Curriculum Undergraduate Programme

Bachelor of Technology
in
ELECTRICAL ENGINEERING

Batch: 2013 – 17, 2014 – 18

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PROPOSED TEACHING SCHEME AND SYLLABUS OF FOUR YEAR UNDER GRADUATE PROGRAMME (B.TECH) IN ELECTRICAL ENGINEERING W.E.F 2013 ADMISSIONS

B.TECH (FIRST SEMESTER)

(COMMON TO ALL BRANCHES)

First Semester Group A :

Sl.No.	Sub. Code	Subjects	L-T-P	Credit
1	PHX 101	Physics	3-1-0	4
2	ICX 101	Electrical Sciences	2-0-0	2
3	CSX 101	Computer Programming	2-0-0	2
4	BTX 101	Introduction to Bio Science	3-0-0	3
5	HMX 101	Introduction to Management, Human Values & Behavior	3-0-0	3
6	PHX 102	Physics Laboratory	0-0-2	1
7	MEX 101	Engineering Graphics	1-0-4	3
8	ICX 102	Electrical Science Laboratory	0-0-1	1
9	CSX 102	Computer Programming Laboratory	0-0-2	1
		TOTAL		**20**

First Semester Group B :

Sl.No.	Sub. Code	Subjects	L-T-P	Credit
1	CYX 101	Chemistry	3-1-0	4
2	IDX/CEX/ MEX 102	Elements of Mechanical Engineering	3-1-0	4
3	HMX 102	English Communication	3-0-0	3
4	IDX 101	Environmental Science and Technology	2-0-0	2
5	INX 101	Manufacturing Process	1-0-4	3
6	ECX 101	Basic Electronics	2-0-0	2
7	HMX 104	English Communication Laboratory	0-0-3	2
8	CYX 102	Chemistry Laboratory	0-0-1	1
9	ECX 102	Basic Electronics Laboratory	0-0-2	1
		TOTAL		**22**

B.TECH (SECOND SEMESTER)

(COMMON TO ALL BRANCHES)

Second Semester Group - A

Sl.No.	Sub. Code	Subjects	L-T-P	Credit
1	MAX 101	Mathematics - I	3-1-0	4
2	CYX 101	Chemistry	3-1-0	4
3	IDX/CEX/ MEX 102	Elements of Mechanical Engineering	3-1-0	4
4	HMX 102	English Communication	3-0-0	3
5	IDX 101	Environmental Science and Technology	2-0-0	2
6	INX 101	Manufacturing Process	1-0-4	3
7	ECX 101	Basic Electronics	2-0-0	2
8	HMX 104	English Communication Laboratory	0-0-3	2
9	CYX 102	Chemistry Laboratory	0-0-1	1
10	ECX 102	Basic Electronics Laboratory	0-0-2	1
		TOTAL		**26**

Second Semester Group - B

Sl.No	Sub. Code	Subjects	L-T-P	Credit
1	MAX 101	Mathematics-I	3-1-0	4
2	PHX 101	Physics	3-1-0	4
3	ICX 101	Electrical Sciences	2-0-0	2
4	CSX 101	Computer Programming	2-0-0	2
5	BTX 101	Introduction to Bio Science	3-0-0	3
6	HMX 101	Introduction to Management, Human Values & Behavior	3-0-0	3
7	PHX 102	Physics Laboratory	0-0-2	1
8	MEX 101	Engineering Graphics	1-0-4	3
9	ICX 102	Electrical Science Laboratory	0-0-1	1
10	CSX 102	Computer Programming Laboratory	0-0-2	1
		TOTAL		**24**

B.TECH (THIRD SEMESTER)

S No	Course No	Course Title	Periods			Contact Hours	Credits	Category	AICTE Para-meters
			L	T	P/D				
1.	MAX-201	Mathematics-II	3	1	0	4	4	ID	BS
2.	EEX-201	Circuit Theory	3	1	0	4	4	DC	DC
3.	EEX-203	Electrical Measurement and Measuring Instruments	3	0	0	3	3	DC	DC
4.	ECX-251	Electronic Devices and Analog Integrated Circuits	3	1	0	4	4	ID	ESTA
5.	HMX-201	Engineering Economics and Industrial Management	3	1	0	4	4	ID	HSS&M
6	CSX-207	Object Oriented Programming	3	0	0	3	3	ID	ESTA
7.	EEX-221	Circuit Theory Laboratory	0	0	2	2	1	DC	DC
8.	EEX-223	Electrical Measurement and Measuring Instruments Laboratory	0	0	2	2	1	DC	DC
9.	ECX-261	Electronic Devices and Analog Integrated Circuits Laboratory	0	0	2	2	1	ID	ESTA
10.	CSX-227	Object Oriented Programming Laboratory	0	0	2	2	1	ID	ESTA
		TOTAL	**18**	**4**	**8**	**30**	**26**		

B.TECH (FOURTH SEMESTER)

S No	Course No	Course Title	Periods			Contact Hours	Credits	Category	AICTE Para-meters
			L	T	P/D				
1.	EEX-202	EMF Theory	3	1	0	4	4	DC	ESTA
2.	MAX-202	Mathematics-III	3	1	0	4	4	ID	BS
3.	EEX-204	Electrical Machines I	3	1	0	4	4	DC	DC
4.	ECX-205	Digital Electronics	3	1	0	4	4	ID	DC
5.	EEX-206	Instrumentation	3	1	0	4	4	DC	DC
6.	HMX-202	Entrepreneurial Development and Management	3	0	0	3	3	ID	HSS&M
7.	EEX-224	Electrical Machines I Laboratory	0	0	2	2	1	DC	DC
8.	ECX-215	Digital Electronics Laboratory	0	0	2	2	1	ID	DC
9.	EEX-226	Instrumentation Laboratory	0	0	2	2	1	DC	DC
		TOTAL	**18**	**5**	**6**	**29**	**26**		

B. TECH (FIFTH SEMESTER)

S No	Course No	Course Title		Periods			Contact Hours	Credits	Cat	AICTE
				L	T	P/D				
1.	MAX-206	Numerical Methods		3	1	0	4	4	ID	BS
2.	EEX-301	Electrical Machines II		3	1	0	4	4	DC	DC
3.	EEX-303	Control System Engineering		3	1	0	4	4	DC	DC
4.	EEX-305	Generation of Electric Power		3	0	0	3	3	DC	DC
5.	EEX-307	Transmission and Distribution of Electric Power		3	1	0	4	4	DC	DC
6.	Elect - I	EEX-361	Operations Research	3	0	0	3	3	DE	DC
		EEX-363	System Modeling and Reliability							
		EEX-365	Computer Organization and Architecture							
7.	EEX-321	Electrical Machines II Laboratory		0	0	2	2	1	DC	DC
8.	EEX-323	Control System Engineering Laboratory		0	0	2	2	1	DC	DC
		TOTAL		**18**	**4**	**4**	**26**	**24**		

B. TECH (SIXTH SEMESTER)

S No	Course No	Course Title		Periods			Contact Hours	Credits	Cat	AICTE
				L	T	P/D				
1.	PHX-301	Material Science (Nano Science)		3	1	0	4	4	ID	EA
2.	EEX-304	Power System Analysis		3	1	0	4	4	DC	DC
3.	EEX-306	Microprocessors and Applications		3	0	0	3	3	DC	DC
4.	EEX-308	Power Electronics		3	1	0	4	4	DC	DC
5.	Elect - II	EEX-362	Smart Sensors and Sensor Networking	3	0	0	3	3	DE	DC
		EEX-364	Advanced Control systems							
		EEX-366	PLC, DCS and SCADA							
6.	EEX-326	Microprocessors and Applications Laboratory		0	0	2	2	1	DC	DC
7.	EEX-328	Power Electronics Laboratory		0	0	2	2	1	DC	DC
		TOTAL		**15**	**3**	**4**	**22**	**20**		

B.TECH (SEVENTH SEMESTER)

S.No	Course No.	Course Title		Periods			Contact Hours	Credits	Category	AICTE Parameters
				L	T	P/D				
1	EEX-401	Power System Protection and Switchgear		3	1	0	4	4	DC	DC
2	EEX-403	Power System Operation and Control		3	0	0	3	3	DC	DC
3	Elective-III	EEX-461	Embedded Systems	3	0	0	3	3	DE	DC
		EEX-463	Renewable Energy Sources							
		EEX-465	Soft Computing Techniques							
4	Elective-IV	EEX-467	Utilization Of Electrical Energy and Electric Traction	3	0	0	3	3	DE	DC
		EEX-469	Electric Machine Design							
		EEX-471	Computer Networks							
5	-	Open Elective-I		3	0	0	3	3	ID	OE
6	EEX-421	Power System Laboratory		0	0	2	2	1	DC	DC
7	EEX-400	Major Project(Part-I)		0	0	4	4	2	DC	DC
8	EEX-405	Seminar		0	0	4	4	2	DC	DC
9	EEX-407	Training		0	0	0	0	4	DC	DC
		Total		15	1	10	26	25		

B. TECH (EIGHTH SEMESTER)

S.No	Course No.	Course Title		Periods			Contact Hours	Credits	Category	AICTE Parameters
				L	T	P/D				
1	EEX-402	Digital Signal Processing		3	1	0	4	4	DC	DC
2	EEX-404	Electric Drive & Control		3	1	0	4	4	DC	DC
3	Elective-V	EEX-462	Flexible A C Transmission System	3	0	0	3	3	DE	DC
		EEX-464	Energy Auditing and Management							
		EEX-466	High Voltage Engineering							
4	Elective-VI	EEX-468	High Voltage Transmission System	3	0	0	3	3	DE	DC
		EEX-470	Power System Deregulation							
		EEX-472	Smart Grid							
5	-	Open Elective-II		3	0	0	3	3	ID	OE
6	EEX-422	Digital Signal Processing Laboratory		0	0	2	2	1	DC	DC
7	EEX-400	Major Project(Part-II)		0	0	8	8	4	DC	DC
		Total		15	2	10	27	22		

LIST OF DEPARTMENTAL ELECTIVES

SR NO.	COURSE CODE	COURSE TITLE	L-T-P-C
7TH SEMESTER			
ELECTIVE-III			
1.	EEX-461	Embedded Systems	3-0-0-3
2.	EEX-463	Renewable Energy Sources	3-0-0-3
3.	EEX-465	Soft Computing Techniques	3-0-0-3
ELECTIVE-IV			
4.	EEX-467	Utilization of Electrical Energy and Electric Traction	3-0-0-3
5.	EEX-469	Electric Machine Design	3-0-0-3
6.	EEX-471	Computer Networks	3-0-0-3
8TH SEMESTER			
ELECTIVE-V			
7.	EEX-462	Flexible AC Transmission System	3-0-0-3
8.	EEX-464	Energy Auditing and Management	3-0-0-3
9.	EEX-466	High Voltage Engineering	3-0-0-3
ELECTIVE-VI			
10.	EEX-468	High Voltage Transmission System	3-0-0-3
11.	EEX-470	Power System Deregulation	3-0-0-3
12.	EEX-472	Smart Grid	3-0-0-3

SYLLABI OF THE COURSES PROPOSED IN TEACHING AND EXAMINATION SCHEME OF FOUR YEAR UNDER GRADUATE PROGRAMME (B.TECH) IN ELECTRICAL ENGINEERING W.E.F 2013 ADMISSIONS

3RD SEMESTER

MAX-201 Mathematics-II [3 1 0 4]

Linear dependence of vectors and rank of matrices, linear transformations and inverse of matrices, reduction to normal form, bilinear form and quadratic form, consistency and solution of linear algebraic system of equations, eigen values, eigen vectors and their applications to system of ordinary differential equations, Cayley Hamilton theorem, orthogonal, unitary, hermitian and similar matrices.

Differential calculus of functions of several variables, partial differentiation, homogeneous functions and Euler's theorem, Taylor's and Maclaurin's series, Taylor's theorem for functions of two variables, functions of several variables, Lagrange's method of multipliers.

Double and triple integrals, change of order of integration, change of variables, applications to evaluation of area, surface area and volume.

Scalar, and vector fields, differentiation of vectors, velocity and acceleration, vector differential operators Del, Gradient, Divergence and Curl and their physical interpretations, formulae involving these operators, line, surface and volume integrals, solenoidal and irrotational vectors, Green's theorem, Gauss divergence theorem, Stoke's theorem and their applications.

Formulation and classification of partial differential equations, solution of first order linear equations, standard forms of non-linear equations, Charpit's method, linear equations with constant coefficients, non-homogenous linear equations, Monge's method for non-homogenous equations of second order, separation of variables method for solution of heat, wave and Laplace equation.

Books Recommended

1. E Kreyszig, "Advanced Engineering Mathematics", 8th Ed., John Wiley, Singapore.
2. R K Jain and S R K Iyengar, "Advanced Engineering Mathematics", 2nd Ed., Narosa Publishing House, New Delhi.
3. I A N Sneddon, "Elements of Partial Differential Equations", Tata McGraw Hill, Delhi.
4. B S Grewal, "Higher Engineering Mathematics", Thirty-fifth edition, Khanna Publishers, Delhi.

EEX-201 Circuit Theory [3 1 0 4]

Network Analysis Techniques: Reciprocity Theorem, Milliman's Theorem, Telegen's Theorem and Maximum Power Transfer Theorem – Applications of Network Theorems to network analysis both with dc and ac inputs and magnetic coupling.

Applications of Laplace Transform: Introduction, some basic theorems, solutions of Linear Differential Equations for electric network-problems, partial fraction expansion-Heaviside's Expansion Theorem, The convolution Integral-evaluation; Application of Laplace Transform analysis of electrical circuits – Linear time invariant first and second order circuits. Zero input response, Zero state response and complete response. Impulse response of first and second order circuits, time varying circuits, Introduction to Fourier Transform.

Network Functions: Ports and terminal pairs, network functions, Poles and zeros, necessary conditions for driving point functions and transfer functions, Time domain behavior from pole-zero plot.

Two Port Networks: Introduction, Characterization of linear time invariant two port networks, Z-,Y-, h- and transmission parameters, Interrelationship between these parameters, Interconnection of 2-port networks, Image parameters, Attenuation and phase shift in symmetrical T- and π- networks.

Filters and Active Networks: Classifications of filters, Filter networks, pass band and stop band types, Constant k-low pass and high pass filters, Characteristics impedance and cut off frequency, m-derived filters.

Graph Theory and Network Equations: Introduction, graph of a network, trees, co-trees and loops, incidence matrix, Cut-set matrix, Tie-set matrix and loop currents, Analysis of networks using graph theory, duality, and general network transformations.

Network Synthesis: Introduction, Hurwitz polynomials, positive real functions, driving point and transfer impedance function, LC-network, synthesis of dissipative network, Two-terminal R-L network, Two-terminal R-C networks, Synthesis of R-L and R-C networks by Cauer and Foster – methods.

