West Bengal University of Technology

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THIRD SEMESTER

A. THEORY:

CODE	THEORY	Contacts periods Per week			Total	Credits
		L	T	P		
MS(EE)-301	Electrical Engineering Materials	3	0	0	3	3
EE-302	Electrical and Electronics measurement	3	1	0	4	4
EE-301	Circuit Theory & Networks	3	1	0	4	4
CS302	Data Structure & Algorithms	3	1		4	4
M302	Mathematics	3	1	0	4	4
CS312	Numerical Methods & Programming	3	0	0	**3**	3
	TOTAL OF THEORY	**18**	**4**	**0**	**22**	**22**

B. PRACTICAL:

CODE	PRACTICAL	Contacts periods Per week			Total	Credits
		L	T	P		
EE-391	Circuit Theory & Networks Lab	0	0	3	3	2
EE-392	Electrical and Electronics measurement	0	0	3	3	2
CS392	Data Structure Lab	0	0	3	3	2
CS382	Numerical Methods & Programming Lab	0	0	3	3	2
	TOTAL OF PRACTICAL				**12**	**8**

	TOTAL OF SEMESTER	**34**	**30**

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FOURTH SEMESTER

A. THEORY:

CODE	THEORY	Contacts periods Per week			Total	Credit
		L	T	P		
EE 401	Electrical Machines-I	3	1	0	4	4
EC(EE) 401	Analog Electronic Circuits	3	0	0	3	3
EC(EE) 402	Digital Electronics &Integrated Circuits	3	1	0	4	4
EE 402	Electromagnetic Field Theory	3	0	0	3	3
ME(EE) 411	Thermal Power Engineering	3	1	0	4	4
	TOTAL OF THEORY				**18**	**18**

B. PRACTICAL :

CODE	PRACTICAL	Contacts periods Per week			Total	Credit
		L	T	P		
EE491	Electrical Machine Lab	0	0	3	3	2
EC(EE)491	Analog Electronic Circuits Lab	0	0	3	3	2
EC(EE)492	Digital Electronics & Integrated Circuits Lab	0	0	3	3	2
ME(EE) 481	Thermal Power Engineering Lab	0	0	3	3	2
	TOTAL OF PRACTICAL				**12**	**8**

C. SESSIONAL :

HU(EE) 481	Technical Report writing & Language Practice Lab	0	0	0	3	2
	TOTAL OF SESSIONAL				3	2
	TOTAL :				**33**	**28**

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FIFTH SEMESTER

A. THEORY:

CODE	THEORY	Contacts periods Per week			Total	Credit
		L	T	P		
EE 501	ELECTRICAL MACHINES – II	3	1	0	4	4
EE 502	POWER SYSTEM – I	3	0	0	3	3
EE 503	CONTROL SYSTEMS-I	3	1	0	4	4
EE 504	POWER ELECTRONICS	3	0	0	3	3
CS513	SYSTEM PROG. & OPERATING SYSTEM	3	0	0	3	3
	TOTAL OF THEORY				**17**	**17**

B. PRACTICAL :

CODE	PRACTICAL	Contacts periods Per week			Total	Credit
		L	T	P		
EE591	ELECTRICAL MACHINES LABORATORY	0	0	3	3	2
EE 592	POWER SYSTEM LAB	0	0	3	3	2
EE 593	CONTROL SYSTEMS LAB	0	0	3	3	2
EE594	POWER ELECTRONICS LABORATORY	0	0	3	3	2
	TOTAL OF PRACTICAL				**12**	**8**

C. SESSIONAL :

	TOTAL :				**29**	**25**

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SIXTH SEMESTER

A. THEORY

SL NO.	CODE	THEORY	CONTACT PERIODS PER WEEK			TOTAL	CREDITS
			L	T	P		
1	EE 601	ELECTRICAL MACHINE DESIGN	3	1	0	4	4
2	EE602	POWER SYSTEMS - II	3	1	0	4	4
3	EE603	CONTROL SYSTEMS - II	3	1	0	4	4
4	EI(EE)611	MICROPROCESSOR & MICROCONTROLLERS	3	1	0	4	4
5	EC 611	DIGITAL SIGNAL PROCESSING	3	1	0	4	4
		TOTAL OF THEORY				20	20

B. PRACTICAL

SL NO.	CODE	THEORY	CONTACT PERIODS PER WEEK			TOTAL	CREDITS
1	EE 691	ELECTRICAL MACHINE DESIGN LAB	0	0	3	3	2
2	EE692	POWER SYSTEMS LAB - II	0	0	3	3	2
3	EE693	CONTROL SYSTEMS LAB -II	0	0	3	3	2
4	EI(EE) 691	MICROPROCESSOR & APPLICATIONS LAB	0	0	3	3	2
		TOTAL OF PRACTICAL				12	8

C. SESSIONALS

1	EE 682	GROUP DISCUSSION AND SEMINAR	0	0	0	3	2
TOTAL OF SESSIONALS						3	2

	35	30

6-week Industrial Training during summer vacation

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SEVENTH SEMESTER

THEORY

Sl. No	Code	Theory	Contact Periods / Week			Total	Credits
			L	T	P		
1.	EE-701	Electric Drives	3	0	0	3	3
2.	HU-701	Financial Management & Accounts	3	0	0	3	3
3.	EE-702	Power System-III	3	0	0	3	3
4.	EE-703	Utilization of Electric Power	3	0	0	3	3
5.	EE-704	Elective-I	3	0	0	3	3
		TOTAL THEORY				15	15

PRACTICAL

Sl. No	Code	**Theory**	Contact Periods / Week			Total	Credits
			L	T	P		
1.	EE-791	Electric Drives Laboratory	0	0	3	3	2
2.	EE792	Power System Lab	0	0	3	3	2
		TOTAL PRACTICAL				6	4

SESSIONAL

Sl. No.	Code	Theory	Contact Periods / Week			Total	Credits
1.	EE-781	Practical Training Evaluation					3
2.	EE-782	Seminar on Assigned / Selected Topics	0	0	3	3	2
3.	EE-794	Assigned Project	0	0	6	6	4
		TOTAL SESSIONAL				9	9

		TOTAL OF SEMESTER				30	28

Elective-I(EE704A/B/C/D/E)

a. High Voltage Engineering
b. Embedded System
c. Power Generation Economics
d. Power Plant instrumentation and Control
e. Non conventional energy sources

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EIGHTH SEMESTER

Proposed Curriculum

THEORY

Sl. No	Code	Theory	Contact Periods / Week			Total	Credits
			L	T	P		
1.	HU-801	Values and Ethics in Profession	3	0	0	3	3
2.	HU-802	Industrial Management	3	0	0	3	3
3.	EE-801	Elective-II	3	0	0	3	3
4.	EE-802	Elective-III	3	0	0	3	3
		TOTAL THEORY	12			12	12

PRACTICAL

Sl. No	Code	Theory	Contact Periods / Week			Total	Credits
			L	T	P		
1.	EE-893	Assigned Project	-	-	12	12	8
		TOTAL PRACTICAL					

SESSIONAL

Sl. No	Code	Theory	Contact Periods / Week			Total	Credits
1.	EE-881	Personality Development			3	3	2
2.	EE-882	Comprehensive Viva-Voce					4
		TOTAL SESSIONAL					6

		TOTAL OF SEMESTER				27	26

Elective-II(EE801A/B/C/D)

A.	Advanced High Voltage Engineering:
B.	Power system dynamics & Control:
C.	Energy Management & Audit.
D.	Non linear Control systems:

Elective-III(EE802A/B/C/D)

A.	Communication Engineering:Old Code: EC802 (a)
B.	Sensors & Transducers:
C.	AI and Soft computing:Old Code: -CS-802 (d)
D.	Project Management & Operation Research: Old Code: M-802(f)

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THIRD SEMESTER SYLLABUS

ELECTRICAL ENGINEERING MATERIALS
MS (EE) 301
Contacts: 3L
Credits: 3

Conductive materials: General properties and specifications of conductor materials; free electron theory of Metals, Relaxation time, collision time and mean free path, joule's law, factors affecting resistively. Thermal conductivity of metals-Wiedemann Franz law, Properties of high conductive materials (Copper, Brass, Bronzes, and Aluminum), Conductor-bimetals: solders, Materials of high resistively; alloys for use in electrical resistance, precision electrical measuring instruments, arc lamps and electric furnaces. Different types of fuses, fusing current and fuse ratings, materials used for highly loaded metal contacts. Electrical carbon materials: characteristics of different carbon brushes and graphite brushes, Superconductivity. 08

Insulating materials: General properties of insulating materials (structure, composition). Dielectric gases. Liquid insulating materials. Solid insulating materials, insulating materials for electrical devices. Insulation measurement (Electric strength of liquid) Thermal classification of insulating material. 05

Magnetic Materials: Magnetic parameters (Permeability, magnetic susceptibility, Magnetic moment, Magnetization,). Classification of magnetic materials, Ferromagnetic behavior below critical Temperature, Spontaneous Magnetism and Weiss Theory of Ferromagnetism, Ferromagnetic Materials at high temperature, Spontaneous magnetization, cyclic magnetization, magnetic anisotropy and magnetostriction. Antiferromagnetism, Ferromagnetic material, Magnetic materials for electrical devices, Soft magnetic materials, Hard magnetic material. 10

Dielectrics: Different types of dielectric materials and their classification, dielectric as an electric field medium.
Dielectric properties of insulators in static fields: Dielectric parameters, mechanism of polarization, ionic polarization, orientational polarization, internal field in solids and liquids, the Clausius Mosotti equation, Ferroelectric material and their application, classification of ferroelectric material, antiferroelectricity, piezoelectricity.
Dielectric properties of insulators in alternating fields: Complex permittivity, Electronic polarizability, frequency dependence of ionic polarization, complex dielectric constant of non polar solids, Dielectric losses, Equivalent circuits. 10

Materials for direct Energy conversion devices: Solar cells, MHD generations, Fuel cells, thermoelectric generator, Thermo ionic converters. 05

Text books:

1. A course in Electrical Engineering Materils, S.P. Seth, P.V. Gupta, Dhanpat Rai & Sons.
2. Electrical Engineering Materials, A.J. Dekker, PHI.

Reference:

1. Materials Science for Electrical & Electronics Engineers, Ian P. Jones, Oxford
2. Electrical Properties of Materials, L. Solymar & D. Walsh, Oxford
3. Introduction to material science for engineers, J.K. Shackelford & M.K. Muralidhara, Pearson Education.

