial Neural Network
Paper Code: AEIE 811(b)
Weekly Load: L: 3 T: 1 P:0
Credit Point: 3
Total Marks: 100

Module	Detailed Description	Lecture / Tutorial Period
1	Introduction of 'The Brain', Engineering of the brain, Fuzzy and Neural Networks, crisp and Fuzzy logic. Human Physiology:-Neuron: Axon and Synapse, types of synapse, weighting factor, the brain and eye- explanation in sense of Neural Networks. Artificial Neural Networks: Mathematics, modeling, basic model of a artificial Neuron, characteristic of ANN. Learning in Artificial Neural Networks: supervised, unsupervised, Reinforced, Competitive, Hebbian and Delta rule learning. ANN learning and program, Learning Algorithm.	12L+1T
2.	Linear, Multi-linear, Nonlinear ANN, adaptability and Stability of ANN models. Neural Network Paradigms: McCulloch-Pitts Model, concept of Perceptron; Perceptron learning procedure, single layer Perceptron, Multilayer Perceptron, Delta learning Algorithm, ADALINE and MADALINE ,Mathematical analysis. Winner-Takes-All algorithm, back propagation Learning- mathematical analysis and application.	13L+4T
3	Hopfield model and Competitive learning Model: Mathematical Analysis, Memory type Paradigm (RAM, CAM, BAM, TAM, LAM), Real time models. Self Organizing Map, Probabilistic NN, Radial Basis Function.	9L+4T
4	Neuro-Fuzzy Networks: ANN and Fuzzy Logic Network, Example, Neuro-Fuzzy Control. Application: Image Data Processing, Traffic control, Switching control in Communication field, Intelligent Control.	8L+5T
	TOTAL:	**42L+14T**
	Total Week Required:	**14**
	No. Of Week Reserved:	**02**

Textand/or**Reference Books:**

1. Artificial Intelligence: N. J. Nilsson, Harcourt Asia Pte Ltd, 2000
2. Artificial Intelligence and Modern Approach: S. Russel, P. Norvig, Pearson Education, 2003
3. Principles of Artificial Intelligence: N. J. Nilsson, Narosa Publishing House, 1993
4. Artificial Intelligence: G. F. Lugar, Pearson Education, 2001
5. Essentials of Artificial Intelligence: M. Ginsberg, Morgan Kaufman Publishers Artificial Intelligence: Rich

Paper Name: Wireless Communication
Paper Code: ECE 811(d)
Weekly Load: L: 3 T: 1 P: 0
Credit Point: 3
Total Marks: 100

Module	Detailed Description	Lecture / Tutorial Period

1. .	Introduction: Introduction to Wireless Personal Communication - Generations of cellular networks (2G, 3G,4G etc.), Introduction to GSM, CDMA, GPRS, EDGE, UMTS, WCDMA, LTE, WLAN, WLL, WiMAX, Wi-Fi etc. The cellular concept - System Design issues: Cell structure and frequency reuse, Hand-off strategies, System capacity and coverage improvement techniques considering interference, Trunking theory and grade of service (GOS) using Erlang method.	10L+3T
2	Mobile Radio Propagation and Fading: Characterization of wireless radio channel, Various path loss and fading models considering free space, outdoor and indoor propagation of RF waves. Modulation and Multiple Access Techniques: Modulation schemes like GMSK & Spread Spectrum Modulation, Multiple Access Techniques like FDMA, TDMA, SDMA, OFDM, CDMA (DS-CDMA, FH-CDMA) etc.	15L+5T
3	Multiple-input and multiple-output(MIMO): Introduction to MIMO in wireless communication for capacity enhancement, Derivation of channel capacity improvement using MIMO over SISO system, Evolution of propagation modeling using spatio-multiplexing considerations for MIMO, Concepts of space time coding etc. Received Signal Quality Improvement Techniques: Equalization for ISI reduction, Diversity for fading channel impairment and Advanced Channel Coding schemes for BER reduction.	11L+3T
4.	Mobile communication standards: (i) Global system for mobile communication (GSM): Architecture, Spectrum, Channel organization, Traffic and Control Channel Frames, Multi-frames, Superframes etc. (ii) CDMA based IS-95 System: Architecture, Spectrum, Detailed operation of forward and reverse link of IS-95 standard. (iii) Overview of Universal mobile telecommunication system (UMTS) and Long term evolution (LTE) system.	6L+3T
	TOTAL:	42L+14T
	Total Week Required:	14
	No. Of Week Reserved:	02