Books Recommended

1. Van-Valkenburg M E, "Network Analysis*",*Prentice Hall, New Delhi
2. Sudhakar, A, "Circuits and Networks", Tata McGraw-Hill
3. Hayt, W., "Engineering Circuit Analysis", Tata McGraw-Hill

Reference Books

4. Bell D A, "Electric Circuit," Oxford University press
5. Van-Valkenburg M E, "Introduction to Modern Network Synthesis", Wiley and Sons
6. Suresh Kumar," Introduction to Modern Network Synthesis", Dorling Kindsley

EEX-203 Electrical Measurement and Measuring Instruments [3 0 0 3]

Analog Measuring Instruments: Classification of analog instruments, operating forces in indicating instruments, T/W ratio, pointers and scales. Working principle, theory, construction and salient features of electromechanical indicating / registering instrument viz. PMMC, Electrodynamometer, Moving iron, Rectifier type, Induction type for the measurement of dc and ac voltage, current, power, energy (1-phase induction type wattmeter), power factor (single phase Electrodynamometer), Volt ohmmeter or multimeter.

Measurement of Resistances: Classification of resistances, measurement of medium resistance, Measurement of low resistance (Kelvin double bridge, Ammeter -Voltmeter) and Measurement of high resistance including loss of charge method and Mega ohm bridge method.

AC Bridges: General theory of ac bridge, Measurement of self inductance, Measurement of capacitance, Measurement of mutual inductance, Measurement of frequency, Sources of error in ac bridges and their minimization.

Potentiometer: Introduction to basic principle, Laboratory type Crompton's potentiometer, Dual range potentiometer, Volt ratio box, application of dc potentiometer, self balancing potentiometer.

Magnetic Measurement: Working principle and theory of Ballistic galvanometer, Measurement of flux density, Determination of B-H curve, hystereris loop, Ewing Double bar permeameter, Hopkinson permeameter, separation of iron losses by wattmeter and Bridge methods.

Instrument Transformers: Theory and construction of current and potential transformers, transformation ratio and phase angle errors and their minimization, effects of pf, secondary burden and frequency.

Cathode Ray Oscilloscope: Principle and working of CRO, Block diagram presentation of CRO and brief description of various elements of CRO – CRT, horizontal Deflecting system, Vertical deflecting system, CRO screen, Measurement of voltage, frequency and phase angle using CRO, CRO probes.

Books Recommended

1. Cooper W D, "Electronic Instrumentation and Measurement Techniques", Prentice Hall, New Delhi
2. Bell David A, "Electronic Instrumentation and Measurements", Prentice Hall, Inc, New Delhi

Reference Books

3. Reissland Martin V, "Electrical Measurements Fundamentals, Concepts, Applications", New Age International
4. Doebelin Ernest O, "Measurement Systems: Application and Design", Tata McGraw Hill Ltd., New Delhi
5. Wolf S and Smith R F M, "Student Reference Manual for Electronic Instrumentation Laboratories", Prentice Hall, New Delhi

ECX-251 Electronic Devices and Analog Integrated Circuits [3 1 0 4]

Introduction to Semiconductors: Semiconductors ,Conductor and Insulators, Intrinsic and extrinsic silicon, p-n junction, Current-Voltage characteristics of a p-n junction, the Diode, Rectifiers-half wave and full wave, Special purpose diodes - Zener diode, Tunnel diode and Varactor diode, Photo diode, clippers-single n two level, clampers, their analysis with ideal and practical diodes.

Bipolar JunctionTransistor: Transistors-construction, operation, characteristics, parameters, Transistor as an amplifier at low frequency, Hybrid model and re model of BJT, Analysis of amplifier using Hybrid model and re model, Amplifier types-CE,CB,CC. DC operating point, DC Biasing circuits-fixed bias, emitter bias, voltage divider bias, bias stabilization.

Field-EffectTransistor: The junction FET - construction, operation, characteristics, parameters, JFET as an amplifier, FET as a VVR and MOSFET- construction, operation, characteristics, parameters.

Power and Multistage Amplifiers: Power Amplifiers, Types, analysis of Class A, B,C,AB; Multistage Amplifiers, Types of multistage couplings.

Feedback Amplifier and Oscillators: Feedback concept, Analysis of various configurations of feedback in amplifiers, Criterion for oscillation and Oscillator based on RC and LC feedback circuits, crystal oscillator.

Introduction to op-amps: Op-amp- analysis, Ideal op-amp building blocks, Open loop op-amp configurations, Practical op-amp- Offset voltage, Input bias and offset current, CMRR, Block diagram representations and analysis of configurations using negative feedback. Applications of op-amp.

Specialized ICs: 555 Timer-Monostablemultivibrator, astablemultivibrator, PLL.

Books Recommended

1. Millman, Jacob, Halkias Christos C and Satyabratajit, "*Electronic Devices and Circuits*", Tata McGraw-Hill, New Delhi
2. Boylestad Nashelsky, "*Electronic Devices and Circuit Theory*", 8th Ed., Pearson Education, 7th Indian Reprint
3. Gayakwad Ramakant A, "*Op-amps and Linear Integrated Circuits*", Pearson Education, 4th Ed., New Delhi
4. Sedra, Adel S and Smith, Kenneth C, "*Microelectronic Circuits*", Oxford University Press, New York, Fourth Edition
5. Streetman Ben J, Sanjay Banerjee, "*SolidState Electronic Devices*", 5th Ed. PHI

HMX-201 Engineering Economics and Industrial Management [3 1 0 4]

Definition and Scope of Engineering Economics: Concept of revenue and costs, break-even analysis, Law of demand & supply, time value of money, present and future worth methods.

Decision Making: Decision making process, decision making under risk certainty, uncertainty and conflict.

Replacement and maintenance Analysis: Types of maintenance, determination of economic life of an asset, replacement of items that fail suddenly and that fail over a period of time.

Methods of depreciation: straight line method, sum-of-the year's digest method, declining balance method, sinking fund method and service output method of depreciation.

Inventory control: Introduction and objective of inventory control, purchase model with instantaneous replenishment, model with shortages, price break model, ABC analysis.

Forecasting: Demand forecasting by quantitative and qualitative techniques, applications of demand forecasting.

Make or Buy Decision: Criteria for make or buy, approaches for make or buy decision.

Value Engineering Analysis: Value analysis vs. value engineering function, aims and value engineering procedure, advantages & applications.

Linear Programming: Linear programming as a tool of decision making, graphical and Simplex Methods and applications in decision making.

Books Recommended

1. Panaeerselvam, R., "*Engineering Economics",* Prentice Hall of India: New Delhi
2. Smith G.W., "*Engineering Economics*", Iowa State Press: Iowa
3. Grant, E.L., Irevan, W.G. and Leanenworh, R.S., "Principles of Engineering Economy", Ronald Press: New York
4. Lee S.M. Moore and Taylor, "*Management Science*"
5. Jaha, H.A , "*Operations Research: An Introduction*", Prentice-Hall of India: New Delhi

CSX-207 Object Oriented Programming [3 0 0 3]

Object oriented thinking: Need for oop paradigm, A way of viewing world – Agents, responsibility, messages, methods, classes and instances, class hierarchies (Inheritance), method binding, overriding and exceptions, summary of oop concepts, coping with complexity, abstraction mechanisms.

Java Basics: History of Java, Java buzzwords, datatypes, variables, scope and life time of variables, arrays, operators, expressions, control statements, type conversion and costing, simple java program, classes and objects – concepts of classes, objects, constructors, methods, access control, this keyword, garbage collection, overloading methods and constructors, parameter passing, recursion, string handling.

Inheritance: Hierarchical abstractions, Base class object, subclass, subtype, substitutability, forms of inheritance- specialization, specification, construction, extension, limitation, combination, benefits of inheritance, costs of inheritance, Member access rules, super uses, using final with inheritance, polymorphism- method overriding, abstract classes.

Packages and Interfaces: Defining, Creating and Accessing a Package, Understanding CLASSPATH, importing packages, differences between classes and interfaces, defining an interface, implementing interface, applying interfaces, variables in interface and extending interfaces, Exploring packages – Java.io, java.util.

Exception handling and multithreading: Concepts of exception handling, benefits of exception handling, Termination or resumptive models, exception hierarchy, usage of try, catch, throw, throws and finally, built in exceptions, creating own exception sub classes. Differences between multi threading and multitasking, thread life cycle, creating threads, synchronizing threads, daemon threads, thread groups.

Event Handling: Events, Event sources, Event classes, Event Listeners, Delegation event model, handling mouse and keyboard events, Adapter classes, inner classes.The AWT class hierarchy, user interface components- labels, button, canvas, scrollbars, text components, check box, check box groups, choices, lists panels – scrollpane, dialogs, menubar, graphics, layout manager – layout manager types – boarder, grid, flow, card and grib bag.

Applets: Concepts of Applets, differences between applets and applications, life cycle of an applet, types of applets, creating applets, passing parameters to applets.

Swing: Introduction, limitations of AWT, MVC architecture, components, containers, exploring swing-JApplet, JFrame and JComponent, Icons and Labels, text fields, buttons – The JButton class, Check boxes, Radio buttons, Combo boxes, Tabbed Panes, Scroll Panes, Trees, and Tables.

Networking: Basics of network programming, addresses, ports, sockets, simple client server program, multiple clients, and Java .net package Packages – java.util.

Books Recommended

1. J.Nino and F.A. Hosch, “An Introduction to programming and OO design using Java”, John Wiley & sons
2. T. Budd, “An Introduction to OOP”, second edition, Pearson education
3. Y. Daniel Liang, “Introduction to Java programming 6th edition”, Pearson education
4. R.A. Johnson-Thomson, “An introduction to Java programming and object oriented application development”
5. Cay.S.Horstmann and Gary Cornell, “Core Java 2, Vol 1, Fundamentals”, seventh Edition, Pearson Education

EEX-221 Circuit Theory Laboratory [0 0 2 1]

1. To study resonance in circuits
2. To Verify Telegen's theorem
3. To verify Thevenin's Theorem and Norton Theorem for a given network
4. To verify maximum power transfer theorem and reciprocity theorem
5. To evaluate two-port parameters for a TTPN
6. To verify working of inter-connected two TTPNs
7. To evaluate transmission parameters of a ladder network
8. To plot current locus of R-L and R-C series circuits
9. a) To observe the response of a RLC circuit to a.c. input.
   b) Determining the phase shift between the applied voltage and current using Lissajous figures.
10. To find the Q of a coil by a series resonance method and verify it using Q meter.
11. a) To draw the characteristics of output voltage of a coupled circuit
    b) Determination of self and mutual inductances of a coupled circuit
12. To convert a four terminal network into a three terminal network (i.e. equivalent T network)
13. To design, fabricate and to obtain characteristics of a low pass T type filter
14. To design, fabricate and to obtain characteristics of a high pass T type filter
15. To design, fabricate and to obtain characteristics of a band pass T type filter
16. To design, fabricate and to obtain characteristics of a composite low pass filter
17. To design, fabricate and to obtain characteristics of a composite high pass filter
18. To design, fabricate and to obtain characteristics of a composite band pass filter
19. To obtain the response of a given network to step and impulse inputs and to verify the result
20. To obtain the impulse response and frequency response of a zero hold circuit
21. To study an active filter and to obtain characteristics in respect of Butterworth filter
22. To study Chebyshev filter and to realize it in both active and passive form

EEX -223 Electrical Measurement and Measuring Instruments Laboratory [0 0 2 1]

1. To measure amplitude and frequency of the signal using CRO (Y-t mode)
2. To measure frequency of an unknown signal and phase angle between two signals obtaining Lissajous pattern using a CRO
3. Measurement of medium resistance with the help of a Wheatstone Bridge
4. Measurement of low resistance with the help of a Kelvin Double Bridge
5. Measurement of high resistance using a Meggar
6. Measurement of capacitance and inductance by Maxwell's Bridge
7. Measurement of capacitance by Schering Bridge
8. Measurement of frequency by Wein's Bridge
9. To study potentiometer and to plot EMF Vs. Displacement characteristics of a potentiometer
10. To plot calibration curve for PMMC, Moving Iron and Electrodynamometer type of voltmeters
11. To measure power consumed by a 3-phase load and to find its power factor using 2-Wattmeter method
12. To plot calibration curve for a single phase energy meter
13. To find Q-factor of the coil using series resonance method and verify it using LCR-Q meter
14. To draw a B-H loop of toroidal specimen by the Fluxmeter
15. To measure iron losses in the magnetic specimen using Wattmeter method

ECX-271 Electronic Devices and Analog Integrated Circuits Laboratory [0 0 2 1]

1. To study bipolar transistor as a switch
2. To plot a load line for a CE amplifier and show effect of input signal on Q-point
3. To demonstrate use of a BJT in a CE amplifier circuit configuration and study its frequency response
4. To demonstrate use of a BJT in a CC amplifier circuit configuration and study its frequency response
5. To demonstrate and study a two stage RC coupled amplifier
6. To demonstrate working of a JFET and study its V-I characteristics
7. To demonstrate working of a Wein Bridge Oscillator
8. To demonstrate working of an op-amp as a voltage level detector
9. To demonstrate working of an op-amp as a square wave generator
10. To demonstrate the operation of a 555 timer as monostable multivibrator
11. To demonstrate the operation of a 555 timer as astablemultivibrator

CSX-227 Object Oriented Programming Laboratory [0 0 2 1]

Objectives:

- To make the student learn the object oriented way of solving problems.
- To teach the student to write programs in Java to solve the problems

1. a) Write a Java program that prints all real solutions to the quadratic equation ax2 + bx + c = 0. Read in a, b, c and use the quadratic formula. If the discriminant b2 -4ac is negative, display a message stating that there are no real solutions.
   b) The Fibonacci sequence is defined by the following rule:
   The fist two values in the sequence are 1 and 1. Every subsequent value is the sum of the two values preceding it. Write a Java program that uses both recursive and non recursive functions to print the nth value in the Fibonacci sequence.
2. a) Write a Java program that prompts the user for an integer and then prints out all prime numbers up to that integer.
   b) Write a Java program to multiply two given matrices.
   c) Write a Java Program that reads a line of integers, and then displays each integer, and the sum of all the integers (Use StringTokenizer class of java.util)
3. a) Write a Java program that checks whether a given string is a palindrome or not. Ex: MADAM is a palindrome.
   b) Write a Java program for sorting a given list of names in ascending order.
   c) Write a Java program to make frequency count of words in a given text.
4. a) Write a Java program that reads a file name from the user, then displays information about whether the file exists, whether the file is readable, whether the file is writable, the type of file and the length of the file in bytes.
   b) Write a Java program that reads a file and displays the file on the screen, with a line number before each line.
   c) Write a Java program that displays the number of characters, lines and words in a text file.
5. a) Write a Java program that:
      i) Implements stack ADT.
      ii) Converts infix expression into Postfix form
      iii) Evaluates the postfix expression
6. a) Develop an applet that displays a simple message.
   b) Develop an applet that receives an integer in one text field, and computes its factorial Value and returns it in another text field, when the button named “Compute” is clicked.
7. Write a Java program that works as a simple calculator. Use a grid layout to arrange buttons for the digits and for the +, -,*, % operations. Add a text field to display the result.
8. Write a Java program for handling mouse events.
9. a) Write a Java program that creates three threads. First thread displays “Good Morning” every one second, the second thread displays “Hello” every two seconds and the third thread displays “Welcome” every three seconds.
   b) Write a Java program that correctly implements producer consumer problem using the concept of inter thread communication.
10. Write a program that creates a user interface to perform integer divisions. The user enters two numbers in the textfields, Num1 and Num2. The division of Num1 and Num2 is displayed in the Result field when the Divide button is clicked. If Num1 or Num2 were not an integer, the program would throw a Number Format Exception. If Num2 were Zero, the program would throw an Arithmetic Exception Display the exception in a message dialog box.
11. Write a Java program that implements a simple client/server application. The client sends data to a server. The server receives the data, uses it to produce a result, and then sends the result back to the client. The client displays the result on the console. For ex: The data sent from the client is the radius of a circle, and the result produced by the server is the area of the circle. (Use java.net)
12. a) Write a java program that simulates a traffic light. The program lets the user select one of three lights: red, yellow, or green. When a radio button is selected, the light is turned on, and only one light can be on at a time No light is on when the program starts.
   b) Write a Java program that allows the user to draw lines, rectangles and ovals.
13. a) Write a java program to create an abstract class named Shape that contains an empty method named number Of Sides ( ).Provide three classes named Trapezoid, Triangle and Hexagon such that each one of the classes extends the class Shape. Each one of the classes contains only the method number Of Sides ( ) that shows the number of sides in the given geometrical figures.

b) Suppose that a table named Table.txt is stored in a text file. The first line in the file is the header, and the remaining lines correspond to rows in the table. The elements are seperated by commas. Write a java program to display the table using JTable component.