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Electrical and Electronics measurement
Code: EE302
Contact: 3L + 1T
Credit: 4

Measurements: Methods of measurement, Measurement system, Classification of instruments, Definition of accuracy, precision, resolution. Speed of response. Errors in measurement, classification of errors. Loading effect due to shunt and series connected instruments. 3

Analog meter: General features, Construction, principle of operation and torque equation of moving coil, moving iron, electrodynamometer, Induction, and Electrostatic type instruments. Principle of operation of the thermoelectric, rectifier type instruments. Extension of instrument ranges using shunt, multipliers. 6

Instrument transformer: Disadvantages of shunt & multipliers, Advantages of Instrument Transformers, Principle of operation of current & potential transformer, errors. 4

Measurement of resistance: measurement of medium resistance, low, and high resistances. Megger. 4

Potentiometers: Principle of operation and application of Crompton's DC potentiometer, Polar and co-ordinate type of AC potentiometers. 4

AC bridges: Measurement of inductances, capacitance and frequency by A.C bridges. 4

Measurement of power: Principle of operation of Electrodynamic & induction type wattmeter, wattmeter errors. 3

Measurement of energy: Construction, theory and operation of AC energy meter, testing of Energy meters. 3

Cathode Ray Oscilloscope: Measurement of voltage, current, frequency & phase by oscilloscope. Frequency limitation of CRO. Sampling and storage oscilloscope. Double beam CRO. 3

Electronic instruments: Advantages of digital meters over analog meters, Digital voltmeter, Resolution and sensitivity of digital meters, Digital multimeter, Digital frequency meter, signal generator. 4

Sensors & Transducers: Introduction to sensors & transducers, strain gauge, LVDT, temperature transducers, Flow measurement using magnetic flow measurement. 3

Text Books:

1. A course in Electrical & Electronic Measurements & Instrumentation; A.K. Sawhney, Dhanpat Rai and sons.
2. Electrical Measurements and Measuring Instruments; E.W Golding & F.C. Wides, Wheeler Publishing
3. Electronic Instrumentation; H.S.Kalsi, Tata McGraw hill, 2nd edition

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Reference Books:

1. Sensors and Transducers; D. Patranabis, PHI, 2nd edition

2. Digital Instrumenttion; A.J. Bouwens, Tata Mc Graw Hill

3. Modern Electronic Instrumentation & Measuring Instruments; A.D. Heltrick & W.D. Cooper, Wheeler Publishing

Electrical and Electronics measurement Lab
EE-392
Credits:2
Contacts:3P
Syllabus:
Experiments related to the topics in EE-302

Circuit Theory & Networks
Code: EE 301
Contact: 3L+ 1T
Credit: 4

Different types of systems & networks: Continuous & Discrete, Fixed and Time varying, Linear and nonlinear, lumped and distributed, passive & Active networks and systems.
2

Laplace transform: Impulse, step & sinusoidal response of RL, RC, LC and RLC circuits. Transient analysis of different electrical circuits with and without initial conditions .Concept of convolution theorem.
10

Fourier series and Fourier Transform (in continuous domain only) 8

Network theorems: Thevenin's, Norton's, Superposition, Maximum power transfer and Millman's theorem and their applications in 3 phase unbalanced circuit analysis, formulation of network equations, Source transformation, Loop variable analysis and node variable analysis.
6

Graph of Network: Concept of tree branch, tree link, Incidence matrix, Tie-set matrix and Loop currents, Cut set matrix and node pair potentials. 4

Two port networks: Open circuit Impedance and Short circuit Admittance parameters, Transmission parameters, Hybrid parameters and their inter relations. 4

Passive and Active filter: Analysis and synthesis of the following filters using operational amplifier, Low pass, High pass, band pass , band reject , all pass (first and second order only).
4

Text Books:

1. Networks and Systems, D. Roy Chowdhury, New Age International Publishers.
2. Network Analysis & synthesis, C.L. Wadhwa, New Age International Publisher.
3. Circuits & Networks: Analysis & Synthesis, A. Sudhakar & S.S. Palli, 3rd Edition, The Mc Graw Hill Company.

Reference Books:

1. Circuit Theory & Networks (TMH WBUT Series), S.P.Ghosh & A.Chakraborty,TMH
2. Network Analysis, M.E. Valkenburg, Pearson Education.
3. Fundamental of Electric circuit theory, D. Chattopadhay & P.C Rakshit, S.Chand
4. Engineering circuit Analysis, W.H. Hyat, J.E. Kemmerly & S.M. Durbin, The Mc Graw Hill Company.
5. Electric circuit, M. Nahra & J.A. Edminister.
6. Basic Circuit Theory, Lowrence P. Huelsman, Pearson Education.
7. Circuit Theory, Dr. Abhijit Chakrabarti, Dhanpat Rai & Co Pvt. Ltd.

Circuit & Network Lab:
Code: EE 391
Contact: 3P
Credit: 2

1. Transient response of R-L and R-C Network : Simulation using PSPICE / hardware
2. Transient response of R-L-C series and parallel circuits: Simulation with PSPICE / hardware.
3. Determination of Impedance (Z) and Admittance (Y) parameters of two port network: Simulation / hardware.
4. Frequency response of LP and HP filters: Simulation / hardware
5. Frequency response of BP and BR filters: simulation / hardware
6. Generation of Periodic, Exponential, Sinusoidal, Damped sinusoidal, Step, Impulse, Ramp signal using MATLAB in both discrete and analog form.
7. Determination of Lap lace transform and Inverse Lap lace transform using MATLAB.
8. Amplitude and Phase spectrum analysis of different signals using MATLAB.
9. Verification of Network theorems using SPICE

Reference book: 1 Introduction to PSpice Using Orcad for circuits and Electronics, Muhammad H. Rashid, Pearson Education.

DATA STRUCTURES AND ALGORITHMS
Code: CS 302
Contact: 3L + IT
Credit: 4

Overview of C language
Time and Space analysis of Algorithms - Order Notations.

Linear Data Structures - Sequential representations - Arrays and Lists, Stacks, Queues and Dequeues, strings, Application.

Linear Data Structures, Link Representation - Linear linked lists, Circularly linked lists. Doubly linked lists, application.

Recursion - Design of recursive algorithms, Tail Recursion, When not to use recursion, Removal of recursion.

Non-linear Data Structure: Trees - Binary Trees, Traversals and Threads, Binary Search Trees, Insertion and Deletion algorithms, Height-balanced and weight-balanced trees, B-trees, B+ -trees, Application of trees; Graphs - Representations, Breadth-first and Depth-first Search.

Hashing - Hashing Functions, collision Resolution Techniques.

Sorting and Searching Algorithms, Bubble sort, Selection Sort, Insertion Sort, Quicksort, Merge Sort, Heapsort and Radix Sort.

File Structures - Sequential and Direct Access. Relative Files, Indexed Files - B+ tree as index. Multi-indexed Files, Inverted Files, Hashed Files.

Text books:

1. Data Structures and Algorithms – O.G. Kakde and U.A. Deshpande, ISTE/EXCEL BOOKS
2. Aho Alfred V., Hopperoft John E., UIlman Jeffrey D., "Data Structures and Algorithms", Addison Wesley
3. Drozdek A –Data Structures and Algorithms
4. Pujari A.K. – Data Mining & Techniques, Universities Press
5. Ajay Agarwal- Data Structure Through C, Cyber Tech

References :

1.Heileman :data structures algorithms &OOP Tata McGraw Hill
2. Data Structures Using C – M.Radhakrishnan and V.Srinivasan, ISTE/EXCEL BOOKS
3. Weiss Mark Allen, "Algorithms, Data Structures, and Problem Solving with C++", Addison Wesley.
4. Horowitz Ellis & Sartaj Sahni, "Fundamentals of Data Structures", Galgotria Pub.
5.Tanenbaum A. S. , "Data Structures using 'C' "

MATHEMATICS
Code: M 302
Contacts: 3L + 1T
Credits: 4

Fourier Series:

Introduction: Euler's formula; Problems on general Fourier Series; Conditions for Fourier Expansion; Fourier Expansions of Discontinuous Functions; Even and Odd functions; Change of interval; Half range series; Typical Waveforms (Square, Saw-toothed, Triangular, Half Wave rectifier, Full Wave rectifier); Parseval's Identity (statement only); Fourier Transform (FT) and its properties; Inverse Fourier Transform (statement only); Fourier transform of derivative (statement only); Convolution (statement only); Application of Fourier Transform in solving partial differential equations — Laplace's Equation (2D only), Heat Conduction Equation (1D only) and Wave Equation (1D only). *12L*

Calculus of Complex Variable:

Functions; Limits and Continuity; Analytic Functions; Cauchy Riemann Conditions; Analytic Continuation; Complex Integration and Cauchy's Theorem; Cauchy's Integral Formula; Taylor's and Laurent Series; Zeros of an Analytic Function; Poles; Essential Singularities; Residue Theorem (statement only) and it's application to evaluation of integral; Introduction to Conformal Mapping; Simple problems. *14L*

Probability and Statistics:

Mean, Median, Mode and Standard Deviation; Samples Space; Definition of Probability; Conditional Probability; General Multiplication Theorem; Independent Events; Bayes' Theorem; Random Variable; Discrete and Continuous Probability Distributions - Probability mass function; Probability density function; Distribution Function; Expectation; Variance; Probability Distribution—Binomial, Poisson and Normal. Correlation and Regression; Method of Least Squares; Linear Curve Fitting. *10L*

Graph Theory:

Graphs; Digraphs; Isomorphism; Walk; Path; Circuit; Shortest Path: Dijkstra's Algorithm; Tree; Properties of Tree; Binary Tree; Fundamental Circuit; Minimal Spanning Tree: Kruskal's Algorithm; Prim's Algorithm. Cut Set; Fundamental Cut Set and Cut Vertices; Matrix Representation of Graphs (Adjacency and Incidence Matrices); Network; Flow Augmenting Path; Ford-Fulkerson Algorithm for Maximum Flow; Max Flow – Min Cut Theorem (statement only). *12L*

Total 48L

Text Books:

1. Rathor, Choudhari,: Descrete Structure And Graph Theory.
2. Gupta S. C and Kapoor V K: Fundamentals of Mathematical Statistics - Sultan Chand & Sons.
3. Lipschutz S: Theory and Problems of Probability (Schaum's Outline Series) - McGraw Hill Book. Co.
4. Spiegel M R: Theory and Problems of Probability and Statistics (Schaum's Outline Series) - McGraw Hill Book Co.
5. Goon A.M., Gupta M K and Dasgupta B: Fundamental of Statistics - The World Press Pvt. Ltd.
6. Spiegel M R: Theory and Problems of Complex Variables (Schaum's Outline Series) - McGraw Hill Book Co.
7. Bronson R: Differential Equations (Schaum's Outline Series) - McGraw Hill Book Co.
8. Ross S L: Differential Equations - John Willey & Sons.
9. Sneddon I. N.: Elements of Partial Differential Equations - McGraw Hill Book Co.
10. West D.B.: Introduction to Graph Theory - Prentice Hall
11. Deo N: Graph Theory with Applications to Engineering and Computer Science - Prentice Hall.
12. Grewal B S: Higher Engineering Mathematics (thirtyfifth edn) - Khanna Pub.
13. Kreyzig E: Advanced Engineering Mathematics - John Wiley and Sons.
14. Jana- Undergradute Mathematics
15. Lakshminarayan- Engineering Math 1.2.3
16. Gupta- Mathematical Physics (Vikas)
17. Singh- Modern Algebra
18. Rao B: Differential Equations with Applications & Programs, Universities Press
19. Murray: Introductory Courses in Differential Equations, Universities Press
20. Delampady, M: Probability & Statistics, Universities Press
21. Prasad: Partial Differential Equations, New Age International
22. Chowdhury: Elements of Complex Analysis, New Age International
23. Bhat: Modern Probability Theory, New Age International
24. Dutta: A Textbook of Engineering Mathematics Vol.1 & 2, New Age International
25. Sarveswarao: Engineering Mathematics, Universities Press
26. Dhami: Differential Calculus, New Age International