Books:Text and/or **Reference:**

1) Wireless Communications: Principles and Practice by Theodore S. Rappaport (Prentice Hall Communications Engineering and Emerging Technologies Series)
2) Wireless Communications (Paperback) by Andreas Molisch (John Willey)
3) Wireless Communications by Andrea Goldsmith (CUP)
4) Wireless and Cellular Communications by William C. Y. Lee (McGRAW-HILL)
5) MIMO System Technology for Wireless Communications by George Tsoulos, Taylor & Francis (CRC)

Paper Name: Computer Networks
Paper Code: CSE 811(i)
Weekly Load: L: 3 T: 1 P: 0
Credit Points: 3
Total Marks: 100

Module	Detailed Description	Lecture / Tutorial Period

1	**Introduction:** Overview on the terms Computer Network, Distributed System, Client-Server model; Main features of computer network. Terminologies- Protocol Standards, Host, Medium/Channel; Network types - LAN, MAN, WAN; Inter-network. **Network Models:** Layered architecture: Advantage and Disadvantages, Service, function. Network design issues; Peer-to-Peer communication in layered architecture. ISO OSI model- layers, Functions of each layer, communication through OSI. TCP/IP model- layers, Functions of each layer, Similarities and Differences between OSI and TCP/IP model, Connection-oriented and connection-less service, Physical and logical address. **Network Topology:** Mesh, Bus, Tree, Ring, Star, Hybrid; Transmission Modes- Simplex, Half-duplex, Full-duplex	**12L+4T**
2	**Transmission Techniques**: Line coding, Line coding schemes, Block coding, Pulse code modulation, delta modulation Different modulation techniques, Sampling; Multiplexing(mainly FDM and TDM) **Transmission media:** Twisted pair, Co-axial cable, Fiber optics, Unguided media; Transmission related terms- Transmission impairment, Transmission performance, Data rate limits, Transmission media comparison. **Flow Control and Error Control:** Framing; Flow control Techniques; Error control techniques – Different type of ARQ; HDLC; Error detection techniques.	**10L+3T**
3	**Medium access control:** ALOHA; CSMA and CSMA/CD; IEEE 802 project for LAN – Architecture and protocols; Case study: - Ethernet, Token Bus, Token Ring and FDDI; Switching Techniques- Circuit switching, Packet Switching, Message Switching; ISDN, ATM. **Addressing:** IPv4 Addressing (Classes, Dotted decimal notation; Subnetting, Classful addressing, Classless addressing), Datagram of IPv4. **Routing:** Forwarding, routing table, different type of routing; Routing algorithms; Networking and internetworking devices.	**12L+4T**
4	**Process to process delivery:** UDP, TCP, Client-server communication, different types of ports, Socket. **Upper OSI Layers:** SMTP, DNS, TELNET, FTP, HTTP, WWW. **Security**: Encryption and Decryption methods, user authentication	**8L+3T**
	TOTAL:	**42L+14T**
	Total Week Required:	**14**
	No. Of Week Reserved:	**02**

Books: Text and/or **Reference:**

1. Data Communication and Networking,4e, Forouzan. TMH
2. Computer Netwotks, 4e, A. S. Tanenbaum, Pearson
3. Communication Networks, Leon, Garica, Widjaja, TMH
4. Data and Computer Communications, W. Stallings, PHI/Pearson Education

Paper Name : Mathematical Modelling & Stochastic Processes
Paper Code : M 811(e)
Weekly Load : L: 3 T: 1 P: 0
Credit Unit : 3
Total Marks : 100

Module	Detailed Description	Lecture / Tutorial Period
1	**Mathematical Modeling:** Introduction to mathematical modeling-its significances and utilities. **Modeling in nonlinear phenomena:** Modeling in biological ecosystem, Epidemiology, Pharmacology, Socio-economic sectors, Demography; Logistic map, Dynamical system, Stable and unstable equilibrium points, Node and focus, Concept of bifurcation and chaos, Different forms of Bifurcation.	**15L+5T**
2	**Modeling in time series data analysis:** Filtering of time series data, Kalman Filter, Simple exponential smoothing; Searching for periodicity in a time series data by Ferraz-Mello's Date compensated Discrete Fourier Transform, Lomb-Scargle Method of Periodogram, Maximum Entropy Method, Maximum Likelihood Method, Rayleigh Power-Spectrum Analysis and Simple Denoising Algorithm using Wavelet Transform; Scaling analysis of a time series data, Hurst Exponent, Finite Variance scaling method; Autocorrelation, stationary and non-stationary time series, Autoregressive and moving average method, chaos in a time series; Persistent and Anti-Persistent data; Fractals and Fractal Dimensions, Higuchi's Method to determine the fractal dimension for a time series data.	**11L+4T**
3	**Soft Computing Techniques:** Basics of Fuzzy Logic, Difference between crisp set and fuzzy set, Concept of membership function, Application of fuzzy logic in engineering systems: an introduction. Introduction to neural network, concept of perceptron, Introduction to artificial neural network, Forward bias and feedback model in neural network, Applications in engineering systems	**8L+3T**
4	**Stochastic processes:** Introduction; Stationary, Ergodic and Markov processes; Markov chains and Absorbing Markov chains.	**8L+2T**
	TOTAL:	**42L+14T**
	Total Week Required:	**14**
	No. Of Week Reserved:	**02**