Books Recommended

1. H.M.Dietel and P.J.Dietel, “Java How to Program”, Sixth Edition,Pearson Education/PHI
2. Y.Daniel Liang, “Introduction to Java programming”, Sixth edition, Pearson Education
3. Cay Horstmann, “Big Java”, 2nd edition, Wiley Student Edition, Wiley India Private Limited

4TH SEMESTER

EEX-202 EMF Theory [3 1 0 4]

Electrostatics: Review of the fundamental postulates of Electrostatics in free space, Coulomb's Law, Gauss's Law and applications, Electric potential, Conductors and Dielectrics in static Electric Field, Electric flux density, boundary conditions for electrostatic fields, Capacitance and capacitors, Electrostatic energy and Forces, Poisson's and Laplace's Equations, Uniqueness of Electrostatic solutions, method of images.

Magnetostatics: Review of the fundamental postulates of magnetostatics in free space, vector magnetic potential, Biot-Savart Law and applications, magnetic Dipole, Magnetic field intensity and relative permeability, boundary conditions for Magnetostatic fields, magnetic forces and torques.

Time varying fields and Maxwell's Equations: Introduction, Faraday's law of Electromagnetic Induction, Maxwell's Equations.

Plane Electromagnetic Waves: Introduction, Plane waves in lossless media, plane waves in lossy media, Group velocity, Flow of Electromagnetic Power and the poynting Vector, Normal Incidence at a plane conducting boundary, Normal incidence at a plane dielectric boundary.

Transmission lines: Introduction, transmission line parameters, transmission line equations, input impedance, SWR, and Power, smith chart, microstrip transmission lines.

Waveguides: Introduction, rectangular waveguides, TM and TE modes, wave propagation in the guide, power transmission and attenuation, waveguide current and mode excitation, wave guide resonators.

Electromagnetic Interference and Compatibility: Introduction, source and characteristic of EMI, control techniques.

Books Recommended

Text Books

1. Hayt W H and J A Buck, “Engineering Electromagnetics”, Tata McGraw Hill Publishing
2. Edminister J A, “Schaum’s outline of theory and problems of Electromagnetics”, Tata McGraw Hill Publishing Co., New Delhi

Reference Books

3. Kraus J D, “Electromagnetics”, McGraw Hill,New York
4. Sadiku M N O, “Elements of Electromagnetics”, Oxford UniveristyPress
5. Jordon E C and K G Balmain, “Electromagnetic waves and radiating systems”, Prentice Hall, New Delhi

MAX-202 Mathematics-III [3 1 0 4]

Limit and derivative of a complex function, analytic functions and Cauchy Riemann equations, line integral of elementary functions, Cauchy's integral theorem, Cauchy's integral formula and derivatives of analytic functions, Taylor and Laurent series, zeros and singularities, residues and residue theorem, evaluation of real improper integrals, conformal mappings, linear fractional transformations and mappings by elementary functions

Series solution of differential equations, Bessel's differential equation and Bessel functions and their properties, differential equations reducible to Bessel's differential equation, Legendre's differential equation, Legendre's polynomials and their properties, Fourier-Legendre expansion of a function.

Fundamental concepts of calculus of variations, functional involving several independent functions, one end fixed- other end free problems, both end free problems, constrained extrema.

Books Recommended

1. Grewal, B S,"Higher Engineering Mathematics", KhannaPublishers, Delhi
2. Elsgole L E," Calculus of Variations ", 1961Pergamon Press ,Addison-Wisley Publishing Company
3. Conway J B, "Functions of One Complex Variables", Narosa Publishing House

EEX-204 Electrical Machines I [3 1 0 4]

Principle of Electromechanical Energy Conversion: Principle of energy conversion, singly and doubly excited magnetic system, Dynamic equations.

D C Generators: EMF equation, classification of D.C. generators, various characteristics, parallel operation of D.C Generators, Tests on Generators, Losses and Efficiency.

D C Motors: Construction and principle of operation, armature winding, torque equation, characteristics of d. c. motors and their applications, Braking and speed control, Brushless DC machines.

Transformers: Construction and working principle, type of single-phase transformer, concept of ideal transformer, emf equation, transformer on load, phasor diagram on no load and on load, equivalent circuit, O.C and S.C tests, Regulation and efficiency, Pulse transformer. Low, intermediate and high frequency response, Three Phase Transformers, Auto Transformer: Principle of operation, advantages, phasor diagram, equivalent circuit.

Three Phase Induction Motors: Construction and principle of operation, slip-torque equation, characteristics, phasor diagram at standstill and on load, equivalent circuit, No load and blocked rotor tests, methods of speed control, applications.

Speciality Motors: Construction and principle of operation, Double revolving field theory, types of single phase induction motor, equivalent circuit, phasor diagram, characteristics, hysteresis motor, reluctance motor, universal motor and their characteristics, applications.

Books Recommended

Text Books

1. Hubert C I, Electric Machines: Theory, Operating Applications, and Controls", Pearson Education
2. Nagrath I J and Kothari D P, "Electric Machines", Tata McGraw Hill

Reference Books

3. Say M G "Alternating Current Machines", ELBS
4. Mcpherson George, Laramore R D, "Introduction to Electric Machines and Transformers", John Wiley and Sons
5. Fitzegerald A F, Kingsley C and Umans S D, "Electrical Machinery", Tata- McGraw Hill

ECX-206 Digital Electronics [3 1 0 4]

Number Systems and Boolean Algebra: Number systems, Radix conversion, Complements 9's &10's, Subtraction using 1's & 2's complements, Binary codes, Error detecting and Correcting codes, Theorems of Boolean algebra, Canonical forms, Logic gates. Digital

Logic Families: Introduction to bipolar Logic families: RTL, DCTL, DTL, TTL, ECL and MOS Logic families: NMOS, PMOS, CMOS, Details of TTL logic family - Totem pole, open collector outputs, TTL subfamilies, Comparison of different logic families.

Combinational Logic: Representation of logic functions, Simplification using Karnaugh map, Tabulation method, Implementation of combinational logic using standard logic gates, Multiplexers and Demultiplexers, Encoders and Decoders, Code Converters, Adders, Subtractors, Parity Checker and Magnitude Comparator.

Sequential Logic Concepts and Components: Flip flops - SR, JK, D and T flip flops - Level triggering and edge triggering, Excitation tables - Counters - Asynchronous and synchronous type Modulo counters, design with state equation state diagram, Shift registers, type of registers, circuit diagrams.

D/A And A/D Converters: Weighted resistor type D/A Converter, Binary ladder D/A converter, Steady state accuracy test, D/A accuracy and resolution, Parallel A/D Converter, counter type A/D converter, Successive approximation A/D converter, Single and Dual slope A/D converter, A/D accuracy and resolution.

Semiconductor Memories: Memory organization, Classification, and characteristics of memories, Sequential memories, ROMs, R/W memories, Content Addressable memories, Charged-Coupled Device memory, PLA, PAL and Gate Array.

Books Recommended

1. Malvino and Leach "*Digital principles and Applications*", Tata McGraw Hill
2. Jain R P "*Modern Digital Electronics*", Tata McGraw-Hill
3. Mano M Morris, "*Digital Design*", Pearson Education
4. James W. Bignell and Robert Donovan, "*Digital Electronics*",Cengage Learning
5. Flecther "*An Engineering Approach to Digital Design*", Prentice Hall of India, New Delhi

EEX-206 Instrumentation [3 1 0 4]

Introduction: Generalized Measurement systems, Transduction principles, Classification of transducers, General transducers characteristics, Criteria for transducer selection.

Transducers: Resistive, Inductive, Capacitive, Elastic andOther types-Principles of operation, construction, theory, advantages, disadvantages and applications

Signal Conditioning: Concept of signal conditioning, Applications of AC/DC bridges in instrumentation, Op-amp circuits used in instrumentation, Instrumentation amplifiers, Signal filtering, averaging, correlation, interference, grounding, and shielding.

Data Transmission Systems: Definition, generalized block diagram of Telemetry system, classification of Telemetry system the working principle, block diagram, construction, salient features and applications of the following Telemetry systems: DC voltage, current and position telemetry system (Landline Telemetry system), Radio frequency amplitude modulated and frequency modulated telemetry system – theory related to amplitude and frequency modulation techniques, Pulse telemetry systems, Modem based telemetry system.

Display Systems: Construction, principle of operation and salient features of various kinds of display devices such as LED, LCD, single and multi digit LED 7-segmental display system (study of BCD to 7 segment code converter / decoder),to design LED Dot Matrix (3 x 5) numeric display system and LCD 7-segmental numeric display system.

Recorders: The working principle, construction, operation and salient features of X-t strip chart recorder, X-Y strip chart recorder.

Books Recommended

1. Kalsi H S, “Electronic Instrumentation”, Tata McGraw Hill
2. Patranabis D, “Sensors and Transducers”, PHI, New Delhi
3. Doebelin Ernest O,”Measurement Systems: Application and Design”, Tata McGraw Hill

Reference Books

4. Murty D V S, “Transducers & Instrumentation”, PHI, New Delhi
5. Tocci Ronald J, “Digital Systems Principles and Applications”, PHI, New Delhi
6. Bell David A, “Electronic Instrumentation and Measurement”, PHI, Inc, New Delhi
7. Mani and Rangan, “Instrumentation Devices and Systems”, Tata McGraw Hill, New Delhi

HMX-202 Entrepreneurial Development and Management [3 0 0 3]

Entrepreneurship Development: Meaning, objectives, scope & philosophy, type of entrepreneurs, factors affecting entrepreneurship, entrepreneurial qualities, need for promotion of entrepreneurship & small business, linkage between entrepreneurship and economic development, problem of increasing unemployment, creativity & entrepreneurship, harnessing locally available resources.

Entrepreneurship Support System: SIDBI, SISIs, SSIEC, SFCs, DICs, NSIC, EDI (Ahmedabad), NRDC, NIESBUD, PSIEC and Technical Consultancy Organisations.

Project Report Preparation: Planning a small scale industry, identifying business opportunities, project report & its importance, various contents of project report: managerial & entrepreneurial capabilities, socio-economic benefits, demand analysis, technical feasibility and financial viability.

Introduction to Marketing Management: Brief introduction to various types of product strategies, pricing strategies, channel strategies and promotional strategies.

Introduction to Production Management: Types of production systems, production planning and control, functions of production manager & materials management.

Introduction to Human Resource Management: Manpower planning, recruitment, selection, placement & induction, training & development, compensation.

Introduction to Financial Management: Sources of finance and working capital management.

Books Recommended

1. Prasanna Chandra, “Projects : Planning, Analysis, Selection, Implementation & Review”, Tata McGraw Hill
2. Kenneth R., Van Voorhis, “Entrepreneurship and Small Business Management”, Allyn& Bacon
3. Gupta C B, & Srinivasan N P, “Entrepreneurial Development”, Sultan Chand & Sons
4. Gopala Krishnan & V.E Rama Moorthy, “Project Management”, Macmillan India Ltd.
5. Jose Paul and Kumar Ajith N, “Entrepreneurship Development and Management”, Himalaya Publishers, New Delhi

EEX-224 Electrical Machines Laboratory [0 0 2 1]

1. To perform Ratio, Polarity and the Load Test on a Single Phase Transformer
2. To perform Open Circuit and Short Circuit Test on a Single Phase Transformer and hence determine its Equivalent Circuit Parameters
3. To perform Parallel Operation on two Single Phase Transformers
4. Speed Control of a DC Shunt Motor
5. To obtain Magnetization characteristics of

a) a separately excited DC Generator
b) a Shunt Generator

6. To obtain the load characteristics of
    a) a DC Shunt Motor
    b) a DC Cumulative Compound Generator
7. To perform no-load test and blocked rotor test on a three-phase induction motor and hence determine its equivalent circuit parameters
8. To perform load test on a three-phase induction motor and obtain its various performance characteristics
9. To perform the retardation test on a three phase induction motor and obtain its moments of inertia
10. To perform no-load and blocked-rotor test on a single phase induction motor and hence determine its equivalent circuit parameters
11. To study dc shunt motor starters.
12. To perform reversal and speed control of Induction motor.
13. Identification of different windings of a dc compound motor.

ECX-226 Digital Electronics Laboratory [0 0 2 1]

1. Verification of the truth tables of TTL gates, e.g., 7400, 7402, 7404, 7408, 7432, 7486.
2. Verify the NAND and NOR gates as universal logic gates.
3. Verification of the truth table of the Multiplexer 74150.
4. Verification of the truth table of the De-Multiplexer 74154.
5. Design and verification of the truth tables of Half and Full adder circuits.
6. Design and verification of the truth tables of Half and Full subtractor circuits.
7. Design and test of an S-R flip-flop using NOR/NAND gates.
8. Verify the truth table of a J-K flip-flop (7476)
9. Verify the truth table of a D flip-flop (7474)
10. Operate the counters 7490, 7493. Verify the frequency division at each stage and with a low frequency clock (say 1 Hz) display the count on LEDs.
11. Operate the universal shift register 74194.
12. Verify the truth table of decoder driver 7447/7448. Hence operate a 7 segment LED display through a counter using a low frequency clock.
13. Design and test D/A converter using R-2R Ladder Network.