NUMERICAL METHODS AND PROGRAMMING
Code : CS 312
Contacts : 3L
Credits :3

Approximation in numerical computation, Truncation and rounding errors;
Interpolation: Lagrange's Interpolation, Newton forward & backward differences Interpolation, Newton divided difference;
Numerical Integration: Trapezoidal, Rule, Simson's 1/3 Rule, Weddle' Rule;
Numerical Solution of a system of linear equation
Gauss elimination method, Matrix Inversion, LU Factorization method, Gauss Jacobi method, Gauss Seidel method;
Algebraic Equation: Bisection method, Secant method, Regular-Falsi method, Newton-Raphson method;
Numerical solution of ordinary differential equation: Taylor's series method, Euler's method, Runge-kutta method, and Predictor-Corrector method;
C Language Overview: Loop, recursion, function, array, pointers, structures, various types of file access methods: Sequential, Indexed Sequential, Random;
Various types of files in C and various types file handling statements in C
Implementation above Numerical & Statistical Problems in C Language;

Text Books:

1. Numerical Analysis & Algorithms, Pradeep Niyogi, TMH, 1st ed.
2. Numerical Mathematical Analysis by J.B.Scarborough
3. C Language and Numerical Methods by C.Xavier
4. Introductory Numerical Analysis by Dutta & Jana
5. Balagurusamy: Numerical Methods
6. Discrete Mathematical Structure – Rakesh Dube and Vijay Vir, EXCEL BOOKS
7. Numerical Methods (Problems and Solution) by Jain, Iyengar , & Jain
8. Numerical Methods In Computer Applications – P.U.Wayse. EPH
9. Computer Orinted Numerical Method- N. Dutta vikash
10. Numerical Methods with Programs in Basic Fortran Pascal & C++ - S.B.Rao, Universities Press
11. Computer Programming & Numerical Analysis – N.Dutta, Universities Press
12. Numerical Methods for Engineers – Gupta, New Age International
13. Numerical Solutions of Differential Equations – Jain M.K.,New Age International
14. Numerical Methods for Scientific & Engg Computation – Jain M.K.,New Age International
15. Numerical Analysis – Rao G.S.,New Age International
16. Discrete Mathematical Structures – Rao G.S., New Age International
17. Foundations of Discrete Mathematics – Joshi K.D., New Age International
18. Applied Discrete Structures – Joshi, New Age International
19. Groups, Rings & Modules with Applications – Adhikari, M.R.,Universities Press

DATA STRUCTURE LAB
Code: CS 392
Contact: 3P
Credit: 2

Experiments should include but not limited to :
Implementation of array operations

Stacks and Queues : adding, deleting elements Circular Queue : Adding & deleting elements Merging Problem : Evaluation of expressions operations on Multiple stacks & queues :
Implementation of linked lists: inserting, deleting, inverting a linked list. Implementation of stacks & queues using linked lists:
Polynomial addition, Polynomial multiplication
Sparse Matrices: Multiplication, addition.
Recursive and Non-recursive traversal of Trees
Threaded binary tree traversal. AVL tree implementation.
Application of Trees, Application of sorting and searching algorithms
Hash tables implementation: searching, inserting and deleting, searching & sorting techniques.

NUMERICAL METHODS & PROGRAMMING LAB
Code: CS 382
Contact: 3P
Credit: 2

1. Assignments on Interpolation: Newton forward & backward, Lagrange
2. Assignments on Numerical Integration: Trapezoidal Rule, Simson's 1/3 Rule, Weddle's Rule
3. Assignments on Numerical solution of a system of linear equation: Gauss elimination, Gauss Jacobi, Matrix Inversion, Gauss Seidal
4. Assignments on Algebric Equation: Bisection, Secant, Regular-falsi, Newton Raphson
5. Assignments on Ordinary Differential Equation: Taylor Series, Euler's method, Runga-Kutta

Assignments on Statistical Problem: Mean, Median, Mode, Standard deviation (for simple & frequency type data), Correlation & Regression

FOURTH SEMESTER SYLLABUS

Electrical Machines-I
EE 401
Contacts: 3L + 1 T
Credits: 4

Direct Current machines:
Review of construction, types of armature winding, physical concepts of winding pitches, derivation of EMF equation & types of excitation.
Armature reaction and its effect on the performance, methods adopted for compensation of armature reaction. . Characteristics of DC generator: separately excited, shunt, series and compound generators.
Compensating winding, Commutation and function of commutators. Improvement of commutation: Brush shift and interpoles. 08

Direct Current motors:
Review of types of DC motors. Torque equation, speed torque characteristics: shunt, series and compound motors.
Starting & speed control of DC motors. 3- point starter & its step calculation. Speed control by controlling armature resistance, field excitation and armature voltage . Ward- Leonard method of speed control. Losses & efficiency of DC machines, Hopkinson's & Swinburne's test.
08

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3 phase Transformers: Determination of polarity and connections ;(Star/star, star/delta, delta/star, star/zigzag, delta/zigzag, open delta), phasor groups. Effects of unbalanced loading, production of harmonic in transformers and their suppression.3- phase to 2- phase transformation, Scott connection, 3-phase to six phase connections: double star & double delta.
3-winding transformers: parameter estimation. Applications. Parallel operation of transformers, autotransformers. Introduction to tap changers and their functions.

12

3 phase Induction machines: Types, construction, rotating magnetic field, principle of operation, slip, development of equivalent circuit. Performance equations, torque slip characteristics & power slip characteristics. Parameter estimation. Starting and speed control of Induction motors. Single phase and three phase induction regulators. 12

Text books:

1. Electrical Machinery, P.S. Bhimra, 6/e, Khanna Publishers.
2. Electric Machines, I.J. Nagrath & D.P. Kothari, 3/e, TMH
3. Electrical Machines, P K Mukherjee & S Chakrabarty, Dhanpat Rai Pub.

Reference books:

1. Electrical Machnery, S.K.Sen, Khanna Publishers.
2. Electric Machinery & Transformers, Bhag S.Guru & H. R. Hiziroglu, Oxford
3. Electrical Machines: Theory & Practice, M.N. Bandoyopadhyay, PHI
4. Electric Machinery & Transformer, Irving L Koskow, 2/e, PHI

ANALOG ELECTRONIC CIRCUITS
Code : EC(EE) 401
Contacts : 3L
Credits :3

Bipolar Transistors and their Current-Voltage characteristics. Biasing and Stability: Self Bias-CE, CC, Compensation techniques.
Small Signal models of -Junction Transistors. Single stage amplifiers, CE, CC Voltage follower . R-C coupled amplifiers
Field Effect Devices : JFET/HFET, MIS structures and MOSFET operation; JFET characteristics and small signal models; MOS capacitor CV and concept of accumulation, depletion and inversion; MOSFET characteristics and small signal models. Discrete FET amplifiers : Common source amplifiers; source followers.
Power amplifiers – Class A, B, AB, C, Tuned amplifier.

Differential Amplifier, Operational Amplifier and its stages, Constant current source (current mirror etc.), level shifter, Ideal and practical OpAmp. Comparator, Schmitt Trigger.
Instrumentation Amplifier, Logarithmic amplifiers, analog multiplier, Precision Rectifier
Linear voltage regulator: series and shunt, Switch mode regulators

Multivibrator – Monostable, Bistable, Astable.
Timer. Monostable and astable operation using 555 timers.
Function generator, wave shapers.
V-I, I-V, V-F & F-V converters. VCO, PLL lock-in amplifier.

Text Book:

1. Malvino—Electronic Principles , 6/e ,TMH
2. Nagrath, Electronics: Analog and Digital, PHI, 2004
3. Mottershed, Electronics Devices & Circuits, Wiley Eastern
4. Millman & Halkias – Integrated Electronics, Tata McGraw Hill.

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5. Gayakwad R.A -- OpAmps and Linear IC's, 4/e, Pearson-PHI
6. Franco—Design with Operational Amplifiers & Analog Integrated Circuits , 3/e,TMH
7. Coughlin and Drisscol – Operational Amplifier and Linear Integrated Circuits – Pearson Education Asia.

Reference:

1. Nagchoudhuri , Microelectronic Devices, 1/e, Pearson Education, 2001
2. Natarajan, Microelectronics: Analysis & Design, 1/e 2005, TMH
3. Maheshwari and Anand , Analog Electronics, PHI
4. Boyle'stead , Nashelsky: & Kishore, Electronic Devices & Circuit theory, 1/e, PHI/Pearson.
5. Millman & Halkias: Basic Electronic Principles; TMH.
6. Tobey & Grame – Operational Amplifier: Design and Applications, Mc Graw Hill.

DIGITAL ELECTRONICS & INTEGRATED CIRCUITS
Code : EC(EE) 402
Contacts : 3L + 1T
Credits :4

Concept of digital data , Binary representation of integers, Octal, Hexadecimal and BCD Codes and their conversions. Unit distance code, Gray code, Shaft position encoder. ASCII code
Serial transmission of binary data (1-byte), Ideal digital signals, practical digital signals: voltage levels, rise time, duty cycle.
Boolean algebra, Venn diagram, Truth Table, De-Morgans Theorem and applications.
Elementary logic gates (NOT, AND, OR, XOR, NOR and NAND) . Realization of binary expressions using gates., universality of NOR and NAND gates.
Normal forms, minterms, maxterms. Minimization of logic expressions by algebraic method, K-map method and Quine Mc Clauskey method. Don't care conditions.
Elementary concepts of hardware description languages (HDL)
Combinational circuits- 1-bit half adder and full adder, encoder, decoder and code-converters (BCD-Hex,BCD-7segment, Hex-7segment), comparator, multiplexer, de-multiplexer, parity generator .
Clocks and timing circuits: Waveform, Scmitt trigger, monostable multi-vibrator.
Flip Flops and Clocked Flip Flops: R-S, J-K and T. D-latch and D-flipflop. Constructing other F/F's by J-K, T and D.
Ripple and Synchronous counters. Ring Counters
Registers and Shift registers, parallel load and serial load.
Memory Systems: RAM, ROM, EPROM, EEROM.
General Sequential systems. State table and state transition diagram, Moore and Mealey machines. Sequential circuit design (Synchronous), using ROM, Algorithmic Sequential Machine, Simple application examples like vending machines.
Design of combinational and sequential circuits using Programmable logic devices and gate arrays.
Digital Integrated Circuits, Different Logic families- TTL, ECL, MOS and CMOS, their operation and specifications.

Signed binary number representation with 1's and 2's complement methods, Binary arithmetic: addition, subtraction, multiplication. Sign-Magnitude Binary representation.
Digital to analog conversion using resistive ladder..A/nalog to Digital conversion: counter /staircase method, Successive approximation; Accuracy and precision of converters.

Textbooks:

1. Leach , Malvino, Saha—Digital Principles & Application, 6/e, TMH

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2. Mano , Digital Logic Design,3/e, PHI/Pearson,
3. Jain—Modern Digital Electronics, 3/e ,TMH,

Reference:

1. Nair, Digital Electronics and Logic Design, PHI, 2004
2. Raj Kamal, Digital Systems : Principles and Design, 1/e, Pearson Education, 2007
3. Givone—Digital Principles & Design, TMH
4. Introduction to Digital Computer Design 4th Ed.- V.Rajaraman & T. Radhakrishnan, P.H.I.
5. Digital Integrated Electronics- H.Taub & D.Shilling, Mc Graw Hill.