Text/Reference Books:

1 Non-Linear Dynamics: Integrability, Chaos and Patterns-M. Lakshmanan, Springer India Pvt. Ltd.
2 Mathematical Modelling-J.N. Kapoor, New Age Publishers
3 Time series analysis: Forecasting and Control: Box, Jenkins & Reinsel, John Wiley and Sons
4 Probability, Statistics and Random Processes: T. Veerarajan, Tata McGraw Hill Publishing
5. Neural Networks-S. Haykin, Macmillian Publishing Company
6. Fuzzy Logic and Neural Networks: Basic Concepts and Application- Chennakesava R. Alavala, New Age International Pvt. Ltd.
7. Introduction to Fuzzy Set Theory and Fuzzy Logic-Chander Mohan, Viva Books Pvt. Ltd., 2015.

Appendix- IV
Elective-IV (AEIE 8th Semester)

Paper Name: Industrial Automation
Paper Code: AEIE 812(a)
Weekly Load: L: 3 T: 1 P: 0
Credit Point: 3
Total Marks: 100

Module	Detailed Description	Lecture / Tutorial Period
1	Introduction, Architecture of Industrial Automation Systems Measurement Systems Characteristics, Data Acquisition Systems	10 L+3T
2	Introduction to Automatic Control, P -I - D Control, PID Control Tuning, Feed Forward control, Ratio Control, Time Delay Systems and Inverse Response Systems, Special Control Structures. Flow control valves.	10 L+3T
3	Introduction to Sequence Control, PLC, RLL, Sequence Control, Scan Cycle, Simple RLL programs, RLL Elements, RLL Syntax, Structured design approach to sequence control, PLC Hardware environment.	11 L+4T
4	Hydraulic control systems, industrial hydraulic circuits, pneumatic control systems, energy savings with variable speed drives, Introduction to CNC machines. Field Bus networks, Higher Level Automation systems,	11 L+4T
	TOTAL:	**42L+14T**
	Total Week Required:	**14**
	No. Of Week Reserved:	**02**

Text/Reference Books:

1. Industrial Instrumentation, Control and Automation,S. Mukhopadhyay,S.Sen and A.K.Deb, Jaico Publishing House, 2013
2. Chemical Process Control, An Introduction to Theory and Practice, George Stephanopoulos, Prentice Hall India, 2012
3. Electric Motor Drives, Modelling,Analysis and Control, R.Krishnan, Prentice Hall India,2002
4. Hydraulic Control Systems, Herbert E. Merritt, Wiley, 1991

Paper Name: Information Theory & Coding
Paper Code: AEIE 812(b)
Weekly Load: L: 3 T: 1 P: 0
Credit Point: 3
Total Marks: 100

Module	Detailed Description	Lecture / Tutorial Period
1.	**Introduction:** Information; Information sources; Information content of a Symbol; information rate; Mathematical representation; Discrete memoryless channel (DMC), types of Channels; Information measure for continuous random variables, **Entropy:** Conditional & Joint Entropies; Channel capacity;Mutual information; entropy relations for a continuous channel; Capacity of Additive White Gaussian Noise (AWGN); Shannon Hartley Law; Exchange of Bandwidth for SNR;	10L+2T