EEX-226 Instrumentation Laboratory [0 0 2 1]

1. To measure displacement using an LVDT (linear variable differential transformer).
2. To measure the temperature using thermocouple and to plot variation of temperature with the voltage.
3. To measure the force using a full bridge strain gauge based transducer.
4. To measure the strain of a deflecting beam with the help of a strain gauge.
5. To measure speed-using proximity type sensor.
6. To measure temperature using a thermistor and to plot variation of resistance with temperature.
7. To study the recording of different signals from sensors on a magnetic tape recorders.
8. To study the acquisition data from strain gauge transducer using a data acquisition system.
9. To study the acquisition of data from inductive transducer using a data acquisition system.
10. To measure the vibrations of system using a piezoelectric crystal.
11. To study the performance of an LCD, LED, BCD to 7-segment display.
12. To measure a load using a load cell.
13. To study the characteristics of a given bourdon tube.

5TH SEMESTER

MAX-206 Numerical Methods [3 1 0 4]

Roots of algebraic and transcendental equations, Bisection Method, Regula – Falsi method, Newton – Raphson method, Bairstow's method and Graeffe's root squaring method.

Solution of simultaneous algebraic equations, matrix inversion and Eigen-value problems, triangularisation method, Jacobi's and Gauss-Siedel iteration method, partition method for matrix inversion, power method for largest Eigen-values and Jacobi's method for finding all Eigen-values.

Finite differences, interpolation and numerical differentiation, forward, backward and central differences, Newton's forward, backward and divided difference interpolation formulas, Lagrange's interpolation formula, Stirling's and Bessel's central difference interpolation formulas, numerical differentiations using Newton's forward and backward difference formulas and Numerical differentiations using Stirling's and Bessel's central difference interpolation formulas.

Numerical integration, Trapezoidal rule, Simpson's one-third rule and numerical double integration using Trapezoidal rule and Simpson's one-third rule.
Taylor's series method, Euler's and modified Euler's methods, Runge-Kutta fourth order methods for ordinary differential equations, simultaneous first order differential equations and second order differential equations.

Boundary value problems, finite difference methods for boundary value problems.Partial differential equations, finite difference methods for elliptic, Parabolic and hyperbolic equations.

Books Recommended

1. Sastry SS, Introductionary Methods of Numerical Analysis, Prentice Hall of India
2. Chapra SC and Canale RP, Numerical Methods for Engineers, McGraw Hill Book Company
3. Grewal, BS, "Numerical Methods", Khanna Publishers

EEX-301 Electrical Machines-II [3 1 0 4]

Polyphase Synchronous Machines: Constructional features. Polyphase Distributed AC Windings: Types, Distribution, coil span and winding factors. Excitation systems, emf equation and harmonic elimination.

Synchronous Generator: Interaction between excitation flux and armature mmf, equivalent circuit model and phasor diagram for cylindrical rotor machine. Salient pole machines: two reaction theory, equivalent circuit model and phasor diagram. Power angle equations and characteristics.Voltage regulation and affect of AVR.

Multi Machine Operation: Synchronizing methods, Parallel operation and load sharing, active and reactive power control, operation on infinite busbar. Analysis under sudden short circuit.Transient parameters. Motoring mode, Transition from motoring to generating mode, Phasor diagram, steady state operating characteristic, V-curves, starting, synchronous condenser, hunting –damper winding effects, speed control including solid state control.

Testing of Synchronous Machines: Stability considerations.Brushless generators, Single Phase generators.

Books Recommended

1. Nagrath IJ and Kothari DP, “Electric Machines,” Tata McGraw Hill
2. Bimbhra PS, “Electrical Machinery,”Khanna Publishers

Reference Books

3. Hubert CI, “Electric Machines: Theory, Operation, Applications, Adjustment, and Control,” Pearson Education India
4. Sarma MS and Pathak M, “Electrical Machines,”Cengage Learning India
5. Say, MG, “Alternating Current Machines”, ELBS.

EEX-303 Control System Engineering [3 1 0 4]

Introductory Concepts: Plant, Systems, Servomechanism, regulating systems, disturbances, Open loop control system, closed loop control systems, linear and non-linear systems, time variant and invariant, continuous and sampled-data control systems, Block diagrams, some illustrative examples.

Modeling: Formulation of equation of linear electrical, mechanical, thermal, pneumatic and hydraulic system, electrical, mechanical analogies. Use of Laplace transforms, Transfer function, concepts of state variable modeling. Block diagram representation, signal flow graphs and associated algebra, characteristics equation.

Time Domain Analysis: Typical test – input signals, Transient response of the first and second order systems. Time domain specifications, Dominant closed loop poles of higher order systems. Steady state error and coefficients, pole-zero location and stability, Routh-Hurwitz Criterion.

Root Locus Technique:The extreme points of the root loci for positive gain. Asympotes to the loci, Breakaway points, intersection with imaginary axis, location of roots with given gain and sketch of the root locus plot.

Frequency Domain Analysis: Closed loop frequency response, Bode plots, stability and loop transfer function. Frequency response specifications,Relative stability, Relation between time and frequency response for second order systems. Log. Magnitude versus Phase angle plot, Nyquist criterion for stability.

Compensation: Necessity of compensation, series and parallel compensation, compensating networks, applications of lag and lead-compensation.

Control Components: Error detectors – potentiometers and synchros, servo motors,AC and DC techno generators, Magnetic amplifiers.

Books Recommended

1. Nagrath IJ and Gopal M, “Control System Engineering”, Wiley Eastern
2. Ogata K, “Modern Control Engineering”, Prentice Hall

Reference Books

3. Kuo B C, “Automatic Control System”, Prentice Hall
4. Dorf RC and Bishop RH, “Modern Control System”, Addison-Wesley, Pearson
5. Stephanopoulos G, “Chemical Process Control”, Prentice Hall of India

EEX – 305 Generation of Electric Power [3 0 0 3]

Introduction: Energy sources and their availability, Principle types of power plants, their special features and application, present status and future trends.

Hydro Electric Power Plants: Essentials, Classifications, Hydroelectric survey, Hydrograph, Flow durations curve, Mass curve, Storage capacity, Site selection, Plant layout, Various components, Types of turbines, Governor and speed regulation, Pumped storage, Small scale hydro-electric plants.

Steam Power Plant: General developing trends, Essentials, Plant layout, Coal –Its storage, Preparation, Handling, Feeding and burning, Ash handling, dust collection, High pressure boilers and steam turbines, super heaters, economizers, Pre-heaters etc., Fuel efficiency/heat balance.

Gas Turbine Power Plants: Field of use, Components, Plant layout, Comparison with steam power plants, Combined steam and gas power plants.

Nuclear Power Plants: Nuclear fuels, Nuclear energy, Main components of nuclear power plant, Nuclear reactors types and applications, Radiation shielding, Radioactive and waste disposal safety aspect.

Performance and operation of Power Plants: Selection of type of generation, Performance and operating characteristics of power plants, Economic Scheduling principles, Load curves, Effect of load on power plant design, Methods to meet variable load, Load forecasting, electric tariffs. Theory of peak load pricing, Theory of issues of real time pricing comparison of public supply and private generating units, Power factor improvement.

Books Recommended

1. Deshpande MV, Power Plant Engineering, Tata McGraw Hill
2. Wood AJ, and Wollenberg BF, Power Generation and Control, John Wiley

Reference Books

3. Pansini AJ, Guide to Electric Power Generation, CRC Press
4. Grigsby LL, Electrical Power Generation Transmission and Distribution, CRC Press
5. Singh SN, Electric Power Generation Transmission and Distribution, Prentice Hall of India.

EEX – 307 Transmission and Distribution of Electric Power [3 1 0 4]

Introduction: Generation, Transmission and Distribution, Various supply systems, Comparison based on copper Efficiency.

Distribution System: Primary and secondary distribution systems, Radial, ring-main and network distribution systems, Distribution Voltage, Choice of conductor size for distributors, Distribution sub stations – types and location, main equipments in distribution sub-station, Supporting structures for distribution lines, Voltage drop and power loss calculations.

Over Head Transmission Lines: Overhead and Underground – transmission, conductor, materials, solid stranded, ACSR, hollow and bundle conductors, different types of supporting structures and tower for OH-lines, Transmission line parameters – calculation of inductance and capacitance of single and double circuit transmission lines, 3-Phase with stranded and bundle conductors, Generalized ABCD – constants, Transposition of OH-conductors.

Performance of Transmission Lines: Short transmission lines – voltage drop, regulation and efficiency calculations. Medium transmission Lines – Nominal – T and π-solution for voltage drop, regulation and efficiency. Long Transmission Lines – current and voltage relations, ABCD – constants, charging current and Ferranti effect.

Mechanical Design of Overhead Lines: Sag and stress calculations, Wind and Ice loads stringing chart and Sag Templates, elementary idea about conductor vibrations.

Insulators of Overhead Lines: Insulator materials, types of insulators, Voltage distribution over an insulator string, string efficiency, equalizing voltage drops across insulators of a string.

Underground Cables: Insulating materials, types of LV and HV – Cable, 3-core solid, oil filled and gas pressure cables, grading of cables, sheath and dielectric loss in cables, elementary idea about cable breakdown, thermal considerations and current rating of cables, cable laying and jointing.

Books Recommended

1. Wadhwa CL, “Electric Power Systems”, Wiley Eastern
2. Nagrath, IJ and Kothari DP “Modern Power System Analysis”, Tata McGraw Hill

Reference Books

3. Cottan H and Barber H “Transmission and Distribution of Electric Energy”, B I Publishing
4. Stevenson WD, Elements of Power System Analysis” McGraw Hill
5. Elgerd O I, “Electric Energy System – An Introduction” Tata McGraw Hill

EEX-361 Operations Research [3 0 0 3]

Section Nature and development of Operations Research: some mathematical preliminaries, OR and managerial decision making, OR applications in industrial and non-industrial fields.
Linear Optimization Models: formulation of linear programming problem, graphical solution, sensitivity analysis in graphical solution, comparison of graphical and simplex algorithm, simplex algorithm, computational procedure in simplex, penalty method, two phase method, degeneracy, duality and its concept, application of LP model to product mix and production scheduling problems.

The transportation model: solution methods, balanced and unbalanced problems, Vogel's approximation method, degeneracy in transportation problems. Assignment problem, methods for solving assignment problems. The traveling sales man problem. Numerical on transportation, assignment and traveling salesman method.Computer algorithms for solution to LP problems.

Dynamic programming problems: model formulation, computational procedures, solution in different stages. Decision making under conditions of risk, assumed certainty.

Waiting line models: queuing systems and concepts, various types of queuing situations, single server queues with poison arrivals and exponential service times, finite queue length model, industrial applications of queuing theory.

Simulation: advantages and limitations of the simulation technique: generation of random numbers, Monte Carlo simulation, computer-aided simulation, applications in maintenance and inventory management.

Books Recommended:

1. Taha HA, "Operations Research - An Introduction", Prentice Hall
2. Hillier, FS, "Operations Research", CBS Publishers & Distributors

Reference Books

3. Wagner HM, "Principles of Operations Research", Prentice Hall
4. Mustafi CK, "Operations Research", New Age International

EEX-363 System Modeling and Reliability [3 0 0 3]

System Models and Studies: Concept of a system, system Environment, stochastic Activities, continuous and discrete systems, systems modeling, types of models, Principles used in Modeling, system Analysis & design.

System Representation: Introduction, Block diagram presentation, Standard Block – Diagram, Signal flow graphs, Determination of overall system response using Block diagram and Signal flow for the various inputs. System Equations: Introduction, Electric circuits and components, Basic linear algebra, state concept, Mechanical Translation system, analogous circuits, Mechanical rotational system.

Probability concepts in simulation: Stochastic variables, discrete probability functions, continuous probability functions, Measures of probability. Functions, numerical evaluation of continuous probability functions, Estimation of mean variances, and Correlation, Random number generator and Properties of Random Numbers.

System Simulation: Step in simulation study, techniques of simulation, comparison of simulation and analytical methods, Experimental Nature of simulation, types of system simulation, Numerical computation Technique for continuous models, Numerical computation technique for Discrete models, Distributed lag models, Real Time Simulation, Selection of Simulation Software, Simulation Packages, Trends in simulation software.

Introduction to system Reliability: Reliability, MTTF, MTBF, failure data analysis, hazard rate, System reliability using: - series configuration, parallel configuration, mixed configuration, Markov model, fault tree analysis. Reliability improvement and maintainability. Case studies using soft computing algorithm.

Books Recommended

1. Nagrath IJ and Gopal M, “System Modeling and Analysis,” Tata McGraw-Hill
2. Srinath LS, “Reliability Engineering,” East West Press Reference Books

Reference Books

3. Gorden G, “System Simulation,” Prentice Hall
4. Law AM and Kelton WD, “Simulation Modeling and Analysis,” Tata McGraw-Hill
5. Banks J, Carson JS, Nelson BL and Nicol DM, “Discrete Event System Simulation,” Prentice Hall

EEX-365 Computer Organization and Architecture [3 0 0 3]

Introduction: Historical overview, economic trends, underlying technologies, Data Representation- Data Types, Complements, Fixed-Point Representation, Floating-Point Representation, Error detection and correction, Addition, subtraction, multiplication and division algorithms and hardware.

Computer Performance: The metrics of performance, popular performance metrics, Comparing and summarizing performance- Transaction Processing Benchmarks.

Arithmetic Logic Unit: Arithmetic, logic and shift micro operations, Constructing an arithmetic logic shift unit.

Basic Computer Architecture and Design: Computer registers, Computer Instructions-Instruction Set Completeness, Classifying Instruction Set Architecture, Basic steps of Instruction Execution, Hardwired control, Micro programmed Control, Horizontal and Vertical Microprogramming, Interrupts.

Central Processing Unit: General Register Organization, Stack Organized CPU, Instruction Formats, Addressing Modes, Data Transfer and Manipulation, RISC Vs CISC.

Pipelining: Parallel and pipeline Processing, Pipeline Control, Pipeline Implementations, Conflicts Resolution, and Pipeline Hazards. Vector Processing, and Array Processors.

Memory Organization: Memory Systems: principle of locality, principles of memory hierarchy Caches, associative memory, main memory, Virtual memory, Paging and Segmentation, Memory Interleaving.