Electro Magnetic Field Theory
EE-402
Contact: 3L
Credit: 3

Introduction: Co-ordinate systems and transformation, Cartesian coordinates, Circular cylindrical coordinates, spherical coordinates & their transformation. Differential length, area and volume in different coordinate systems, 3

Introduction to vector calculus: Del operator, Gradient of a scalar, Divergence of a vector & Divergence theorem, Curl of a vector & Strokes theorem. Laplacian of a scalar. Classification of vector fields. Helmholtz's theorem. 3

Electro static field: Coulomb's law, field intensity, Gauss's law- Maxwell's equation, Electric potential and potential gradient, Relationship between E and V-Maxell's equation An electric Dipole & flux lines, Energy density in electrostatic fields.

Boundary conditions: Dielectric-dielectric, Conductor-dielectric, Conductor-free space,

Poisson's and Laplace's equations, General procedure for solving Poisson's and Laplace's equation. 8

Magneto static fields: Biot-Savart Law, Ampere's Circuit law-Maxwell's equation, Magnetic Flux density-Maxwell's equation, Maxwell's Equation for static fields, Magnetic static and vector potential, forces due Magnetic fields, Magnetic torque and moments, Magnetisation in material, Magnetic boundary condition, inductor and inductances, Magnetic energy, Force on magnetic materials. 10

Electromagnetic field: Farady's law, Transformer and motional EMF, Displacement current, Maxwell's equations, Time varying potentials, Time harmonic fields. 4

Electromagnetic wave propagation: Wave propagation in lossy dielectrics, plane waves in lossless dielectric, plane wave in free space, plane wave in good conductor, skin effect, skin depth, power and the poynting vector, reflection of a plane wave at normal incidence, reflection of a plane wave at oblique incidence, Polarisation . 7

Transmission lines, Transmission line parameters, Transmission line equation. 3

Text Books:
1. Elements of Electromegnetics, Mathew N.O. Sadsiku, 3/e, Oxford University press,
2. Engineering Electromanetics, 7/e, Hyat, TMH
3. Theory & Problems in Electromagnetic, 2/e, Edminister, TMH
4. Electromagnetic field theory fundamentals, Guru & Hizroglu, 2/e, Cambridge University Press.

Reference: 1. Electromagnetics with applications, 5/e, Krause, TMH
2. Elements of Engineering Electromagnetics, 6/e, N.N. Rao, Pearson Education.

THERMAL POWER ENGINEERING
Code : ME(EE) 411
Contacts : 3L + 1T
Credits :4

Water Tube & Fire Tube boilers, Circulating Principles, Forced Circulation, Critical pressure, Superheaters, Reheaters, attemperators, induced draught, forced draught and secondary air Fans, Boiler performance analysis and heat balance. Combustion Systems, Environmental Protection – ESP, Cyclone Separator, Dust Collector etc.

Rotary Thermodynamic devices – Steam turbines & their classifications – Impulse & Reaction type Turbines, Thermodynamics of compressible fluid-flow, equation and continuity – Isentropic flow through nozzles, velocity diagram, Blade efficiency, optimum velocity ratio, multi-staging, velocity & pressure compounding, losses in turbines, erosion of turbine blades, turbine governing, performance analysis of turbine, Condensing system.
IC Engines – classification. Analysis of a standard cycle, fuel characteristic of SI & CI Engine, Combustion, Engine performance. Automotive Engine exhaust emission and their control.

Gas turbine Analysis – Regeneration - Reheating, Isentropic efficiency. Combustion efficiency.
Text:

1. P.K.Nag- Engineering Thermodynamics – TMH ,2/e
2. P K Nag- Power Plant Engg. - TMH Pub
3. P.S. Ballaney- Thermal Engineering – Khanna Pub
4. Domkundwar & Arora- Power Plant Engineering –.Dhanpat Rai & Co.

Reference:

1. Cengel --- Thermodynamics , 3/e ,TMH
2. Et-Wakil—Power Plant Engineering , MH
3. M W Zemansky & R.H.Dittman -Heat and Thermodynamics – McGraw Hill ,7/e

ELECTRICAL MACHINES LAB
Code: EE 491
Contacts: 3 P
Credit2: 2

1. Study of the characteristics of a separately excited D.C generator.
2. Studies of the characteristics of a D.C shunt motor.
3. Speed control of a D.C motor.
4. Study of the characteristics of a compound D.C generator (short shunt)
5. Measurement of the speed of a D.C series motor as a function of load torque.
6. Study of the equivalent circuit of a single-phase transformer.
7. Polarity test on single phase transforms and study of the different connections of three-phase transformer.

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8. Study of the equivalent circuit of three-phase induction motor by No-Load & Blocked-Rotor tests.
9. Study of the performance of wound Rotor induction motor under load.
10. Study of the performance of three-phase Squirrel-Cage induction Motor-Determination of Iron-Loss, Friction & Windage Losses.

ANALOG ELECTRONIC CIRCUITS LAB
Code: EC(EE)491
Contacts: 3 P
Credits: 2

1. Introduction: Study of characteristics curves of B.J.T & F.E.T .
2. Construction of a two-stage R-C coupled amplifier & study of it's gain & Bandwidth.
3. Study of class A & class B power amplifiers.
4. Study of class C & Push-Pull amplifiers.
5. Realization of current mirror & level shifter circuit using Operational Amplifiers.
6. Study of timer circuit using NE555 & configuration for monostable & astable multivibrator.
7. Construction & study of Bistable multivibrator using NE555.
8. Study of Switched Mode Power Supply & construction of a linear voltage regulator using regulator IC chip.
9. Construction of a simple function generator using IC.
10. Realization of a V-to-I & I-to-V converter using Op-Amps.
11. Realization of a Phase Locked Loop using Voltage Controlled Oscillator (VCO).
12. Study of D.A.C & A.D.C.

DIGITAL ELECTRONICS & INTEGRATED CIRCUITS LAB
Code: EC(EE) 492
Contacts: 3 P
Credits: 2

1. Realization of basic gates using Universal logic gates.
2. Code conversion circuits- BCD to Excess-3 & vice-versa.
3 .4-bit parity generator & comparator circuits.
4. Construction of simple Decoder & Multiplexer circuits using logic gates.
5. Design of combinational circuit for BCD to decimal conversion to drive 7-segment display using multiplexer.
6. Construction of simple arithmetic circuits-Adder, Subtractor.
7. Realization of RS-JK & D flip-flops using Universal logic gates.
8. Realization of Universal Register using JK flip-flops & logic gates.
9. Realization of Universal Register using multiplexer & flip-flops.
10. Construction of Adder circuit using Shift Register & full Adder.
11. Realization of Asynchronous Up/Down counter.
12. Realization of Synchronous Up/Down counter.
13. Design of Sequential Counter with irregular sequences.
14. Realization of Ring counter & Johnson's counter.
15. Construction of adder circuit using Shift Register & full Adder.

THERMAL POWER ENGG. LAB
Code: ME(EE) 481
Contacts: 3P
Credits: 2

1. Study of Cut Models – Boilers IC Engines
   - ❖ Lanchashire Boiler
   - ❖ Bahcock & Willcox Boiler
   - ❖ Cochran Boiler
   - ❖ Vertical Tubular Boiler
   - ❖ Locomotive Boiler
   - ❖ 4S Diesel Engine
   - ❖ 4S Petrol Engine
   - ❖ 2S Petrol Engine
2. Load Test on 4 Stroke Petrol Engine & Diesel Engine by Electrical Load Box.
3. Load Test on 4 Stroke Diesel Engine by Rope Brake Dynamometer.
4. Heat Balance on 4 Stroke Diesel Engine by Rope Brake Dynamometer & by Electrical Load Box.
5. Valve Timing Diagram on 4S Diesel Engine Model & 4S Petrol Engine Model.
6. To find the Calorific Value of Diesel Fuel & Coal by Bomb Calorimeter.
7. To find the Flash Point & Fire Point of Petrol & Diesel Fuel.
8. To find the Cloud Point & Pour Point of Petrol & Diesel Fuel.
9. To find Carbon Particle Percentage in Diesel Engine Exhaust Smoke by Smokemeter and trace the BHP Vs. % Carbon Curve.
10. Measurement of the Quality of Steam – Enthalpy & Dryness fraction.
11. To find out the Boiler performance – Boiler efficiency & Steam evaporation rate.
12. To visit a Thermal Power Station & study of the followings :

    a) Boiler b) Steam pipe c) Furnace
    d) Economizer e) Preheater f) Steam turbines
    g) Alternator h) Water treatment plant i) E. S. P.

TECHNICAL REPORT WRITING & LANGUAGE PRACTICE LABORATORY
Code: HU(EE) 481
Contacts: 3
Credits: 2

Topics to be covered and number of hours required for it:

1. Introductory lecture is to be given to the students so that they get a clear idea of the syllabus and understand the need for having such a practice lab in the first place(3 hours)
2. Conversion practice is done on given situation topics. The students are also made to listen to pre-recorded cassettes produced by British Council and also by the Universities of Oxford and Cambridge (6 hours)
3. Group Discussions:- The students are made to understand the difference between the language of conversion and group discussion. Strategies of such discussions are to teach to them. It is also helpful to use videocassettes produced by the U.G.C. on topics like group-discussion. After wards the class is divided into groups and the students have to discuss on given topics on current socio-economic-political-educational importance(12 hours)
4. Interview sessions-students are taught the do's and don'ts of facing a successful interview. They then have to face rigorous practices of mock-interviews. There simulations of real life interview sessions where students have to face an interview panel(12 hours)
5. Presentations: The secrets of an effective presentation are taught to the students. Then each and every student has to make lab presentations with the help of the Overhead projector/ using power point presentation and other audio-visual aids in the laboratory. They also have to face the question answer sessions at the end of their presentation (12 hours)
6. Classes are also allotted to prepare the students for competitive examinations like the T.O.E.F.L. by making the students listen to specially produced C.D. cassettes of such examinations (3 hours)

The overall aim of this course is to inculcate a sense of confidence in the students and help them to become good communicators in their social as well as professional lives.

Text:
1. Sharma—Business Correspondence & Report Writing, TMH
2. Prasad—Group Discussion & Interview (With Audio Cassette) , TMH

Reference:
1. Sashi Kumar—Spoken English (with Cassette) , TMH

West Bengal University of Technology
BF-142, Salt Lake City, Kolkata-700064

Revised & Final Syllabus of B.Tech in EE upto 8th Semester(To be followed from the academic session,July 2007 ,i.e. for the students who were admitted in Academic Session 2006-2007).The syllabi of other semesters will be published soon.

5th SEMESTER SYLLABUS

ELECTRICAL MACHINES – II

EE – 501

Contact : 3L + 1T **Credit : 4**

Single phase Induction motor :
Construction, Double revolving field theory, Cross field theory, Starting methods, Speed — Torque characteristics, Phasor diagram, Condition of maximum torque, Determination of equivalent circuit parameters, Applications.
Single Phase AC series motor, Compensated & uncompensated motors.

10

Synchronous machines:
Construction, Types, Excitation systems, Generator & Motor modes, Armature reaction, Theory for salient pole machine. Two reaction theory **,** Voltage regulation (EMF, MMF, ZPF)
Parallel operation of Alternators, Synchronous machine connected to infinite bus, effect of change of excitation and speed of prime mover. Starting of Synchronous motor, V- Curve, Damper winding. Hunting.