2.	**Source coding:** Source Coding Theorem, Classification of Codes; Kraft Inequality; Entropy Coding-Huffman and Shanon-Fano. Lempel-Ziv Encoding and Run-Length Encoding, Rate Distortion Function and Optimum Quantizer. **Error Control Coding:** Classification of Codes; Detection and Correction errors; Error classification; Error detection and correction techniques; Generation and detection of coded signals; Drawbacks of Coding techniques; Classification of Error correcting codes; Types of error control	10L+4T
3.	**Linear Block Codes:** Error detection method; Error detection using VRC and LRC; Burst Error and its Correction; Hamming code; Error detection and correcting capabilities of hamming code; Hamming code encoder; Syndrome decoder; Decoding of LBC; **Cyclic Codes:** Cyclic Property, Polynomials, Division Algorithm for Polynomials, Method of Generating Cyclic Code	11L+3T
4	Cyclic Redundancy Check; Generator and Parity check matrices of Cyclic code; Systematic form of Generator matrix; Encoder for Cyclic code; Difference between Source coding, Lin coding and error detection; Syndrome calculator for Cyclic codes; Decoder for Cyclic code; Bose Chaudhuri Hocquenghem Code: Minimal Polynomials, Generator Polynomials, Reed-Solomon Code. Turbo code. Golay code; **Convolutional Codes:** Time Domain approach; Transfer domain approach; graphical representation; Code tree; Code Trellis; State diagram; Decoding methods; Viterbi Algorithm; Metric Diversion effect; Free distance and Coding gain; Transfer function of Convolutional codes;	11L + 5T
	TOTAL:	**42L+14T**
	Total Week Required:	**14**
	No. Of Week Reserved:	**02**

Text/Reference Books:

1. Ranjan Bose, Information Theory, Coding and Cryptography, TMH.
2. Jones, Information & Coding Theory, Springer.
3. Senn J., Analysis and Design of Information Systems, McGraw Hill.
4. M. Mansurpur, Introduction to Information Theory, McGraw Hill.
5. Shu Lin and D.I. Costello Jr., Error Control Coding, Prentice Hall.
6. Dr. Sanjay Sharma, Communications System, Katson Books.

Paper Name: Nanotechnology
Paper Code: AEIE 812(c)
Weekly Load: L: 3 T: 1 P: 0
Credit Point: 3
Total Marks: 100

Module	Detailed Description	Lecture / Tutorial Period
1	Generic methodologies for nanotechnology: Introduction, classification and fabrication, Summary of the electronic properties of atoms and solids, Effects of the nanometer length scale, Fabrication methods, Preparation, safety and storage issues. Strategies for the scalable synthesis of quantum dots and related Nano dimensional materials –I: Nano dimensional Materials, Potential uses for Nanodimensional Materials, The General Methods available for the Synthesis of Nanodimensional, Materials, Precipitative Methods, Reactive Methods in High Boiling Point Solvents.	11L+2T
2	Strategies for the scalable synthesis of quantum dots and related Nano dimensional materials –II: Reactive methods in high boiling point solvents 20, hydrothermal and	10L+3T

	solvothermal methods 22, gas-phase synthesis of semiconductor nanoparticles 23, synthesis in a structured medium 24, the suitability of such methods for scaling	
3	Nanotechnology and ceramics : Introduction, Synthesis, Vapor Condensation Methods, Sputtering, Laser Method, Spray Pyrolysis, Thermo Chemical /Flame Decomposition of metal organic Precursors methods	10L+3T
4	Tools to characterize nanomaterials: X-Ray Diffraction (XRD), Scanning Electron Microscopy, Transmission Electron Microscopy, Atomic Force Microscopy, UV/Visible Spectroscopy Applications of nanomaterials: Cosmetics and Consumer Goods, Nano Sensor, Nano catalysts, Water Treatment and the Environment, Paints, Food and Agriculture Industry	11L+6T
	TOTAL:	**42L+14T**
	Total Week Required:	**14**
	No. Of Week Reserved:	**02**

Text/Reference Books:

1. Nanostructures and Nanomaterials: Synthesis, Properties and Applications by G. Cao, ImperialCollege Press, 2004.
2. Nanoscale Science and technology by Robert Kelsall (editor), Ian W. Hamley (co-editor),Mark Geoghegan (co-editor) , ISBN: 978-0-470-85086-2
3. The Chemistry of Nanomaterials: Synthesis, Properties and Applications by C. N. R. Rao, A.Muller, A. K. Cheetham, WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim,
4. Nanoscale Materials in Chemistry Edited by Kenneth J. Klabunde, John Wiley & Sons, Inc.,
5. Textbook of Nanoscience and Nanotechnology, B.S. Muty, P. Shankar, Baldev Raj, B.B Rathand James Murday, University Press, IIM (ISBN-978 81 7371 738 3).
6. Introduction to Nanotechnology by Charles P. Poole Jr and. Frank J. Owens, Wiley-Interscience, 2003.