Input Output Organization: I/O performance measures, types and characteristics of I/O devices, I/O Modes-Programmed I/O, Interrupt Initiated I/O and DMA. Buses: connecting I/O devices to processor and memory, interfacing I/O devices to memory, processor, and operating system.

Parallel Computers: Classification, SIMD, MIMD Organizations, Connection Networks, Data Flow Machines, and Multithreaded Architectures.

Books Recommended

1. Mano MM, “Computer System Architecture”, Pearson Education
2. David A Patterson and John L. Hennessy, “Computer Organization & Design-The Hardware/Software Interface”, Morgan Kaufmann

Reference Books

3. Stallings W, “Computer Organization and Architecture, Designing for Performance”, Pearson Education Asia
4. Jordan HF and Alaghband G, “Fundamentals of Parallel Processing”, Pearson Education
5. Wilkinson B and Allen M, “Parallel Programming”, Prentice Hall

EEX-321 Electrical Machines -II Laboratory [0 0 2 1]

At least 8 experiments are to be performed out of the following list:

1. No-load short-circuit and ZPF tests on a synchronous machine. Determination of voltage regulation at specified load by i) EMF ii) MMF iii) Potier's method iv) ASA methods and comparison of results.
2. Load-angle characteristic and comparison with theoretically predicted results.
3. V-curves and inverted V-curves of synchronous machines. Comparison with predicted characteristics.
4. Synchronization of three phase alternator with infinite bus bar. Study of variation of excitation and mechanical power input on performance.
5. Slip-test, short circuit and lagging current tests on a salient pole machine and determination of armature parameters. Estimation of voltage regulation at specified loads using Blondel‟s method. Comparison with results from load test.
6. Sudden short circuit test and determination of Xd, Xd‟, Xd„„ and machine time constants.
7. Determination of XI, X2, X0 by fault simulation methods.
8. Study of Automatic Voltage Regulators (AVR) and switch over from grid to stand alone mode.

The list of experiments given above is only suggestive. The Instructor may add new experiments as per the requirement of the course.

EEX-323 Control System Engineering Laboratory [0 0 2 1]

At least 8 experiments are to be performed out of the following list:

1. To study the characteristics of potentiometer and to use it as an error detector in a control system
2. To study the synchro Transmitter-Receiver set and to use it as an error detector
3. To study the Speed – Torque characteristics of an AC Servo Motor
4. To study the Speed – Torque characteristics of an DC Servo Motor
5. To study the various electro-mechanical transducers i.e. resistance, capacitance, inductive transducers
6. To study a LVDT (AC-AC, DC-DC) as a transducer and its processing circuits
7. To study the characteristics of a thermocouple, a thermistor and a RTD
8. To study photo-conductive cell, semi-conductor photodiode and a silicon photo voltaic cell
9. To study a silicon phototransistor and obtain response of photo conductive cell
10. To study the variations of time lag by changing the time constant using control engineering trainer
11. To simulate a third order differential equations using an analog computer and calculate time response specifications
12. To obtain the transfer function of a D.C. motor – D.C. Generator set using Transfer Function Trainer
13. To study the speed control of an A.C. Servo Motor using a closed loop and an open loop systems
14. (i)To study the operation of a position sensor and study the conversion of position in to voltage
    (ii) To study the PI control action and show its usefulness for minimizing steady state error
15. To measure Force / Displacement using Strain Gauge in a wheat stone bridge

The list of experiments given above is only suggestive. The Instructor may add new experiments as per the requirement of the course.

6TH SEMESTER

PHX-301 Material Science (Nano Science) [3 1 0 4]

Crystal Structure: Fundamental concepts, Crystal systems, Closed packed structures, Crystallographic planes and directions, Miller indices, Crystal defects.

Electrical Properties: Classical free electron theory of metals, Quantum theory – Particle in a box, Wave function and energy states, Finite potential barrier, Tunneling, Fermi-Dirac distribution law, Density of energy states, Classification of solids into conductors, Semiconductors and insulators, Hall effect and its applications.

Semiconductor Materials: Intrinsic and extrinsic materials, Electron and hole concentrations at equilibrium, Temperature dependence of carrier concentrations, Conductivity and mobility.

Magnetic Properties: Basic concepts, Soft and hard magnetic materials, Ferrites, Selection techniques for applications, Magnetic recording, Magnetic memories.

Superconductivity: Properties of superconductors, London equations, Quantum explanation of superconductivity, Applications of superconductors.

Dielectric & Optical Properties: Dielectric materials, Polarization mechanisms, Dipole moment, Dielectric strength, Methods for producing polarization, Application of dielectric materials, Index of refraction, Damping constant, Characteristic penetration depth and absorbance, Reflectivity and transmissivity, Optical storage devices.
Nano materials: Introduction to nanotechnology, Nanowire and nanotube, Carbon nanotubes, Single wall carbon nanotubes, Multiwall carbon nanotubes, Fabrications, Properties and applications.

Books Recommended

1. Hummel RE, “Electronic Properties of Materials”, Narosa Publishing House,
2. Callister WD, ,“Materials Science and Engineering”, John Wiley and Sons, Inc.

Reference Books

3. Dekker AJ, “Solid State Physics”, MacMillan, India Limited
4. Pillai SO, “Solid State Physics”, New Age International Publishers
5. VanVlack LH, “Elements of Material Science and Engineering”, Addison-Wesley Publishers
6. Poole CP and Owens FJ, “Introduction to Nanotechnology”, Wiley Edition

EEX- 304 Power System Analysis [3 1 0 4]

Introduction: Need of system planning and operational studies, basic components of power system, Introduction to restructuring, Single line diagram, per phase and per unit analysis, Generator, transformer, transmission line and load representation for different power system studies, Primitive network – construction of Y-bus using inspection and singular transformation methods, Z-bus.

Power flow analysis: Importance of power flow analysis in planning and operation of power systems, statement of power flow problem, classification of buses, development of power flow model in complex variables form, iterative solution using Gauss-Seidel method, Q-limit check for voltage controlled buses, power flow model in polar form, iterative solution using Newton-Raphson method.

Fault analysis of balanced faults: Importance of short circuit analysis, assumptions in fault analysis, analysis using Thevenin's theorem, Z-bus building algorithm, fault analysis using Z-bus, computations of short circuit capacity, post fault voltage and currents.

Fault analysis of unbalanced faults: Introduction to symmetrical components, sequence impedances, sequence circuits of synchronous machine, transformer and transmission lines, sequence networks analysis of single line to ground, line to line and double line to ground faults using Thevenin's theorem and Z-0bus matrix.
Stability analysis: Importance of stability analysis in power system planning and operation- classification of power system stability, angle and voltage stability, Single Machine Infinite Bus (SMIB) system: Development of swing equation, equal area criterion, determination of critical clearing angle and time, solution of swing equation by modified Euler method and Runge-Kutta fourth order method.

Books Recommended

1. Kothari DP and Nagrath IJ, "Modern Power System Analysis", Tata McGraw Hill
2. Wadhwa CL, "Electrical Power Systems", New Age International Publication

Reference Books

3. Elgerd OI, "Electric Energy Systems Theory: An Introduction", Tata McGraw Hill
4. Gainger JJ and Steveson WD "Power System Analysis", McGraw Hill
5. Kundur P, "Power System Stability and Control", McGraw Hill
6. Kimbark EW, "Power System Stability, Vol. I : Elements of Stability Calculations", Johns Wiley & Sons

EEX-306 Microprocessors and Applications [3 0 0 3]

Introduction to 8-Bit Microprocessor: General 8-bit Microprocessor and its architecture – Intel 8085 Microprocessor, Pin Configuration, CPU Architecture, Registers, ALU Control Unit, Stack.

Microprocessor Instruction Set (INTEL 8085): Complete instruction set of INTEL 8085, instruction format, types of instructions, various addressing modes, Timing diagrams – T-states, machine cycles, instruction cycle.

Assembly Language Programming: Programming of Microprocessors using 8085 instructions, use of Arithmetic, logical, Data transfer, stack and I/O instructions in programming, Interrupt in 8085.

Peripherals and Interfacing for 8085 Microprocessors: Memory interfacing, I/O interfacing – memory mapped and peripheral mapped I/O, Data transfer schemes – Programmed, Interrupt driven and Direct memory Access (DMA) data transfers, Block diagram representation, Control word formats, modes and Simple programming of 8255A PPI, 8254 Programmable Interval Timer, Interfacing of Data converters (A/D & D/A), Serial I/O and data communication

Introduction to 8086 Microprocessors: Architecture of 8086, block diagram, register set, flags, Queuing, concept of segmentation, Pin description, operating modes, addressing modes and interrupts.

Pentium Microprocessors: Introduction to Pentium processors

Books Recommended

1. Gaonkar R S, “Microprocessor architecture, programming and application with 8085”, Wiley
2. Ram B, “Fundamentals of Microprocessors and Microcomputers”, DhanpatRai and Sons

Reference Books

3. Liu Yu-Cheng, “Microcomputer Systems”, The 8086/8088 family,” Prentice Hall.
4. Mathur AP, ”Introduction to Microprocessors”,Tata McGraw Hill.
5. Ray AK and Bhurchandi KM. “Advanced Microprocessor and peripherals: Architecture programming and interfacing”, Tata McGraw Hill.

EEX-308 Power Electronics [3 1 0 4]

Power Semi-Conductor Devices: Study of switching devices, Frame, Driver and Snubber circuit of SCR, TRIAC,BJT, IGBT, MOSFET, Turn-on and turn-off characteristics, switching losses, Commutation circuits for SCR.

Phase-Controlled Converters: 2-pulse, 3-pulse and 6-pulse converters, Effect of source inductance, performance parameters, Reactive power control of converters, Dual converters, Battery charger.

DC to DC Converter: Step-down and step-up chopper, Time ratio control and current limit control, Buck, boost, buck boost converter, concept of Resonant switching, SMPS.

Inverters: Single phase and three phase (both 1200 mode and 1800 mode) inverters, PWM techniques: Sinusoidal PWM, modified sinusoidal PWM, multiple PWM,

AC to AC Converters: Single phase AC voltage controllers, Multi-stage sequence control, single and three phase cyclo-converters,

Books Recommended

1. Rashid MH, “Power Electronics: Circuits, Devices and Applications,” Pearson Education.
2. Krein PT, “Elements of Power Electronics,” Oxford University Press.

References Books

3. Ahmed A, “Power Electronics for Technology, Pearson Education,” Indian reprint.
4. Bimbra PS, “Power Electronics” Khanna Publishers.
5. Mohan N, Undeland TM, Robbins WP, “Power Electronics: Converters, Applications and Design,” John Wiley.

EEX-362 Smart Sensors and Sensor Networking [3 0 0 3]

Review of Basic Concepts: Measurement system, transducers, sensors and actuators; signal conditioners; data communications and networking.

Basics of Smart Sensors: Definition and architecture of smart sensor; different levels of integration in small sensors, differences between smart, intelligent and network sensors; advantages of smart sensors ;smart actuators and transmitters.

Smart Sensor Technologies: IC Technologies: thick film, thin film and monolithic IC technologies; Micro-machining processes: materials for micro-machining, wafer bonding, bulk and surface micromachining, other micro-machining techniques.

Examples of Smart Sensors: Principles, characteristics and constructional details of typical smart sensors for temperature, humidity, pressure and vibrations.

Basics of Sensor and Actuator Networking: Field-level, controller-level and enterprise-level networks; Sensor and actuator network (SAN): Network topologies; seven-layer OSI model of communication system.

Wired Network Protocols: RS-422, RS-485, HART and Foundation Fieldbus protocols, comparison with Ethernet (IEEE – 802.3) protocol.

Wireless Network Protocols: Need and advantages of wireless sensor and actuator network(WSAN); Zigbee (IEEE – 802.15.4) protocol, Merits of Zigbee over WiFi (IEEE – 802.11) and Bluetooth for sensor and actuator networking.

IEEE Standard 1451: Introduction to IEEE Standard 1451: “Smart Transducer Interface for Sensors and Actuators”; highlights of parts 1451.1, 1451.2, 1451.3, 1451.4 and 1451.5 of the Standard.

Books Recommended

1. Patranabis D, “Sensors and Transducers,” Prentice Hall
2. Frank Randy, “Understanding Smart Sensors,” Artech House

Reference Books

3. Callaway EH, “Wireless Sensor Networks : Architecture and Protocols,” CRC Press
4. Anand MMS, “Electronic Instruments and Instrumentation Techniques,” Prentice Hall
5. William S, “Data and Computer Communications,” Pearson Education
6. IEEE Standard 1451, “Smart Transducer Interface for Sensor and Actuators,” IEEE Press

EEX-364 Advanced Control Systems [3 0 0 3]

State Space Analysis of Continuous System: Review of state variable representation of continuous system, conversion of state variable models to transfer function and vice-versa, solution of state equations and state transition matrix, controllability and observability, design of state observer and controller.

Analysis of Discrete System: Discrete system and discrete time signals, state variable model and transfer function model of discrete system, conversion of state variable model to transfer function model and vice-versa, modeling of sample-hold circuit, solution of state difference equations, steady state accuracy, stability on the z-plane and Jury stability criterion, bilinear transformation, Routh-Hurwitz criterion on rth planes.

Stability: Lyapunov's stability theorems for continuous and discrete systems, methods for generating Lyapunov function for continuous and discrete system, Popov's criterion.

Nonlinear System: Types of non linearities, phenomena related to non - linear systems. Analysis of nonlinear systems-Linearization method, second order non-linear system on the phase plane, types of phase portraits, singular points, system analysis by phase-plane method, describing function and its application to system analysis.

Optimal Control: Introduction, formation of optimal control problem, calculus of variations minimization of functions, constrained optimization. Pontryagin's Minimum Maximum Principle, Linear Quadratic Problem-Hamilton Jacobi equation, Riccati equation and its solution.

Adaptive Control: Introduction, modal reference adaptive control systems, controller structure, self-tuning regulators.

Books Recommended

1. Gopal M, "Digital Control and State Variable Methods," Tata McGraw-Hill
2. Kirk DE, "Optimal Control Theory: An Introduction," Prentice Hall
3. Khalil HK, "Non-linear Systems", Prentice Hall

Reference Books

1. Astron KJ, "Adaptive Control", Dover Publications
2. Kuo BC, "Digital Control Systems," Oxford University Press
3. Ogata K, "Modern Control Engineering," Prentice Hall
4. Houpis CH and Lamont GB, "Digital Control Systems: Theory, Hardware, Software," McGraw-Hill

EEX-366 PLC, DCS and SCADA [3 0 0 3]

Computer Based Control: Implementing control system using computer or microprocessor; computer based controller: hardware configuration and software requirements.

Distributed Control System: Meaning and necessity of distributed control; hardware components of DCS; DCS software.

Introduction Programmable Logic Controller (PLC): PLC versus microprocessor/ microcontroller/ computer, advantages and disadvantages of PLC, architecture and physical forms of PLC.