20

Special Electromechanical Devices:
Principle and construction of Switched reluctance motor, Permanent magnet machines, Brushless D.C machines, Stepper motor, Tacho generators, Synchros & resolvers, & AC servo motors. Principle, Construction and operational characteristics of Induction Generators

11

TEXT BOOKS

1. Electrical Machinery — P.S. Bimbhra, *Khanna Publishers*
2. Generalised Theory of Machine- P.S. Bimbhra, *Khanna Publishers*
3. Electrical Machines — Nagrath & Kothary, *TMH*
4. Electrical Machines — M.N. Bandyopadhyay, *Pearsons*
5. Performance & Design of A.C. Machines — M.G. Say, CBS Publishers & Distributors

REF. BOOKS

1. Mukherjee P K & Chakraborty S : Electrical Machines ; Dhanpat Rai Pub.
2. Sen S K : Electrical Machines ; Khanna Pub.
3. Fitzgerald : Electrical Machinery, *TMH*
4. Parker Smith – Problems in Electrical Engg ; – CBS Pub & Distributors.

ELECTRICAL MACHINES LABORATORY
EE 591
Contact: 3P
Credit: 2
List of Experiments:

1. Different method of starting of 3 phase squirrel cage Induction motor & their comparison [D.O.L, Auto transformer & Star-Delta]
2. Speed control of 3 phase squirrel cage induction motor by different methods & their comparison [voltage control & frequency control]
3. Speed control of three phase slip ring Induction motor by rotor resistance control.
4. Determination of regulation of Synchronous machine by Potier reactance method.
5. Determination of regulation of an Alternator by Synchronous Impedance method.
6. Determination of equivalent circuit parameters of a single phase Induction motor.

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7. Load test on single phase Induction motor to obtain the performance characteristics.
8. To determine the direct axis reactance [X_d] & quadrature axis reactance [X_q] of three phase synchronous machine by slip test.
9. Load test on wound rotor Induction motor to obtain the performance characteristics.
10. To make connection diagram of full pitch & fractional slot winding of 18 slot squirrel cage Induction motor for 6 pole & 4 pole operation.

POWER SYSTEM – I

EE – 502

Contact : 3L + 1T + 3P **Credit : 4**

Overhead Transmission line : Choice of Voltage, Types of conductors, Inductance and Capacitance of single phase and three phase symmetrical and unsymmetrical configurations, Bundle conductors, Transposition, Concept of GMD and GMR. **10**

Overhead line construction: Line supports, Towers, Poles, Sag, Tension and Clearance, Effect of Wind and Ice on Sag, Dampers. **6**

Insulators: Types, string Insulator efficiency & methods of its improvement. **3**

Corona: Principle of Corona formation**,** Critical disruptive voltage, Visual critical corona discharge potential, Corona loss, advantages & disadvantages of Corona, methods of reduction of Corona. **3**

Underground Cables: Types of cables, capacitance of single core & 3 core cables, dielectric stress, optimum cable thickness, grading, dielectric loss and loss angle. **5**

Performance of lines: Short, medium (nominal Π , T) and long lines and their representation. A, B, C, D constants, voltage regulation, Ferranti Effect, Power Equations and line compensation, Power Circle Diagrams. **8**

Tariff : Guiding Principle of Tariff, different types of tariff. **1**

Indian Electricity Rules-2003 – General Introduction. **1**

Distribution System: Feeders and Distributors, radial and loop systems. **3**

Distribution substation: Types of substations, Location of Substation, Substation — equipment and accessories, Earthing of Substation. **3**

TEXT BOOKS

1. Electrical Power System — Subir Roy, *Prentice Hall*
2. Power System Engineering — Nagrath & Kothary, *TMH*
3. Electrical Power System — C.L.Wodhwa, *New Age International*
4. Elements of Power System Analysis — W.D. Stevens, *McGraw Hill International*

REF. BOOKS

5. Switch Gear & Protection — S.S.Rao, *Khanna Publication*.
6. Power System Protective Relaying Vol.I — Van Warrington AR, *Chapman Hall*
7. Power System Protective Relaying Vol.II — Van Warrington AR, *Chapman Hall*

POWER SYSTEMS LAB
Code : EE 592
Contacts : 3 P
Credit : 2

List of experiments

1) Determination of the generalized constants A,B,C,D of a long transmission line.
2) Simulation of DC distribution by network analyzer.
3) Measurement of earth resistance by earth tester.
4) Di electric strength test of insulating oil.
5) Determination of break down strength of solid insulating material.
6) Different parameter calculation by power circle diagram.
7) Study of different types of insulators.
8) Active & reactive power control of an alternator.
9) Study and analysis of an electrical transmission line circuit with the help of PSPICE.
10) Dielectric constant , tan delta , resistivity test of transformer oil.

CONTROL SYSTEMS-I
EE 503
Contacts : 3L + 1T
Credits : 4

Introduction to control system:
Concept of feedback and Automatic Control, Effects of feedback, Objectives of control systems. Definition of linear and nonlinear systems. Elementary concepts of sensitivity and robustness. Types of control systems: Servomechanisms and regulators, examples of feedback control systems.
(3)

Mathematical modeling of dynamic systems.
Electrical analogy of spring-mass-dashpot system. Transfer Function concepts, poles and zeroes of a transfer function. Block diagram representation of Control Systems. Block Diagram Algebra Signal Flow Graph. Mason's gain formula.
(6)

Control system component
Potentiometer, synchros, resolvers, position encoders, D.C. and A.C. tacho-generators, actuators. Block diagram level description of feedback control systems for position control, speed control of DC motors, temperature control, liquid level control, voltage control of an alternator.
(5)

Time domain analysis:
Time domain analysis of a standard second order closed loop system. Concepts of undamped natural frequency, damping, overshoot, rise time and settling time. Dependence of time domain performance parameters on natural frequency and damping ratio. Step and impulse response of first and second order systems. Effects of poles and zeroes on transient response. Stability of linear system by pole location. Routh-Hurwitz criteria.
(8)

Error analysis:
Steady state errors in control systems due to step, ramp and parabolic inputs. Concept of system types and error constants. (2)

Stability analysis:

Root locus techniques, Construction of Root Loci for simple systems. effects of gain on the movement of poles and zeros. (4)

Frequency domain analysis of linear systems :
Bode plots, Polar Plots, Nichols chart. Concept of resonance frequency of peak magnification.
Nyquist criteria, measures of relative stability – phase and gain margins. Determining margins in Bode Plots and Nichols chart, M-circle and M-Contours in Nichols chart. (8)

Control system performance measures.:
Improvement of system performance through compensation, Lead, lag and lead-lag compensation , PI, PD and PID control. (4)

Text Books :

1. Ogata, K : Modern Control Engineering, 4e, Pearson Education.
2. Nagrath I. J& Gopal, M: Control Systems Engineering, New Age International publication.
3. Roy Choudhury, D., Control system Engineering, PHI
4. Kuo, B.C. Automatic Control System, PHI

Reference Books:

1. Control Systems (TMH WBUT Series), Purkait, Satpati, Mondal & Mallik,TMH
2. Bandyopadhyaya, Control Engineering Theory and Practice, PHI
3. Nise, Norman S, Control System Engineering, 3rd Edition, John Wiley & Sons.
4. Dorf R C & Bishop R.H., Modern Control System, 11e : Pearson Education
5. Graham C Goodwin, Stefan F. Graebe, Mario E. Salgado, Control System Design, PHI
6. Macia & Thaler, Modeling & Control of dynamic system. Thompson.
7. Christopher T. Kilian, Modern Control Technology Components & Systems. 3e, Cengage Learning.

CONTROL SYSTEM LAB (PSPICE & MAT LAB)
Code : EE 593
Contacts : 3 P
Credit : 2
List Of Experiments

1) Familarisation with MAT- Lab- control system tool box, MAT –Lab- simulink tool box & PSPICE.
2) DETERMINATION OF STEP RESPONSE FOR FIRST ORDER & SECOND ORDER SYSTEM WITH UNITY FEEDBACK ON CRO &CALCULATIONS OF CONTROL SYSTEM SPECIFICATIONS LIKE TIME CONSTANT , % PEAK OVERSHOOT, SETTLING TIME ETC., FROM THE RESPONSE.
3) SIMULATION OF STEP RESPONSE & IMPULSE RESPONSE FOR TYPE-0 , TYPE-1 & TYPE –2 SYSTEM WITH UNITY FEEDBACK USING MATLAB & PSPICE.
4) DETERMINATION OF ROOT LOCUS, BODE- PLOT, NYQUIST PLOT USING MATLAB-CONTROL SYSTEM TOOLBOX FOR 2ND ORDER SYSTEM & DETERMINATION OF DIFFERERNT CONTROL SYSTEM SPECIFICATIONS FROM THE PLOT.
5) DETERMINATION OF PI, PD,PID CONTROLLER ACTION OF FIRST ORDER SIMULATED PROCESS.
6) DETERMINATION OF APPROXIMATE TRANSFER FUNCTION EXPERIMENTALLY FROM BODE PLOT.
7) EVALUATION OF STEADY STATE ERROR, SETTING TIME, PERCENTAGE PEAK OVERSHOOT, GAIN MARGIN, PHASE MARGIN WITH ADDITION OF LEAD

COMPENSATOR & BY COMPENSATOR IN FORWARD PATH TRANSFER FUNCTION FOR UNITY FEED BACK CONTROL SYSTEM USING PSPICE OR OTHERWISE.

8) STUDY OF A PRACTICAL POSITION CONTROL SYSTEM & DETERMINATION OF CONTROL SYSTEM SPECIFICATIONS FOR VARIATION OF SYSTEM PARAMETERS.

POWER ELECTRONICS
EE504
Contact: 3L + 1 T
Credit: 4

Introduction:
Concept of power electronics, application of power electronics, uncontrolled converters, advantages and disadvantages of power electronics converters, power electronics systems, Power diodes, Power transistors, Power MOSFETS, IGBT. (4)

PNPN devices:
Thyristor, brief description of members of Thyristor family with symbol, V-I characteristics and applications. Two transistor model of SCR, SCR turn on methods, switching characteristics, gate characteristics, ratings, SCR protection, series and parallel operation, gate triggering circuits. Different commutation techniques of SCR. (5)

Phase controlled converters:
Principle of operation of single phase and three phase half wave, half controlled, full controlled converters with R, R-L and RLE loads, effect of free wheeling diodes and source inductance on the performance of converters. External performance parameters of the converters, techniques of power factor improvement, Single phase and three phase dual converters, Resonant converters. (8)

DC-DC converters:
Principle of operation, control strategies, step up choppers, types of choppers circuits based on quadrant of operation, performance parameters, multiphase choppers and switching mode regulators. (5)

Inverters:
Definition, classification of inverters based on nature of input source, methods of commutation and connections. Principle of operation with R and R-L loads, three phase full bridge inverters, performance parameters of inverters, methods of voltage control and harmonic reduction of inverters. (8)

AC controllers:
Principle of on-off and phase control, single phase and three phase controllers with R and R-L loads.
Principle of operation of Cycloconverters, circulating and non circulating mode of operation, single phase to single phase step up and step down Cycloconverters, three phase to single phase Cycloconverters, three phase to three phase Cycloconverters. (6)

Applications:
Speed control of AC and DC motors, HVDC transmission, static circuit breaker, UPS, static VAR controller. (4)

Text Books:

1. Power Electronics, M.D. Singh and K.B. Khanchandani, Tata Mc Grawhill, 2007.
2. Power Electronics, V.R. Moorthi, Oxford, 2005
3. Power Electronics, M.H. Rashid, Pearson Education, 3rd edition.
4. Power Electronics, P.S. Bhimra, Khanna Publishers, Third edition

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Reference books:

1. Modern Power Electronics & AC drives, B.K. Bose, Prentice Hall
2. Element of Power Electronics, Phillip T Krein, Oxford, 2007
3. Power Electronic systems, J.P. Agarwal, Pearson Education, 2006
4. Power Electronics, M.S. Jamal Asgha, PHI, 2007
5. Analysis of Thyristor power conditioned motor, S.K. Pillai, University press.