Paper Name: Pattern Recognition
Paper Code: AEIE 812(d)
Weekly Load: L: 3 T: 1 P: 0
Credit Point: 3
Total Marks: 100

Module	Detailed Description	Lecture / Tutorial Period
1.	**Introduction:** Mathematical preliminaries, What is Pattern recognition; Applications and Examples, Clustering vs. Classification; Supervised vs. unsupervised, Relevant basics of Linear Algebra, vector spaces, Probability Theory basics, Basics of Estimation theory, Decision Boundaries, Decision region / Metric spaces/ distances, Mathematical Assignments	10L+2T
2.	**Classification:** Bayes decision rule, Error probability, Normal Distribution, Linear Discriminant Function (equal covariance matrices), Non-linear Decision Boundaries (unequal covariance matrices), Mahalanobis Distance, K-NN Classifier, Fisher's LDA, Layer Perceptron, Multi-layer Perceptron, Training set, test set; standardization and normalization, List of Assignments	12L+5T
3.	**Clustering:** Basics of Clustering; similarity / dissimilarity measures; clustering criteria. Different distance functions and similarity measures, Minimum within cluster distance criterion, K-means algorithm; Single linkage and complete linkage algorithms, MST, K-medoids, DBSCAN, Data sets - Visualization; Unique Clustering; No existence of clusters	9L+3T

4.	**Feature selection:** Problem statement and Uses; Algorithms - Branch and bound algorithm, sequential forward / backward selection algorithms, (l,r) algorithm; Probabilistic separability based criterion functions, interclass distance based criterion functions. **Feature Extraction:** PCA + Kernel PCA **Recent advances in Pattern Recognition:** Structural PR, SVMs, FCM, Soft-computing and Neuro-fuzzy techniques, and real-life examples	11L+4T
	TOTAL:	**42L+14L**
	Total Week Required:	**14**
	No. Of Week Reserved:	**02**

Text/Reference Books:

1. Required: Duda, Hart and Stork, Pattern Classification, Second Edition, Wiley, 2001.
2. T.M. Mitchell, Machine learning, McGraw-Hill, New York, 1997.
3. S. Theodoridis, K. Koutroumbas, Pattern recognition, Academic Press, 1999.

Paper Name: Internet on Things & Applications
Paper Code: AEIE 812(e)
Weekly Load: L: 3 T: 1 P: 0
Credit Point: 3
Total Marks: 100

Module	**Detailed Description**	**Lecture / Tutorial Period**
1.	**M2M to IoT:** Introduction, M2M towards IoT - the global context, Fundamental Definitions, M2M &IoT Value Chains, M2M to IoT-An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations. M2M &IoT Differing Characteristics. **M2M and IoT Technology Fundamentals:** Devices and gateways, Local and wide area networking, Data management, Business processes in IoT, Everything as a Service(XaaS), M2M and IoT Analytics, Knowledge Management	10L+4T
2	**IoT Architecture:** Introduction, State of the art, Architecture, IoT reference Model, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views. **Networking:** Basics of networking, Basics of Communication, Communication Protocols, Sensor Network, Interoperability of Sensors and networks.	10L+4T
3	**Introduction of Python:** Basics of Python, Integration of Sensors and Actuators with Arduino; Implementation of IoT with Raspberry Pi; Basics of Cloud Computing.	10L+3T
4	**Real-World Design Constraints:** Introduction, Technical Design constraints, Data representation and visualization, Interaction and remote control. **Industrial Automation:** Service-oriented architecture-based device integration, **SOCRADES:** realizing the enterprise integrated Web of Things, **IMC-AESOP:** Web of Things to the Cloud of Things, Commercial Building Automation- Introduction, phase one-commercial building automation today, Case studies.	12L+4T
	TOTAL:	**42L+14T**
	Total Week Required:	**14**
	No. Of Week Reserved:	**02**

Text/Reference Books:

1. "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", by Pethuru Raj and Anupama C. Raman (CRC Press)

2. "Internet of Things: A Hands-on Approach", by ArshdeepBahga and Vijay Madisetti (Universities Press)
3. Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, StamatisKarnouskos, David Boyle, "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", 1st Edition, Academic Press, 2014.
4. Vijay Madisetti and ArshdeepBahga, "Internet of Things (A Hands-on-Approach)", 1st Edition, VPT, 2014.
5. Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1st Edition, Apress Publications, 2013.