Basic PLC functions: Registers: holding, input and output registers; Timers and timer functions; counters and counter functions

Intermediate PLC functions: Arithmetic functions: addition, subtraction, multiplication, division and other arithmetic functions; Number comparison and conversion.

Data Handling Functions of PLC: Skip function and applications; master control relay function and applications; jump with non-return and return; data table, register and other move functions.

Bit Functions of PLC: Digital bit functions and applications; sequencer functions and applications.

Advanced Functions of PLC: Analog input and output functions, analog input and output modules, analog signal processing in PLC; PID control function, network communication function.

PLC programming: PLC programming languages, ladder programming, mnemonic programming and high level language programming.

SCADA: Supervisory control versus distributed control; Layout and parts of SCADA system, detailed block schematic of SCADA system; Functions of SCADA system: data acquisition, monitoring, control, data collection and storage, data processing and calculation, report generation; MTU: functions, single and dual computer configurations of MTU; RTU: functions, architecture / layout; MTU-RTU communication and RTU-field device communication.

Books Recommended

1. Johnson CD, “Process Control Instrumentation Technology,” Prentice Hall
2. Chemsmond CJ, “Basic Control System Technology,” Viva Books

Reference Books

3. Webb JW and Reis RA, “ Programmable Logic Controllers” Prentice-Hall India
4. Hackworth JR and Hackworth FD, “ Programmable Logic Controllers,” Pearson Edition
5. Boyer SA, “Supervisory Control and Data Acquisition (SCADA), International Society of Automation

EEX-326 Microprocessors and Applications Laboratory [0 0 2 1]

At least 8 experiments are to be performed out of the following list:

1 a) Familiarization with the 8085 kit (trainer kit)
b) To execute at least 8 programs on the above kit.
2 a) Familiarization with the 8085 kit (trainer-cum-development)
b) To execute at least 5 program on the above kit.
3. Study of 8155 card
4. Study of 8212 card
5. Study of 8255 card
6. Study of 8253 card
7. Study of 8251 card
8. Study of latch, buffer, decade, RAM study card.
9. Study of 8257/8237 DMA control study card.
10. Study of DC motor study card.
11. Study of traffic control study card.
12. Study of A to D and D/A converter.
13. Familiarization with 8086 trainer kit

The list of experiments given above is only suggestive. The Instructor may add new experiments as per the requirement of the course.

EEX-328 Power Electronics Laboratory [0 0 2 1]

Note: At least 8 experiments are to be performed.

1. Study the performance of single-phase half-wave and full-wave uncontrolled rectifiers.
2. Study different firing circuits of SCR.
3. Study forced commutation circuits of SCR.
4. Study protection circuits of SCR: (i) dv/dt (ii) di/dt (iii) Over voltage (iv) Over current
5. Study the characteristics of a Thyristor and a TRIAC.
6. Study firing circuit of SCR using ramp-comparator scheme.
7. Study firing circuit of SCR using cosine-wave scheme.
8. Study firing circuit of SCR using Op-amps and Gates.
9. Study digital firing circuit of SCR.
10. Study operation of TRIAC in all four modes and study AC phase control using TRIAC.

The list of experiments given above is only suggestive. The Instructor may add new experiments as per the requirement of the course.

7th SEMESTER

EEX-401 Power System Protection and Switchgear [3 1 0 4]

Circuit Breakers: Fault Clearing time of a circuit breaker, Arc Voltage, Arc Interruption, Restriking Phenomenon, Restriking Voltage and Recovery voltages, Current Chopping and Resistance Switching, Interruption of capacitive current, Circuit breaker rating Fuse, H.R.C. fuse, Isolators**,** Description and Operation of following types of circuit breakers: Oil Circuit breakers, Air Blast Circuit Breakers, Vacuum and SF6 circuit breaker, Comparative merits and demerits.

Relays: Principle and operation of Electromagnetic and Induction type Relays, Relay settings, Directional, Distance, Differential, Overcurrent and Earth-fault Relays, Static Relays, Numerical Relays/IEDs, Device Numbers.

Generator Protection: Protection of generators against stator faults, Rotor faults, Overvoltage and Over-speed protection, Protection against Motoring and vibration, Generator Management Relays.

Transformer Protection: Differential Protection, Protection CTs and Accuracy class, Buchholtz relay, Transformer Management Relays.

Neutral Grounding: Grounded and Ungrounded Neutral Systems, Effects of Ungrounded Neutral on system Performance, Methods of Neutral Grounding and Grounding Practices.

Over-voltage Protection: Causes of overvoltage, Lightning phenomena, Klydonograph and magnetic Link, Protection of Transmission lines against Direct Lightning Strokes, Protection of station and substation from Direct Strokes, Protection against Travelling Waves, Peterson Coil, Insulation Coordination, Basic Impulse Insulation Level (BIIL).

Recommended Books:

1. Sunil S Rao “Switchgear and Protection”, Khanna Publlishers
2. Badari Ram, D.N Viswakarma “Power System Protection and Switchgear”, TMH Publications

Reference books:

1. Paithankar and S.R. Bhide “Fundamentals of Power System Protection” ,PHI.
2. C R Mason “Art & Science of Protective Relaying”, Wiley Eastern Ltd.
3. C.L.Wadhwa “Electrical Power Systems”, New Age international (P) Limited,
4. B.L.Soni, Gupta, Bhatnagar, Chakrabarthy “A Text book on Power System Engineering”, Dhanpat Rai & Co.

EEX-403 Power System Operation and Control [3 1 0 4]

Introduction: General characteristics of modern power systems, evolution, structure, power system control, operating states of a power system and control strategies, economic load dispatch, function and applications, price based unit commitment problem.

Hydro-thermal Scheduling: Optimal scheduling of Hydro-thermal System, Hydroelectric power plant models, scheduling problems, Short-term hydro-thermal scheduling problem.

Modeling of Turbine, Generator and Automatic Controllers: Modeling of Turbines: First order Turbine model, Block Diagram representation of Steam Turbines and Approximate Linear Models. Modeling of Generator (Steady State and Transient Models), Simplified Network Model of a Synchronous Machine (Classical Model).

Modeling of Governor: Mathematical Modeling of Speed Governing System, Derivation of small signal transfer function. Modeling of Excitation System, Fundamental Characteristics of an Excitation system, Transfer function, Block Diagram Representation of IEEE Type-1 Model, Power system stabilizer.

Load Frequency Control: Single area control – Block diagram representation of an isolated power system – Steady state analysis – Dynamic response – Uncontrolled case, Load frequency control of 2-area system – uncontrolled case and controlled case, tie-line bias control, Proportional plus Integral control of single area and its block diagram representation, steady state response – Load Frequency Control and Economic dispatch control.

Reactive Power Control: Overview of Reactive Power control – Reactive Power compensation in transmission systems – advantages and disadvantages of different types of compensating equipment for transmission systems; load compensation – Specifications of load compensator, Uncompensated and compensated transmission lines: shunt and Series Compensation.

Recommended Books:

1. C.L.Wadhwa “Electrical Power Systems” , Newage International
2. I.J.Nagrath & D.P.Kothari “Modern Power System Analysis” Tata M Graw

Reference books:

1. J.Duncan Glover and M.S. Sarma “Power System Analysis and Design”., THOMPSON,
2. O.I.Elgerd “Electric Energy systems Theory”, Tata Mc Graw-hill Publishing Company Ltd.,
3. Grainger and Stevenson “Power System Analysis”, Tata McGraw Hill.
4. Hadi Saadat “Power System Analysis” TMH
5. P Kundur “Power System Stability and Control”, McGraw Hill

EEX-461 Embedded Systems [3 0 0 3]

Introduction &Architecture of 8051 Microcontroller: Review of architecture and instruction set of 8085 microprocessor. Overview of 8051 architecture. CISC & RISC processors.

8051 Instructions: Addressing modes, data transfer arithmetic and logical instructions. Bit instructions, jump, loop and call instructions. Time delay using instructions.

Programming of 8051 Microcontroller: Input/output port programming, Timer/counter programming for different modes. Serial communication and programming for different modes.
Programming of interrupts and priority of interrupts; power down mode programming; programming in C language.

Interfacing to8051 Microcontroller: Interfacing of 7 segment display, LCD and keyboard.Interfacing of DC motor, stepper motor and relay. Interfacing of ADC, DAC and sensors.

Advanced Topics: On board buses for embedded systems-I^2C & SPI; real time tasks and types, real time systems, real time operating systems. Hardware software co-design, embedded product development lifecycle management. Introduction to PIC and ARM microcontrollers.

Text Books

1. Mazidi MA, Mazidi JG and Mchinlay RD, “The 8051 Microcontroller and Embedded Systems using assembly and C,” Pearson Education
2. Das LB, “Embedded Systems: An integrated approach,” Pearson Education

Reference Books

3. Morton TD, “Embedded Microcontrollers,” Pearson Education
4. Valvano JW, “Embedded Microcomputers Systems: Real Time Interfacing,” Cengage Learning India
5. Ram B, “Advanced Microprocessors and Interfacing,” Tata McGraw-Hill
6. Rajkamal, “Microcontrollers: Architecture, Programming, Interfacing and System Design,” Pearson Education
7. Ray AK and Bhurchavdi KM, “Advanced Microprocessors and Peripherals: Architecture, Programming and Interfacing,” Tata McGraw-Hill

EEX-463 Renewable Energy Resources [3 0 0 3]

Introduction: Energy Sources and their availability, renewable energy sources, Prospects of renewable energy sources, application of non-conventional and renewal energy sources, smart grid.

Environmental Aspects of Electric Energy Generation: Introduction Thermal pollution, Atmospheric pollution, Effects of Hydroelectric projects, Nuclear power generation and environment, Green House Gas Effects, Global Environmental awareness, Energy options for Indian Economy.

Solar Energy: Solar radiation estimation, Basic Principle of Solar Energy physical Principal of the conversion of solar radiation into heat, Collectors, Solar Energy storage system, solar thermal electric conversion, solar electric Power Plant & applications.

Wind Energy: Basic Principle of wind energy conversion, nature & Power of wind, site selection, wind energy conversion SYSTEM. Scheme for Electric Generation, Generator Control load control, Inter connected SYSTEM & applications.

Small Hydro Power: General description, classification of schemes, siting and economic considerations, system components: weir/intake channel, desilting tank, forbay, spillway, penstock, turbine, generator, governor, control.

Biomass Energy: Biomass conversion technologies bio mass generation, classification of Bio Gas Plants material used in Bio Gas Plants., Selection of site & applications.

Geothermal Energy: Sources of Geothermal energy Estimation of Geothermal Power, Geothermal Power Plants, Geothermal energy in India and Prospects.

Ocean Energy: Ocean thermal electric conversion, site selection, Power Plant, Prospects of ocean energy in India, tidal Power tidal Power Plant, Prospects in India.

MHD & Hydrogen Energy: Basic Principle MHD SYSTEM, advantages, Power OUTPUT of MHD Generation, future Prospects. Principle and classification of fuel cell energy, hydrogen as alternative fuel for Generation of Electrical Energy & applications.

Fuel Cell: Fuel Cell, Management of Fuel, Thermonic power generation, water Resource Electricity deviend scenario storage and handling,

Introduction to smart grid

Recommended Books:

1. D.P Kothari, K.C. Singla, Rakesh Ranjan “Renewable Energy Sources and Emerging Technologies” PHI Publications.
2. G.D. Rai “NON-Conventional energy Sources” Khanna Publications.
3. Abbari, “Renewal energy sources and their environmental aspects”: PHI
4. Dr. S.L. Uppal “Electric Power” Khanna Publications

Reference Books:

1. Jain &Bala Subramanyam “Power Plant Engineering”

EEX-465 Soft Computing Techniques [3 0 0 3]

Introduction: History of development in neural networks, neural network characteristics, Artificial neural network technology, Model of a neuron, topology, learning, types of learning, supervised, unsupervised and reinforcement learning.

Supervised Learning: Basic hop field model, the perceptron, linear reparability, Basic learning laws, Hebb's rule, Delta rule, Widroff and Huff LMS learning rule, correlation learning rule, In star and out star learning rules. Unsupervised learning, competitive learning, K mean clustering algorithm, Kolwner's feature maps.

Radial Basis Function: Basic learning laws in RBF network, recurrent networks, recurrent back propagation, Real time recurrent learning algorithm.

Counter Propagation Networks: Introduction to counter propagation networks, CMAC networks, ART networks, Application of neural networks, pattern recognition, optimization, associative memories, vector quantization, control.

Fuzzy Logic: Basic concepts of fuzzy logic, Fuzzy logic crisp set, Linguistic variable, Membership functions, Operation of fuzzy set, Fuzzy IF-THEN rules, Variable inference techniques, Defuzzification techniques, Basic fuzzy inference algorithm, Application of fuzzy logic, Fuzzy system design, Implementation of fuzzy system, Useful tools supporting design.

Support Vector Machines: Introduction, Support Vector classification, Support Vector regression, applications.

Basics of Genetic Algorithms: Evolution of Genetic and Evolutionary Algorithms, Applications.

Text Books

1. Berkin R and Trubatch, "Fuzzy System Design Principles, "Prentice Hall
2. Cristianini N and Taylor JS, "An Introduction to Support Vector Machines (and other Kernel – based learning methods)," Cambridge University Press

Reference Books

3. Kosko B, "Nueral Networks and Fuzzy Logic," Prentice Hall
4. Haykin S, "Neural Networks," Pearson Education
5. Anderson JA, "An Introduction to Neural Networks," Prentice Hall
6. Jang JRS, Sun CT and Mizutani E, "Neuro-Fuzzy and Soft Computing – A Computational Approach to Learning and Machine Intelligence," Pearson Education
7. Sivanandam S and Deepa SN, "Principles of Soft Computing," Wiley India

EEX-467 Utilization of Electrical Energy and Electric Traction [3 0 0 3]

Illumination Engineering: Nature of light, definitions, units, basics laws of illumination, determination of luminous flux, Light sources and their characteristics, Photometry-Photovoltaic & photo emissive cell, incandescence and fluorescence, sources of light- filament lam, halogen lamp, discharge lamp, fluorescent lamp, incandescent lamp, arc lamp and their applications, Direct lighting and mixed reflection, reflection factor, transmission factor, refractors, Flood lighting and calculations, street lighting, exterior and interior lighting, Design of choke and capacitor.

Electric Heating & Welding: Advantages of electric heating, resistance heating, types of furnaces, types of heating materials, temperature control of furnaces, variable voltage supply, design of heating element, arc furnace, induction heating, dielectric heating, microwave oven, Electric Welding, Resistance Welding, Electric arc welding

Electric Traction: Introduction, general features, track specification, arrangement of locomotive drives, transmission of power from motor to driving wheel. Mechanics of train movement, speed-timecurves, tractive effort for acceleration and propulsion, power and energy output from drivingaxis.