POWER ELECTRONICS LABORATORY
EE 59
Contact: 3 P
Credit: 2
List of Experiments:

1. Study of the characteristics of an SCR.
2. Study of the characteristics of a Triac.
3. Study of different triggering circuits of SCR.
4. Study of firing circuits suitable for triggering SCR in a single phase fully controlled bridge converter.
5. Study of the operation of single phase fully controlled bridge converter.
6. Study of single phase half controlled symmetrical and asymmetrical bridge converters.
7. Study of step down Chopper.
8. Simulation of single phase controlled converter with & without the source inductance.
9. Simulation of step up and step down chopper with MOSFET and GTO.
10. Simulation of single phase half controlled symmetrical and asymmetrical bridge converters.
11. Simulation of PWM bridge inverter using MOSFET with R-L load.
12. Simulation of three phase AC regulator

SYSTEM PROGRAMMING & OPERATING SYSTEM
CS 513
Contacts : 3L
Credits - 3

Assemblers [12L]
One pass and Two Pass, Macro Processors, Linkers, Loaders: absolute and relocating loaders, editors and Debuggers, Introduction to Compilers

System Calls [3L]
Programming using system calls (in DOS or Unix)

Operating System [3L]
Introduction to Operating system, O.S. services and Kernel, Multiprogramming and Time Sharing

Processor Scheduling [3L]
Preemptive and non-preemptive, algorithms (FCFS, SJF, RR, priority)

Process Synchronization [6L]
Critical section problem, critical region, semaphores, monitors

Memory management [3L]
Swapping, paging, Demand paging and virtual memory

I/O and device management [4L]
I/O hardware, interrupts, DMA, Block and Character Devices, blocking and non-blocking I/O, spooling and device reservation

Disk and File Management [4L]
Disk structure, disk scheduling (FCFS, SSTF, SCAN), boot block

Deadlocks, Concurrent processes, protection and security [4L]

Introduction to multiprocessors and Distributed O.S. [6L]

Text Books / References:

1. L. L. Beck: "An introduction to System Programming" Addison Wesley/Pearson Education
2. D. Dhandhere "System Programming" TMH
3. A Silberschaz & Galvin " Operating System Concepts" Addision Wesley/Pearson Education
4. Tanenbaum "Modern Operating System" Prentice Hall of India/Pearson Education
5. Sumitava Das " Unix Systems V.4 Concept and Application" TMH
6. Maurice J Bach " The Design of Unix Operating System" PHI/Pearson Education

SIXTH SEMESTER SYLLABUS

ELECTRICAL MACHINE DESIGN
Code: EE 601
Contacts : 3L+1T
Credits : 4

Fundamental Aspects of Electrical Machine Design:
Design factors, limitation in design, modern trends in design of electric machines, modern machine manufacturing techniques. Temperature rise, cooling and thermal grading (classification) of insulations. (2)

Design of Resistances:
Material of resistance elements, design of loading rheostat, design of heating element. (2)

Principles of Magnetic circuit design:
Magnetic leakage, calculation of total mmf in a magnetic circuit, determination of iron losses, pulsation losses, magnetic leakage calculations, specific permeance, leakage reactance, armature leakage, slot leakage, calculation of magnetizing current. (5)

Design of Electromagnets:
Design of Electromagnet core, selection of materials, electromagnet coils. (2)

Design of Power Inductors:
Inductor design calculations choke (small inductors), design procedure. (2)

Design of Transformer:
Core, core cross section, yoke cross section, clamping of core, core earthing, transformer winding, cooling of transformers, transformer insulation, bushings, design details of single phase transformer. Introduction of 3 phase transformer with special emphasis on core design. (10)

Design of three phases Induction motor (Squirrel Cage and Slip Ring):
Stator frames, rotor, rotor windings, slip rings, shaft and bearings, design details. (10)

Design of Capacitors and Inductors for Power system. (2 + 2)

Books:

1. A course in Electrical Machine Design, A.K. Sawhney & A. Chakrabarty, Sixth edition, Dhanpat rai & Co.
2. Principle of Electrical Machine Design with computer programming, S.K. Sen, Oxford & IBH.

POWER SYSTEMS-II
Code : EE 602
Contacts : 3L + 1T
Credits :4

General layout of a typical coal fired power station, hydro electric power station, nuclear power station, their components and working principles. Comparison of different methods of power generation. Introduction to solar and wind energy systems. (6)

Nature of Faults in Electrical systems:
Symmetrical fault: Short circuit of a synchronous machine with no load and load, Symmetrical components transformation. Sequence impedance and sequence network of power system, synchronous machine, transmission lines and transformers. Representation of sequence network of power system. Unsymmetrical faults: Single line to ground, line to line, double line to ground fault. (8)

Power system dynamics:
Steady state stability, transient stability, equal area criterion, swing equation, multimachine stability concept. (4)

Load flow studies:
Network model formation, formation of Y bus, load flow problems, Gauss-Siedel, Newton-Raphson, Fast decupled methods and their comparison. (6)

Power System Protection:
Protective zones, Relaying elements and quantities.
Protective relays: Basic requirements and type of protection, phase and amplitude comparator. Grading (time & current), Classification of electromagnetic (attracted armature & induction type) relays, Directional relay, Distance relay, Differential relay, Basic aspects of static and digital relays. Relay protection scheme for transformers, feeder, generators and AC motors. (10)
Circuit breakers: circuit breaking transients, transient recovery voltage, current chopping and resistance switching, circuit breaker rating, Arc and Arc extinction. Circuit breaker types, oil circuit breaker, Vacuum circuit breaker, Air blast circuit breaker, SF6 circuit breaker and operating mechanism, Advantages and disadvantages of different types. (8)

Text Book:

1. Power system Engineering, D.P. Kothari & I.J. Nagrath, MC Graw Hill
2. Electrical Power system, Subir Ray, Prentice Hall

References:

1. Power system analysis, operation and control, A. Chakrabarty & S. Haldar, 2nd Edition .PHI
2. Power Systems Analysis, A.R. Bergen & V. Vittal, 2nd Edition, Pearson Education.
3. Power systems Stability, Vol-I, II, III, E.W.Kimbark, Wiley India.
4. Computer Modelling of Electrical Power systems, J. Arrillaga & N.R. Watson, Second edition, John Wiely & Sons, Ltd

CONTROL SYSTEMS-II
Code : EE 603
Contacts : 3L + 1T
Credits :4

State variable model of continuous dynamic systems:
Converting higher order linear differential equations into state variable form. Obtaining SV model from transfer functions. Obtaining characteristic equation and transfer functions from SV model. Obtaining SV equations directly for R-L-C and spring-mass-dashpot systems.
Concept and properties associated with state equations. Linear Transformations on state variables. Canonical forms of SV equations. Companion forms. Solutions of state equations, state transition matrix, properties of state transition matrix.
Controllability and observability. Linear State variable feedback controller, the pole allocation problems. Linear system design by state variable feedback. (15)

Analysis of discrete time (sampled data) systems using Z-transform:
Difference Equations. Inverse Z transform. Stability and damping in z-domain.
Practical sampled data systems and computer control. Practical and theoretical samplers. Sampling as Impulse modulation. Sampled spectra and aliasing. Anti-aliasing filters. Zero order hold. Approximation of discrete (Z-domain) controllers with ZOH by Tustin transform and other methods. State variable analysis of sampled data system. Digital compensator design using frequency response. (10)

Introduction to non-linear systems:
Block diagram and state variable representations. Characteristics of common nonlinearities.
Phase plane analysis of linear and non-linear second order systems. Methods of obtaining phase plane trajectories by graphical method – isoclines method. Qualitative analysis of simple control systems by phase plane methods.
Describing Function method. Limit cycles in non-linear systems. Prediction of limit cycles using describing function.
Stability concepts for nonlinear systems. BIBO vs. State stability. Lyapunov's definition. Asymptotic stability, Global asymptotic stability. The first and second methods of Lyapunov methods to analyse non-linear systems. (15)

Text Books

1. Gopal M : Digital Control and State Variable Methods, 2e, – TMH
2. Roy Choudhuri, D., Control System Engineering, PHI
3. Nagrath I J & Gopal M : Control Systems Engg. - New Age International
4. Anand,D.K, Zmood, R.B., Introduction to Control Systems 3e, (Butterworth-Heinemann)Asian Books

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Reference Books:

1. Goodwin, Control System Design, Pearson Education
2. Bandyopadhyaya, Control Engg.Theory and Practice, PHI
3. Kuo B.C. : Digital Control System- Oxford University Press.
4. Houpis, C.H, Digital Control Systems, Mc Graw Hill International.
5. Ogata, K., Discrete Time Control Systems, Prentice Hall, 1995
6. Jury E.I. : Sampled Data Control System- John Wiley & Sons Inc.
7. Umez-Eronini, Eronini., System Dynamics and Control, Thomson
8. Dorf R.C. & Bishop R H : Modern Control System- Pearson Education.
9. Ramakalyan, Control Engineering, Vikas
10. Natarajan A/Reddy, Control Systems Engg., Scitech
11. Lyshevski, Control System Theory with Engineering Applications, Jaico
12. Gibson J E : Nonlinear Control System - McGraw Hill Book Co.

MICROPROCESSORS & MICROCRONTROLLERS
Code : EI(EE) 611
Contacts : 3L +1T
Credits : 4

Introduction to computer architecture and organization; Architecture of a typical microprocessor; Bus configuration; The CPU module; ROM and RAM families; Introduction to assembly language and machine language programming; Instruction set of a typical microprocessor (e.g. 8085) ; Subroutines and stacks; Timing diagrams; Memory interfacing; interfacing input-output ports; Interrupts and interrupt handling; Serial and parallel data transfer schemes; Programmed and interrupt driven data transfer; Direct memory access; Programmable peripheral devices; Programmable interval timer; Analog input-out using AD and DA converters. (25)

Assembly language programming of a typical microprocessor; Use of compiler, assembler, linker and debugger. (5)

Basic 16 bit microprocessors (e.g. 8086): Architecture and Min – Max mode. (4)

Introduction to microcontrollers- architecture and instruction set of a typical microcontroller (e.g. PIC16F84 device). Features of popular controller (Processor 8031/8051) and its programming and interfacing. (8)

Text:

1. Microprocessor Architecture, Programming and Application with the 8085, 5th edition, Gaonkar, R., Penram International.
2. Advanced Microprocessors and Peripherals, Ajoy Kumar Ray & Kishor M Bhurchandi, Tata McGraw-Hill.
3. Microprocessors and Interfacing, 2nd Edition, Hall D.V., Mc Graw Hill.
4. Microprocessor and Programmed Logic, Short, Pearson Education.

References:

1. Microchip technology data sheet, www.microchip.com

DIGITAL SIGNAL PROCESSING :
Code : EC 611
Contacts : 3L + 1T
Credits :4

Introduction : Discrete and continuous time signals and systems. Data acquisition and conversion including multi-channel data converter and monitors. Stability, linearity and causality of linear shift in variant signal transmission and processing. Review of Z- transformation. .

DFS : Its properties, Fourier representation of finite duration sequences.