Traction motors – DC shunt motors, DC series motor, AC series motor, three phase induction motor, series and parallel operation with unequal and equal wheel diameters, effect of sudden change in supply voltage, temporary interruption of supply, tractive effort and horse power, DC series motor control, AC series motor control, three phase induction motor control, Multiple unit control, Braking of electric motors, recent trends in solid state speed control methods.

Refrigeration and Air-Conditioning: Control of temperature - basic wiring diagram - simple heat load and motor calculations. Air-conditioning - function of complete air conditioning system - type of compressor motor and fan motor-wiring diagram for a typical air conditioning unit.

Recommended Books

1. S. C. Tripathy, “Electric Energy Utilisation and Conservation”, Tata McGraw Hill,
2. W. F. Stocker and J. W. Jones, “Refrigeration & Air Conditioning”, McGraw Hill,
3. C. L. Wadhwa, “Generation, Distribution and Utilization of Electrical Energy”, New Age
4. N. V. Suryanarayana, “Utilisation of Electric Power”, Wiley Eastern Ltd.,
5. M. Prasad, “Refrigeration and Air Conditioning”, Wiley Eastern Ltd

EEX-469 Electrical Machine Design [3 0 0 3]

DC Machine design- Main dimensions, output equation, specific electrical loading, specific magnetic loading, torque developed, choice of number of poles, Armature reaction-mmf distribution, shape of mmf wave, saturation and brush shifting, methods to reduce armature reaction. Commutation-commutator design. Magnetic circuit- mmf, reluctance, slot and ventilating ducts, apparent and real flux, flux density in teeth, calculations Field coil Armature winding- types, lap and wave, numbering, number of slots, equalizer connections, symmetry of commutator winding, layout Starters.

Transformer Design: Output equation, design of core, yoke and windings, overall dimensions, computation of no load current, voltage regulation and design of cooling systems.

Induction Motor Design- Main dimensions, output equation, specific electrical loading, specific magnetic loading, air gap, winding-layout, Calculation of magnetizing current, no laod current. Leakage reactance calculations- specific slot permeance, significance, semi-closed rectangular slot, inductance calculations, rotor bar current calculation, semi-closed round slot, reactance/slot and slot reactance per phase. Eddy current loss ratio, Rotor bar currents- slip ring induction motor, squirrel cage induction motor, current distribution, cage rotor resistance, transformation ratio, rms value of rotor bar current, ring current, copper losses, equivalent cage resistance.

Synchronous Motor Design- Main dimensions. Harmonic calculations- pitch factor, distribution factor, winding factor, mmf wave, armature reaction, design considerations to reduce harmonics, Cooling design-cooling system, cooling media, calculations, AC Windings- three phase windings, single layer windings, doube layer windings, fractional slot winding.

Computer aided design: Philosophy of computer aided design, advantages and limitations. Computer aided design approaches analysis, synthesis and hybrid methods. Concept of optimization and its general procedure. Flow charts for design of transformer, dc machines, three phase induction and synchronous machines.

Recommended Books

1. Balbir Singh, Electrical Machine Design, Vikas Publishing House, New Delhi.
2. M.G. Say, “Performance and Design of A.C. Machines”, CBS Publishers.
3. A. K. Sawhney, Electrical Machine Design”, Dhanpat Rai and sons
4. Murthy,Vishnu “Computer aided design for electric machines” BSP Hyderabad

Reference Books:

1. S.K. Sen, “Principle of electrical machines design” Oxford and IBH.
2. Ghosh, Samarjeet. “Electrical Machines” Pearson Education

EEX-471 Computer Networks [3 0 0 3]

Introduction: Uses of Computer Networks, Network Hardware and Software, OSI, TCP/IP Reference Models, Networking Terminology, Internet Evolution**.**

Ethernet Technology: IEEE Standard, Switched Ethernet, fast Ethernet, Gigabit Ethernet, Logical link control Retrospectives on Ethernet.

ATM Networks: Introduction, Reference Model, Routing and Addressing, ATM Signalling, ATM Switching Overview,ATM Traffic Management& Congestion, SS7.

Wireless Networks: Introduction, Wireless LANs, IEEE 802.11 Standard, Physical Layer, MAC sub Layer, 802.11 Frame Structure and Services, ad-hoc networks: Introduction, Proactive and Reactive protocols- AODV, DSR and TORA, performance issues- Quality of Service (QoS).
Bluetooth Technology, Bluetooth Architecture and Applications, Protocol Stack, Radio layer, Baseband Layer, L2CAP Layer, Frame Structure.

Broad Band Wireless Networks: IEEE 802.16 Standard, Comparison of 802.11 with 802.16, 802.16 Protocol Stack, 802.16 Physical Layer, 802.16 MAC sub Layer Protocol, 802.16 Frame Structure and Services.

Sensor Networks: Introduction, topology and Applications

Recommended Books

1. Tananbum AS, “Computer Networks, ”Pearson Education
2. Forouzan BA, “Data Communication and Networking,” Tata McGraw Hill

Reference Books

3. Peterson LN and Davie BS, “Computer Networks: A system approach,” Elsevier
4. Walrand J and Varaiya P, “High Performance Communication Networks,” Morgan Kauffman
5. Vasseure JP, Picavet M and Demeester P, “Network Recovery Protection and Restoration of Optical, SONET-SDH, IP and MPLS,” Elsevier
6. Stalling William, “Wireless communication and networks,” Pearson Education

EEX-421 Power System Laboratory [0 0 2 1]

At least 8 experiments are to be performed out of the following list:

1. To develop a computer program to solve the set of non-linear load flow equations using G-S load flow algorithm.
2. To develop a software program to obtain real and reactive power flows, bus voltage magnitude and angles by using N – R method.
3. To become proficient in the usage of software in solving load flow problems using Fast decoupled load flow method.
4. Program to read and print out the power system load flow data of 5 BUS – IEE 14 Bus and IEEE 30 Bus systems.
5. To develop a computer program to carry out simulation study of a symmetrical three phase short circuit on a given power system.
6. To develop a program to transient stability of a given power system.
7. To develop a program for solving economic dispatch problem without transmission losses for a given load condition using direct method and Lambda-iteration method.
8. To develop a Simulink model of single-area and two-area load frequency control of power system.
9. To develop a computer program to obtain the building algorithm for bus impedance matrix of the given power system.
10. To measure ABCD parameters of a transmission line and calculate its efficiency at various loads.
11. To plot the trip time characteristics of over voltage relay (microprocessor based) on testing kit.
12. To plot the trip time characteristics of under voltage relay (microprocessor based) on testing kit.
13. To plot the characteristics of an over current relay (Inverse Type CDG) for plug setting of 2.5A and 5A and TMS of 0.6 and 1.0.
14. To study the Negative phase sequence protection scheme on testing kit.
15. To find the string efficiency
    (A). Without the guard ring,
    (B). With guard ring.
16. To measure zero sequence components of line current in a 3-phase, 4 wire system.
17. To measure (PPS and NPS) sequence components of supply voltage by segregating networks and verify graphically.
18. To measure earth resistance with the help of digital earth resistance tester.

The list of experiments given above is only suggestive. The Instructor may add new experiments as per the requirement of the course.

EEX-400 Major Project (Part-I) [0 0 4 2]

EEX-405 Seminar [0 0 4 2]

EEX-407 Training [0 0 0 4]

8th SEMESTER

EEX-402 Digital Signal Processing [3 1 0 4]

Introduction: Classification of systems: Continuous, discrete, linear, causal, stable, dynamic, recursive, time variance; classification of signals: continuous and discrete, energy and power; mathematical representation of signals; spectral density; sampling techniques, quantization, quantization error, Nyquist rate, aliasing effect. Digital signal representation.

Discrete Time System Analysis: Z-transform and its properties, inverse Z-transforms; difference equation – Solution by Z-transform, application to discrete systems - Stability analysis, frequency response – Convolution – Fourier transform of discrete sequence – Discrete Fourier series.

Discrete Fourier Transform & Computation: DFT properties, magnitude and phase representation - Computation of DFT using FFT algorithm – DIT & DIF - FFT using radix 2 – Butterfly structure.

Design of Digital Filters: FIR & IIR filter realization – Parallel & cascade forms. FIR design: Windowing Techniques – Need and choice of windows – Linear phase characteristics. IIR design: Pole-zero placement, Impulse-invariant, matched z-transform and bilinear transformation methods.

Digital Signal Processors: Introduction – Architecture – Features – Addressing Formats – Functional modes - Introduction to Commercial Processors.

Applications of Digital Signal Processing to solve problems in the power system.

Recommended Books:

1. Proakis JG and Manolakis DG, “Digital signal processing,” Pearson Education India
2. Ifeacher EC and Jerris BW, “Digital signal processing - A practical approach,” Pearson Education

Reference Books:

1 Chen C-T, “Digital signal processing - Spectral computation and filter design,” Oxford University
2 Ambardar A, “Digital signal processing - A modern introduction,” Cengage Learning
3 Lyons RG, “Understanding Digital Signal Processing,” Pearson Education

EEX-404 Electric Drive & Control [3 1 0 4]

Introduction: Electric drives, Requirement of electric drives, fundamental torque equation, speed torque converter and multi quadrant operation, equivalent values of drive parameters, concept of load torque, calculation of time and energy loss in transient operation, steady state stability and load equalization

Control of Electric Drive: Closed loop control of drives, current limit control, closed loop torque control, closed loop speed control, closed loop speed control of multi motor drives, phase locked loop controller (PLL), closed loop position control.

DC Drives: Single-phase half controlled and fully controlled converter fed dc motor drives, operation of dc drives with continuous armature current, voltage and current waveforms; Concept of energy utilization and effect of free-wheeling diode; Operation of drive under discontinuous current, expression for speed-torque characteristic, Chopper controlled dc drives, motoring operation of chopper fed separately excited dc motor, Chopper controlled of Series motor, steady state analysis of drive with time-ratio control.

AC Drives: Variable voltage, rotor resistance and slip power recovery control of induction motors, torque-speed characteristic sunder different control schemes; Variable frequency control of induction motor, analysis of induction machine under constant V/f operation, Inverter fed AC Drives, Voltage source inverter fed induction motor drive in open loop, frequency and voltage control in PWMVSI; Current source inverter Control, advantage of CSI fed drives, scalar control, vector control, sensor-less control.

Brushless DC Drive: Self- control, CSI with load commutation, low speed commutation, inverter control strategies and performance.

Switched Reluctance Motor Drive System: Construction, principle of operation, advantages, disadvantages, characteristics, closed loop control, applications.

Recommended Books:

1. Dubey G. K., “Fundamentals of Electric Drives”, 2nd Ed., Narosa Publishing House
2. Bose B. K., “Power Electronics and Variable Frequency Drives”, IEEE Press, Standard Publisher Distributors.

Reference Books:

2. Pillai S. K., “A First Course in Electric Drives”, 2nd Ed., New Age International Private Limited.
3. Sen P. C., “Thyristor DC Drives”, John Wiley and Sons.
4. Dubey G. K., “Power Semiconductor Controlled Drives”, Prentice Hall International Edition.
5. Murphy J. M. D. and Turnbull F. G., “Power Electronics Control of AC Motors”, Peragmon Press.

EEX-462 Flexible AC Transmission System [3 0 0 3]

Fundamentals of ac power transmission: Transmission problems and needs - emergence of FACTS-FACTS control considerations - FACTS controllers

Principles of shunt compensation: Variable Impedance type & switching converter type -Static Synchronous Compensator (STATCOM) configuration - characteristics and control

Static Series Compensators: Principles of static series compensation using GCSC, TCSC and TSSC: applications -Static Synchronous Series Compensator (SSSC)

Static Voltage and Phase Angle Regulators: Principles of operation-Steady state model and characteristics of a static voltage regulators and phase shifters - power circuit configurations

UPFC: Principles of operation and characteristics - independent active and reactive power flow control - comparison of UPFC with the controlled series compensators and phase shifters

Stability Analysis: Modeling of FACTS devices, optimization of FACTS, transient and dynamic stability enhancement

Recommended Books

1. Song, Y.H. and Allan T. Johns, 'Flexible AC Transmission Systems (FACTS)', Institution of Electrical Engineers Press, London,
2. Hingorani ,L.Gyugyi, 'Concepts and Technology of Flexible AC Transmission System', IEEE Press, New York, 2000 ISBN –078033 4588.
3. Mohan Mathur R. and Rajiv K.Varma , 'Thyristor - based FACTS controllers for Electrical transmission systems', IEEE press, Wiley Inter science
4. Padiyar K.R., 'FACTS controllers for Transmission and Distribution systems' New Age International Publishers.
5. Enrique Acha, Claudio R.Fuerte-Esqivel, Hugo Ambriz-Perez, Cesar Angeles-Camacho ' FACTS – Modeling and simulation in Power Networks' John Wiley & Sons

EEX-464 Energy Audit and Management [3 0 0 3]

Energy Scenario: Commercial and Non-commercial energy, primary energy resources, commercial energy production, final energy consumption, Indian energy scenario, Sectorial energy consumption (domestic, industrial and other sectors), energy needs of growing economy, energy intensity, long term energy scenario, energy pricing, Energy security, energy conservation and its importance, energy strategy for the future, Energy Conservation Act 2001 and its features.

Basics of Energy its various forms and conservation: Electricity basics – Direct Current and Alternative Currents, electricity tariff, Thermal Basics-fuels, thermal energy contents of fuel, temperature and pressure, heat capacity, sensible and latent heat, evaporation, condensation, steam, moist air and humidity and heat transfer.

Evaluation of thermal performance: calculation of heat loss – heat gain, estimation of annual heating & cooling loads, factors that influence thermal performance, analysis of existing buildings setting up an energy management programme and use management – electricity saving techniques.

Energy Management & Audit: Definition, energy audit, need, types of energy audit. Energy management (audit) approach-understanding energy costs, 3.1 Bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel and energy substitution, energy audit instruments and metering

Financial Management: Investment-need, appraisal and criteria, financial analysis techniques simple payback period, return on investment, net present value, internal rate of return, cash flows, risk and sensitivity analysis; financing options, energy performance contracts and role of Energy Service Companies (ESCOs)

Energy Monitoring and Targeting: Defining monitoring & targeting, elements of monitoring & targeting, data and information-analysis, techniques – energy consumption, production, cumulative sum of differences (CUSUM). Energy Management Information Systems (EMIS) Energy Efficiency.

Thermal Utilities and systems: Energy efficiency in thermal utilities like boilers, furnaces, pumps and fans , compressors, cogeneration (steam and gas turbines), heat exchangers ,lighting system, Motors belts and drives, refrigeration system.

Heat Recovery and Co-generation: Heat recovery from ventilation, air co-generation of heat and electricity, heat recovery and bottoming cycles.

Recommended Books:

1. W. F. Kenny, “Energy Conservation In Process Industry”.
2. AmlanChakrabarti, “Energy Engineering and Management”, Prentice hall
3. CB Smith, “Energy Management Principles” , Pergamon Press, New York
4. Hand outs New Delhi, Bureau of energy efficiency
5. W. C. Turner, “Energy Management Hand Book”.John Wiley and sons

EEX-466 High Voltage Engineering [3 0 0 3]

Breakdown in Gases: insulating media, Ionization processes, Electron avalanche, Townsend's criterion for breakdown, streamer theory of breakdown, Gaseous discharge in uniform field, Paschen's law, Breakdown in non-uniform field, corona discharges, effect of polarity on corona & breakdown voltage. Corona in transmission lines, Empirical formulae for corona loss, Methods of reducing corona loss.

Dielectrics Liquid Dielectrics: conduction & breakdown in pure liquids and commercial liquids, Methods for determination of breakdown strength. Factors affecting dielectric strength of liquids

Solid Dielectrics: -Breakdown mechanism, Intrinsic breakdown, Electromechanical breakdown, thermal breakdown, breakdown of solid dielectric in practice, Breakdown due to treeing & tracking, breakdown due to the internal discharges.

Generation of high voltages: Generation of high D.C. voltages, half wave & full wave rectifier circuits, Voltage doublers and multiplier circuits Van De Graff generators, Electro-static Generators, Generation of high alternating voltages, cascade transformers, Resonant transformer, Generation of impulse voltages, Standard impulse wave shapes, Analysis of model, Multistage Impulse generator, Marx circuit, Tripping & control of Impulse generators.

Measurement of high Voltages: Measurement of high AC and DC voltages by micro ammeter, Resistance and potential divider, series Impedance voltmeter, series capacitance voltmeter capacitance potential dividers & capacitance voltage transformers, Resistance potential dividers, Generating voltmeters, Electrostatic voltmeter, Spark gap for measurement of high D.C., A.C. & impulse voltages, Potential divider for impulse voltage measurements, CRO for impulse voltage measurements.

High Voltage Testing of Electrical Apparatus: Test on insulators, Dry & wet flash Over tests & withstand tests, Impulse flash over & withstand voltage test, High voltage tests on cables Impulse testing of transformers. Non-Destructive Testing: Measurement of dielectric constant & loss factor, High voltage Schering Bridge, Partial Discharge Measurements.

Recommended Books:

1. M.S. Naidu &V.Kamraju"High Voltage Engineering", TMH Pbs.
2. KuffelE "High Voltage: Engineering fundamentals"; Butterworth-Heineman,

Reference Books:

1. RavindraArora,"High voltage Insulation Engineering", New Age International.
2. Dr.R.S.Jha"High Voltage Engineering" Dhanpat Rai & Sons.
3. Wadhawa, C.L. "High Voltage Engineering" Wiley Eastern Ltd, New Age Ltd,
4. R.D. Begamudre"Extra High Voltage A.C. Transmission Engineering" Wiley Eastern Limited.

EEX-468 High Voltage Transmission System [3 0 0 3]

Basic Concepts: Historical development of HVDC, Limitations and advantages of EHVAC and DC transmission, classification of DC links, Applications, Ground Return, Economic factors, future of HVDC transmission.

Converter Operation (Normal and Abnormal): 6-pulse and 12- pulse rectifiers and inverters; Equivalent circuits of rectifier and inverter, relations between ac and dc quantities.

EHVAC Transmission System: Sequence impedance calculation, calculation of transmission line parameters and sequence impedances for lines with ground returns, lines with bundle conductors and ground returns, sequence networks for various three phase transformer connections.

Reactive Power Compensation: Basic concepts of reactive power compensation, principles of series and shunt compensation; Improvement of system performance due to reactive power compensation.

HVDC Transmission System: Brief history of HVDC transmission system, comparison with EHVAC transmission, analysis of converter circuits for HVDC transmission, HVDC control system: CIA, CC and CEA control, analysis of faults in HVDC converters, basic concepts of multi-terminal HVDC system.

Selection of HVDC Converter, six pulse Converters, cascade converters, basic principle of HVDC protection. Analysis of 3-phase.Bridge Converter, 3-phase.Bridge inverter, HVDC link and Converter control, characteristics, Analysis of HVDC link performance.

Converter Fault & Protection: Converter faults – protection against over current and over voltage in converter station – surge arresters – smoothing reactors – DC breakers –Audible noise-space charge field-corona effects on DC lines-Radio interference.

Harmonics and Filters: Characteristic and non-characteristic harmonics, input harmonics, output harmonics, problems due to harmonics, ac and dc filters.

Recommended Books:

1. K.R.Padiyar “HVDC Power Transmission Systems: Technology and system Interactions”, New Age International (P) Limited,.
2. S.Rao “EHVAC and HVDC Transmission Engineering and Practice”
3. Begamudre R. D., “Extra High Voltage AC Transmission Engineering”, 3rd Ed., New Age International Private Limited.

Reference Books:

1. J.Arrillaga “HVDC Transmission”
2. E. W. Kimbark “Direct Current Transmission”, John Wiley & Sons.
3. E. Uhlmann “Power Transmission by Direct Current”, B.S. Publications
4. Ulmann E., “Power Transmission by Direct Current”, Springer- Verlag.

EEX-470 Power System Deregulation [3 0 0 3]

Deregulation of the Electricity Supply Industry: Background of deregulation and the current situation, Benefits from a competitive Electricity Market, After effects of Deregulation.

Power System Operation in Competitive Environment: Role of Independent System operator, Operational Planning activities of ISO, operational planning activities of Genco.

Transmission open Access and Pricing Issues: Power Wheeling, Transmission Open Access, Cost component in Transmission, Pricing of Power Transmissions, Security Management in Deregulated environment, Congestion management in Deregulation.

Reliability and Deregulation: Reliability Analysis, Optimal Power Flow as a Basic Tool, Unit Commitment, Formation of Power Pools.

Recommended Books

1. Lei Lee Lal, “Power System Restructuring and Deregulation”. UK: John Wiley and Sons,
2. Kankar Bhattacharya, Math H.J.Bollen and Jaap E. Daalder, “Operation of Restructured Power Systems”. USA: Kluwer Academic Publishers, 2001.
3. MdShahidehpour and MuwaffaqAlomoush,“Restructured Electrical Power Systems”. Marcel Dekker, Inc.
4. S.S. Rao, “Switch Gear Protection and Power System Analysis”. Khanna Publications

EEX-472 Smart Grid [3 0 0 3]

Introduction: Smart Grid, Working definitions of Smart Grid and Associated Concepts –Smart Grid Functions-Traditional Power Grid and Smart Grid –New Technologies for Smart Grid –Advantages –Indian Smart Grid –Key Challenges for Smart Grid.

Smart Grid Architecture: Components and Architecture of Smart Grid Design –Review of the proposed architectures for Smart Grid. The fundamental components of Smart Grid designs –Transmission Automation –Distribution Automation –Renewable Integration
Tools and Techniques for Smart Grid: Computational Techniques –Static and Dynamic Optimization Techniques –Computational Intelligence Techniques –Evolutionary Algorithms –Artificial Intelligence techniques.

Distribution Generation Technologies: Introduction to Renewable Energy Technologies –Micro grids –Storage Technologies –Electric Vehicles and plug –in hybrids –Environmental impact and Climate Change –Economic Issues.

Communication Technologies and Smart Grid: Introduction to Communication Technology –SynchroPhasor Measurement Units (PMUs) –Wide Area Measurement Systems (WAMS).

Control of Smart Power Grid System: Load Frequency Control (LFC) in Micro Grid System –Voltage Control in Micro Grid System –Reactive Power Control in Smart Grid. Case Studies and Test beds for the Smart Grids.

Reference Books:

1. James Momoh, “Smart Grid Fundamentals of Design and Analysis”, Wiley-IEEE Press
2. Stuart Borlase, “Smart Grids, Infrastructure, Technology and Solutions”, CRC Press.
3. Gil Masters, “Renewable and Efficient Electric Power System”, Wiley-IEEE Press.
4. A.G. Phadke and J.S. Thorp, “Synchronized Phasor Measurements and their Application”, Springer Edition.
5. T. Ackermann, “Wind Power in Power Systems”, Hoboken, NJ, USA, John Wiley.

EEX-422 Digital Signal Processing Laboratory [0 0 2 1]

At least 8 experiments are to be performed out of the following list:

1. Plotting discrete signals: Plot δ[n-3], u[n-3], r[n-3], sinc(n/4) and $4(0.8)^n \cos(0.2n\pi)u[n]$ over the range $-10 \le n \le 10$.
2. Signal measures: Let x[n] = r[n] – r[n-5] – 5u[n-10].
   (a) Sketch x[n], x[n+2], x[-n], $x_e[n]$, and $x_o[n]$.
   (b) Find the signal energy in x[n].
   (c) Is x[n] absolutely summable? Square summable?
   (d) Sketch the periodic extension of x[n] with period N = 7 and find its signal power.
3. Random distributions: Generate about 500 points each of a uniform and Gaussian random signal.
   (a) Plot their first 100 values.
   (b) Plot their histograms using 20 bins.
   (c) Compute their mean and variance.
4. The central limit theorem: Demonstrate the central limit theorem by generating five realizations of a uniformly distributed random signal and plotting the histogram of the individual signals and their sum.
5. Signal-to-Noise Ratio: For a noisy signal x(t) = s(t)+An(t) with a signal component s(t) and noise component An(t), the signal to noise ratio (SNR) is the ratio of signal power σ_s^2 and noise power $A^2\sigma_n^2$ and defined as $SNR = 10\log\frac{\sigma_s^2}{A^2\sigma_n^2}$ dB. We can adjust the SNR by varying the noise amplitude A. Use the result to generate the noisy sinusoid with SNR of 18 dB.
6. Signal Averaging: Using coherent signal averaging extract the signals from the noise given below.
   (a) Sample x = sin(40πt) at 1000Hz for 0.2s to obtain the discrete signal x[n].
   (b) Generate 16 runs (realizations) of a noisy signal by adding uniformly distributed random noise (with zero mean) to x[n] and average the results.
   (c) Repeat part (b) for 64 runs and compare results.
   (d) Does averaging improve the quality of the noisy signal?
7. Discrete system response: Consider the second oreder system y[n]-0.64y[n-2] = x[n]+2x[n-1] with zero initial conditions and $x[n]=20(0.8)^n u[n]$.
   (a) Find its response using dlsim and filter and compare the results.
   (b) Is this system BIBO stable?
8. Smoothing effects of a moving average filter: Consider a 20-point moving average filter y[n] = 1/20{x[n]+x[n-1]+.....x[n-19]}. It is also called a smoothing filter because it tends to smooth out the rapid variations in a signal, To confirm this try the following;
   (a) Generate 200 samples of 1Hz sine wave sampled at 40 Hz.
   (b) Add some noise to generate a noisy signal.
   (c) Filter the noisy signal through the 20-point MA filter.
   (d) Plot each signal to display the effects of noise and smoothing.
9. Convolution and convolution indices: An input $x[n] = \{2, \underset{\uparrow}{-1}, 3\}$ is applied to an FIR filter whose impulse response is given by $h[n] = \{1, 2, \underset{\uparrow}{2}, 3\}$. Find the response y[n] and sketch all three signals using the same axis limits.
10. Approximating analytical convolution: The impulse response of a digital filter is described by $h[n] = (0.4)^n u[n]$. Evaluate and plot the response y[n] of this filter to the input $x[n] = (0.8)^n u[n]$ over the range $0 \le n \le 20$.
11. System response to sinusoidal inputs: We claim that the response of LTI system to a sinusoidal input is a sinusoid at the input frequency. Justify the statement using an input x[n] = cos(0.2πn) to a digital filter whose impulse response is described by $h[n] = \{\underset{\uparrow}{1}, 2, 3, 4, 5, 6, 7, 8\}$.
12. Convolution and filtering: The difference equation describing the digital filter of the previous example may be written as y[n]=x[n]+2x[n-1]+.....+8x[n-7].Use this to find the response to x[n] = cos(0.2πn) and compare with the previous example.
13. Deconvolution: Given $y[n] = \{\underset{\uparrow}{3}, 9, 17, 21, 19, 13, 6, 2\}$ and $x[n] = \{\underset{\uparrow}{3}, 3, 2, 2\}$ identify h[n].

14. Circular convolution: Consider two periodic signals described over one period by $x_p[n] = \{\underset{\uparrow}{1},2,-1,0,2,3\}$ $h_p[n] = \{\underset{\uparrow}{2},1,0,-1,-2,-3\}$. Find their periodic convolutions.
15. Let $x_p[n] = \{\underset{\uparrow}{1},2,-1,0,2,3\}$ and $h_p[n] = \{\underset{\uparrow}{2},1,0,-1,-2,-3\}$.
    (a) Find the periodic convolution $y_1[n]$ using one period of x and h.
    (b) Find the periodic convolution $y_5[n]$ using 5 periods of x and h.
    (c) How is the period of $y_5[n]$ related to that of $y_1[n]$?
    (d) How are the convolution values of $y_5[n]$ and $y_1[n]$ related?
16. Let $x_p[n] = \{\underset{\uparrow}{1},2,-1,0,2\}$ and $h_p[n] = \{\underset{\uparrow}{2},1,0,-1,-2,-3\}$. Find their regular convolution using zero padding and periodic convolution.
17. Autocorrelation and cross-correlation: Consider the sequences x[n] = n, 0≤n≤8 and h[n] = n, 0≤n≤3.
    (a) Evaluate and plot $r_{xx}[n]$ and $r_{hh}[n]$ and find where they attain their maximum.
    (b) Evaluate and plot $r_{xh}[n]$ and $r_{hx}[n]$.
    (c) Evaluate and plot the correlation of h[n] and h[n-4] and find where it attains a maximum.
18. Signals buried in noise: Generate two noisy signals by adding noise to a 20Hz sinusoid sampled at t_s=0.01s for 2s.
    (a) Verify the presence of the signal by correlating the two noisy signals.
    (b) Estimate the frequency of the signal from the FFT spectrum of the correlation.
19. Convolution by FFT: Use FFT to find
    (a) The periodic convolution of $x_p[n] = \{\underset{\uparrow}{1},2,-1,0,2,3\}$ and $h_p[n] = \{\underset{\uparrow}{2},1,0,-1,-2,-3\}$.
    (b) The regular convolution of $x_p[n] = \{\underset{\uparrow}{1},2,-1,0,2\}$ and $h_p[n] = \{\underset{\uparrow}{2},1,0,-1,-2,-3\}$.

The list of experiments given above is only suggestive. The Instructor may add new experiments as per the requirement of the course.

EEX-400 Major Project (Part-II) [0 0 4 2]