DFT : Representation of periodic sequence computational algorithms.

Fast Fourier Transformation (FFT): Computational considerations. Digital Filters: Structures, different forms, finite impulse response (FIR) and Infinite Impulse response (IIR). Flow graph representation of digital filter. Digital filter design: IIR filter design by impulse invariant and bilinear transformation. FIR filter design using windows and frequency sampling method. Effect of finite register length in DSP and effect of quantization of filter parameters in the filter design.

Computer control of processes – supervisory and direct digital control. Simple filter design using MATLAB.

Introduction to DSP hardwares : Architectural features, Fixed point processors, floating point processors. Control and Instrumentation application – Telemetry and metering.

BOOKS :

1. Mitra S : Digital Signal Processing - A computer based approach ; TMH
2. Proakis J.C. & Manslakis M G: Digital Signal Processing : Principles, Algorithms & Applications: PHI/ Pearson Education.
3. Chen, Digital Signal Processing , OUP
4. Johnson, Digital Signal Processing, PHI
5. Babu Ramesh, Digital Signal Processing,Scitech
6. Ingle, Digital Signal Processing Using MATLAB,Vikas
7. Ifeachor, Digital Signal Processing, Pearson Education
8. Salivahanan S, Vallavaris A, Gnanpruja C: Digital Signal Processing ; TMH Pub.
9. Oppenhein A V & Shaffer R.W. : Digital Signal Processing, Pearson Education /PHI;
10. Oppenhein A V & Shaffer R.W : Discrete time Signal Processing, Pearson Education /PHI;
11. Rabiner L R & Gold B : Theory & Applications of Digital Signal Processing, PHI

ELECTRICAL MACHINE DESIGN LAB
Code : EE 691
Contacts : 3P
Credits :2

1. Familiarization of synchronous machine, single phase & three phase induction machine, DC machine, single phase & three phase transformers with the help of cut section models.

2. Familiarization with the construction of single phase fan. (Students should be able to understand windings, rotor and starting of the fan).
3. Design & Fabrication of air and iron core inductor.
4. Design & fabrication of small single phase transformer, 100 VA, 220/12 V.
5. Design & fabrication of 10 W wire wound resistor.
6. Introduction to computer aided machine design.

POWER SYSTEM LAB
Code : EE 692
Contacts :3P
Credits : 2

1. Study on (i) on load Time Delay Relay (ii) off load Time Delay Relay
2. Polarity, Ratio and Magnatisation Characteristics Test of CT & PT
3. Testing on (i) Under Voltage Relay and (ii) Earth Fault Relay
4. Study on D C Load Flow
5. Study of A C Load Flow Using Gauss – Seidel Method
6. Study of A C Load Flow Using Newton Raphson Method
7. Study on Economic Load Dispatch
8. Study of Transformer Protection by Simulation
9. Study of Generator Protection by Simulation
10. Study of Motor Protection by Micon Relay
11. Study of Different Characteristics of Over Current Relay

CONTROL SYSTEM LAB-II
Code : EE 693
Contacts : 3P
Credits : 2

1. STUDY OF A PRACTICAL POSITION CONTROL SYSTEM. Obtaining closed step responses for gain setting corresponding to over-damped and under-damped responses. Determination of rise time and peak time using individualized components in SIMULINK. Determination of un-damped natural frequency and damping ratio from the experimental data.

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2. TUNING OF P, PI, AND PID CONTROLLER FOR FIRST ORDER PLANT WITH DEAD TIME USING Z-N METHOD. Process parameters (time constant and delay/lag) will be provided, the students would compute controller gains by using Z-N method. Steady state and transient performance of the closed loop plant with and without steady disturbances will have to be noted. Theoretical phase and gain margins will have to be manually computed for each gain settings.

3. DESIGN OF LEAD AND LAG COMPENSATION USING CACSAD TOOLS (Plant transfer function will be provided. Step response is to be obtained. (PSPICE, MATLAB, SciLab may be used).

4. STATE VARIABLE ANALYSIS USING CACSAD COMMAND TOOL. Familiarization and use of CACSAD command for state variable analysis. Obtaining transfer function from SV model and vice versa. Obtaining step response for a SISO system given in SV form. (PSPICE, MATLAB, SciLab may be used).

5. STATE VARIABLE ANALYSIS USING CACSAD BLOCK DIAGRAM TOOL. Familiarization and use of CACSAD BLOCK DIAGRAM TOOL for state variable analysis. Obtaining step response and initial condition response for a single input, two output system given in SV form. (PSPICE, MATLAB, SciLab may be used).

6. PERFORMANCE ANALYSIS OF A DISCRETE TIME SYSTEM USING CACSAD TOOL. Familiarization and use of CACSAD block diagram tool for Digital Control System. Study of closed response of a continuous system with a digital controller with sample and hold. (PSPICE, MATLAB, SciLab may be used).

7. STUDYING THE EFFECTS OF NONLINEARITY IN A FEEDBACK CONTROLLED SYSTEM USING TIME RESPONSE. Determination of step response with a limiter nonlinearity introduced into the forward path of 2nd order unity feedback control systems. The open loop plant will have one pole at the origin and the other pole will be in LHP or RHP. To verify that (i) with open loop stable pole, the response is slowed down for larger amplitude input and (ii) for unstable plant , the closed loop system may become oscillatory with large input amplitude. (PSPICE, MATLAB, SciLab may be used).

8. STUDYING THE EFFECTS OF NONLINEARITY IN A FEEDBACK CONTROLLED SYSTEM USING PHASE PLANE PLOTS. Determination of phase plane trajectory and possibility of limit cycle of common nonlinearities. CACSAD block diagram tool will be used. (PSPICE, MATLAB, SciLab may be used).

Reference Books;

1. Herniter, Programming in MATLAB, Vikas
2. Ogata K : Modern Control Engg. 4e, Pearson/PHI

MICROPROCESSOR AND APPLICATIONS LAB
Code : EI(EE) 691
Contacts : 3P
Credits : 2

1. Familiarization with 8085 register level architecture and trainer kit components, including the memory map. Familiarization with the process of storing and viewing the contents of memory as well as registers.

2. a) Study of prewritten programs on triainer kit using the basic instruction set (date transfer, load/store, Arithmetic, Logical)

   b) Assignments based on above.

3. a) Familiarization with 8085 simulator on PC.

   b) Study of prewritten programs using basic instruction set (data transfer, load/Store, Arithmetic, Logical) on the simulator.

   c) Assignments based on above.

4. Programming using kit/simulator for
   i) table look up
   ii) copying a block of memory
   iii) shifting a block of memory
   iv) packing and unpacking of BCD numbers
   v) addition of BCD numbers
   vi) Binary to ASCII conversion
   vii) string matching

5. Program using subroutine calls and IN/OUT instructions using 8255 PPI on the trainer kit eg. subroutine for delay, reading switch state and glowing LEDs accordingly, finding out the frequency of a pulse train etc.

6. Interfacing any 8-bit latch (eg 74LS373) with trainer kit as a peripheral mapped output port with absolute address decoding.

7. Interfacing with I/O modules :
   a) ADC
   b) Speed control of mini DC motor using DAC
   c) Keyboard
   d) Multi-digit Display with multiplexing
   e) Stepper motor

8. Study of 8031/8051 Micro Controller kit and writing programms for the following tasks using the kit.

9. a) Table look up
   b) Basic arithmetic and logical operations
   c) Interfacing of keyboard and stepper motor

West Bengal University of Technology
BF-142, Salt Lake City, Kolkata-700064

Revised & Final Syllabus of B.Tech in EE upto 8th Semester(To be followed from the academic session,July 2007 ,i.e. for the students who were admitted in Academic Session 2006-2007).The syllabi of other semesters will be published soon.

SEVENTH SEMESTER SYLLABUS

ELECTRICAL DRIVES
Code: EE-701
Contacts: 3L
Credits: 4

Electrical drive: Concept, classification, parts and advantages of electrical dives.
(2)

Dynamics of Electrical Drives: Types of Loads, Components of load toques, Fundamental torque equations, Equivalent value of drive parameters for loads with rotational and translational motion. Steady state stability, Transient stability. Multiquadrant operation of drives. Load equalization.
(4)

Motor power rating: Thermal model of motor for heating and cooling, classes of motor duty, determination of motor rating for continuous, short time and intermittent duty, equivalent current, torque and power methods for fluctuating and intermittent loads.
(4)

Stating of Electric Drives: Effect of starting on Power supply, motor and load,
Methods of stating of electric motors, Acceleration time Energy relation during stating, methods to reduce the Energy loss during starting. (3)

Braking of Electric Drives: Types of braking, braking of DC motor, Induction motor and Synchronous motor, Energy loss during braking, (4)

DC motor drives: Single phase, three phases fully controlled and half controlled rectifier fed DC drives. Dual converter control of DC drives. Power factor, supply harmonics and ripple in motor current. Chopper control of DC drives.
(4)

Induction motor drives: Stator voltage variation by three phase controllers, Speed control using chopper resistance in the rotor circuit, slip power recovery scheme. Pulse width modulated inverter fed and current source inverter fed induction motor drive. Volts/Hertz Control, Vector or Field oriented control.
(8)

Synchronous motor drive: Variable frequency control, Self Control, Voltage source inverter fed synchronous motor drive, Vector control.
(4)

Introduction to Solar and Battery Powered Drive, Stepper motor, Switched Reluctance motor drive

(3)

Industrial application: Drive consideration for Textile mills, Steel rolling mills, Cement mills, Paper mills, Machine tools. Cranes & hoist drives. (4)

Text Books:

1. Fundamental of Electrical Drives, G.K. Dubey, New Age International Publication.
2. Electric Drives, Vedam Subrahmanyam, TMH
3. A first course on Electrical Drives, S.K. Pillai, , New Age International Publication.

Reference Books:

1. Electric motor Drives, R. Krishnan, Pearson Education.

Modern power Electronics and AC drives , Bimal K Bose, PHI

ELECTRICAL DRIVES - LIST OF EXPERIMENTS
Code: EE-791

Contacts: 3P

Credits: 2

1. Study of thysistor controlled DC Drive.
2. Study of Chopper fed DC Drive
3. Study of AC Single phase motor-speed control using TRIAC.
4. PWM Inverter fed 3 phase Induction Motor control using PSPICE / MATLAB / PSIM Software.
5. VSI / CSI fed Induction motor Drive analysis using MATLAB/DSPICE/PSIM Software.
6. Study of V/f control operation of 3Φ induction motor drive.
7. Study of permanent magnet synchronous motor drive fed by PWM Inverter using Software.
8. Regenerative / Dynamic braking operation for DC Motor - Study using software.
9. Regenerative / Dynamic braking operation of AC motor - study using software.

PC/PLC based AC/DC motor control operation.

FINANCIAL MANAGEMENT AND ACCOUNTS

Code: HU 701
Contacts: 3L
Credits: 3
Allotted Hrs: 45L

Introduction [3L]
Financial Management, Financial Planning and Capitalization- definitions, objectives, changing roles and functions, Financial Decision.

Capital Budgeting [7L]
Nature of Investment decision, Importance of Capital Budgeting, The Capital. Budgeting Process - Investment Criterion, Pay-back period, Accounting, ROR (Rate of Return) Method, Discounting Cash flow method, Net - present value method, IRR (Internal Rate of Return) method, The benefit-Cost Ratio method.

Management of Working Capital [7L]
Various concepts, Elements, Classification, Financing and importance of working capital, Investment analysis, Cash flow determination, cost of capital, capital budgeting methods.

Budgeting Control Technique [5L]
Concepts of Budget, budgeting and budgetary control, Objectives, Functions, Uses, Advantages, Limitations; Master Budget and Report.

Cost - Volume - Profit Analysis [8L]
Classification of costs, Allocation, apportionment and absorption, Cost centers, different costing systems, Cost analysis for managerial decisions, Meaning of Linear CVP analysis, Objectives, Assumptions, Break - Even analysis, determining the Break-Even point profit, Volume graph profit, Volume ratios margin of Safety.

Introduction to Accounting [8L]

Basic accounting concepts, important definitions, uses, limitations, advantages; types of Accounting, Financial statements, introduction to Journal Accounting; different types of Vouchers, double entry bookkeeping, different types of transactions related to Financial Accounting.

Financial Control [7L]
Posting of Ledgers and preparation of Trial Balance; preparation of Balance Sheet and Profit and Loss Accounts; Controlling other departments by Financial Accounting (A practical Approach).

Books:

1. Financial Management and Accounting - P. K. Jain, S. Chand & Co.
2. Management & Accounting: Principles and Practice - R. K. Sharma & Shashi Kumar Gupta, Kalyani Publishers.
3. Advanced Management Accounting - Kaplan & Atkinson, PHI.
4. Fundamentals of Financial Management - Van Home, PE.
5. Financial Mgmt Accounting, Gupta,Pearson
6. Financial Mgmt, I.M. Pandey, Vikas
7. Financial Mgmt., Khan & Jain, TMH
8. Financial Mgmt , Mcmenamin, OUP
9. Financial Mgmt & Policy, Van Horne, PHI
10. Financial Mgmt,Kulkarni & Satyaprasad, Himalaya

POWER SYSTEM –III
Code: EE 702
Contacts: 3L
Credits: 3
Allotted Hrs: 45L

Introduction: Objective of the course, Power systems in restructured environment, Distributed and Dispersed generation, Environmental aspect of Electric Generation.
(2)

Economic Operation of Energy Generations systems: Introduction, Economic operation of Thermal system, Plant Scheduling, Transmission loss and Penalty factor, Hydro thermal scheduling, Scheduling of pumped storage plants, Unit Commitment.
(8)

Automatic Generation Control: Introduction, Load frequency control (Single area case), Load frequency control of two area systems, response of load frequency controller, Optimal control of AGC.
(8)

Compensation in power systems: Reactive power sensitivity and voltage control, Exciter and VAR control, Load compensation, Line compensation, Passive shunt and series compensation, introduction to FACTs controller (SVC, STATCOM) .
(8)

Power system transients: Introduction, Types of System Transients, Traveling Waves or Propagation of Surges, Generation of over Voltages on transmission lines, Protection against Lighting, Protection of Power system Apparatus against surges.
(8)

Text Books

1. Power System Engineering, Kothari & Nagrath, Mc Graw Hill
2. Power system analysis, operation and control, Chakrabarti and Halder, PHI
3. Power System Analysis, Granger and Stevension, Mc Graw Hill

Reference Books:

1. Power system stability and Control, P. Kundur , Mc Graw Hill
2. Modern power system analysis, Kothari & Nagrath, Mc.Graw Hill
3. Power system Analysis, Nagsarkar & Sukhija, Pearson
4. Electric Power Genration operation and control, Wood and Woolenberg, Mc Graw Hill.

POWER SYSTEM LABORATORY
Code: EE-792
Contacts: 3P
Credits: 2

1. Computation of scheduling of thermal power plants without network losses.
2. Computation of P-V and Q-V profiles in simple power systems.
3. Application of SVC at load bus of a simple power system.
4. Application of Swing equation and its solution to determine transient stability.
5. Simulation of LFC for two area power system
6. Economic load dispatch considering network losses
7. Simulation of Reactive power by STATCOM

UTILISATION OF ELECTRIC POWER
Code: EE 703
Contacts: 3L
Credits: 3
Allotted Hrs: 45L

Traction: System of Traction Electrification, Train movement & energy consumption (Speed-time curves, Crest speed, Average speed & Schedule speed), Tractive effort, Factors affecting energy consumption (Dead weight, Acceleration weight & Adhesion weight), Protective devices.
(10)

Electric Traction motor & their control: Starting, braking with special emphasis on power electronic controllers, Current collector, Interference with telecommunication circuit. A brief outline of linear Induction motor principle in Traction. (10)

Illumination: Laws of illumination, Polar cuvees, Photometry, Integrating sphere, Types of Lamps: Conventional and Energy Efficient, Basic principle of Light control, Different lighting scheme & their design methods, Flood and Street lighting. (10)

Heating: Types of heating, Resistance heating, Induction heating, Arc furnace, Dielectric heating, Microwave heating.
(6)

Welding: Resistance welding, Arc welding, Ultrasonic welding, Electron bean welding, Laser beam welding, Requirement for good welding, Power supplies for different welding schemes.
(6)

Text:
1. Wadha C L: Generation, Distribution and Utilization of electrical energy - New Age International Ltd.
2. Partab H: Art and Science of Utilization of Electrical Energy, Dhanpat Rai & Sons.
3. E.Openshaw Taylor – Utilisation of Electric Energy – Orient Longman.

Electives-I

High Voltage Engineering
Code: EE-704A
Contacts: 3L
Credits: 3

Hours

Brekdown Phenomena (14)

Breakdown of Gases: Charge multiplication,Secondary emission,Townsend Theory, Streamer Theory, Paschen's Law, Determination of Minimum breakdown voltage, Breakdown in non uniform field, Effect of polarity on corona inception and break down voltage. Partial Discharge : definition and development in solid dielectric.
Break Down of Solids: Intrinsic breakdown, Electromechanical break down, Thermal breakdown, Streamer Breakdown.
Breakdown of Liquid: Intrinsic Break down, Cavitation Theory, Suspended particle Theory.

Lightning Phenomena: Electrification of cloud, Development of Lightning Stroke, (2) lightning induced over voltage, direct stroke, indirect stroke.

Protection of Electrical Apparatus against over voltage: (4)
Lightning Arrestors, Valve Type, Metal Oxide arresters, Expulsion type. Effect of location of lightning arresters on protection of transformer. Protection of substation, Earthwire.

Insulation Co ordination: (3)
Basic Insulation level. Basic Impulse level, Switching Impulse level. Volt time characteristics of protective devices, Determination of Basic Impulse level of substation equipment.
Generation of High Voltage (10)
Generation of high a.c voltage by testing transformer, cascaded transformer, series resonant circuit, single stage and multi stage. Advantages of Series Resonant Circuit in testing of cables
Generation of d.c high voltage: Cockcroft Walton doubler and multistage circuit.Definition of Impulse Voltage as per Indian Standard Specification, Wave front and wave tail time ,Generation of Impulse Voltage, Multistage impulse generator,triggering of Impulse Generator
Measurement of High Voltage: (7)
Sphere gap voltmeter : a.c, d.c and impulse ,high voltage measurement as per Indian Standard Specifications. Resistance and Capacitance Potential dividers, Peak voltmeters for measurement of high a.c voltage in conjunction with capacitance dividers. Capacitance Voltage Transformer, Rotating Voltmeter for the measurement of d.c high voltage, Electrostatic Voltmeter
High Voltage testing: Testing as per Indian Standard Specifications: (3) Power frequency withstand, induced over voltage and impulse test on transformers, Power frequency wet withstand test and impulse test on insulators.

References:

High Voltage Engineering : M.S.Naidu and V. Kamraju, 4th Edition,
Tata McGraw Hill Publishing Company Limited.
High Voltage Engineering: C.L.Wadhwa,New Age International (P) Ltd, Publishers.
An introduction to High Voltage Engineering: Subir Roy,Prentice Hall Pvt. Ltd

Embedded System
Code: EE-704B
Contacts: 3L
Credits: 3

INTRODUCTION TO EMBEDDED SYSTEMS

Introduction – Features – microprocessors – ALU - Von Neumann and Harvard Architecture - CISC and RISC - Instruction pipelining, Microcontroller: characteristics and Features, Overview and architectures of Atmel 89C52 and Microchip PIC16F877 and 18F452. Examples of embedded Systems: Bar-code scanner, Laser printer, Underground tank monitoring. (10)

PIC MICROCONTROLLERS

PIC Microcontrollers: 16F877 Architecture and Instruction Set. External Interrupts, Timers, watch-dog timer, I/O port Expansion, analog-to-digital converter, UART, I^2C and SPI Bus for Peripheral Chips, Accessories and special features. (8)

SOFTWARE ARCHITECTURE AND RTOS

Software Architecture: Round Robin- Round Robin with interrupts -Function Queue.Scheduling Architecture RTOS: Architecture -Tasks and Task States -Tasks and Data -Semaphores and Shared Data - Message Queues -Mail Boxes and pipes -Timer Functions -Events -Memory Management Interrupt Routines. (8)

BASIC DESIGN USING A REAL TIME OPERATING SYSTEM:

Overview. General principles. Design of an embedded system (Underground tank monitoring System). (6)

SOFTWARE DEVELOPMENT TOOLS AND DEBUGGING TECHNIQUES

Development Tool: Cross-Compiler, Cross-Assemblers, Linker/locator. PROM Programmers, ROM Emulator, In-Circuit Emulators. Debugging Techniques. Instruction set simulators. The assert macro. Testing using laboratory tools. (10)

TEXT BOOKS:

1. Raj Kamal, Embedded Systems Architecture, Programming and Design, TMH, 2008
2. Simon, D. E., An Embedded Software Primer, Pearson Education, 1999.
3. Peatman, J. B., Design with PIC Microcontrollers, Pearson Education, 1998

Power Generation Economics
Code: EE-704C
Contacts: 3L
Credits: 3

Cost of power generation- Thermal, Hydro and Nuclear- Types of Consumers in a distribution system- Domestic, Commercial, Industrial etc. Concept of load factor, diversity factor, demand factor. (6)

Electricity Tariff- Block rate, flat rate, two part, and three part tariffs. Subsidization and Cross subsidization. Availability tariff of generation companies. Pool tariff of transmission companies. Availability based tariff (ABT). (8)

Economics of Power Generation- Unit commitment solution, Spinning reverse. (4)

Economic Dispatch – Transmission loss formulae and its application in economic load scheduling. Computational methods in economic load scheduling. Active and reactive power optimization. (10)

State estimation and load forecasting- Introduction, state estimation methods, concept of load for casting and application in power system. (8)

Text Books:

1. Kirchmayar, L.K. –Economic Operation of Power System-John Wiely, New York.
2. Nagrath, I.J & Kothari, D.P. – Modern Power System Analysis, Tata Mc Graw Hill
3. Chakrabarti & Haldar, Power system Analysis, Operation & Control, 2nd Edition, PHI

Power Plant instrumentation and Control
Code: EE-704D
Contacts: 3L
Credits: 3

Block Diagram of different parts of a Power Plant and scope of Instrumentation - Measurements on Boiler Plant, Turbo-generator Plant and Nuclear Reactors.

Measurement:

Fuel Measurement and various types of weighing systems.

Pressure Measurement - capsules; bellows; diaphragm gauges; bourdon tube pressure gauges; pressure transducers - capacitive type, piezo resistive type; Smart pressure transmitters.

Temperature Measurement - resistance temperature detectors; thermocouples; radiation pyrometers.

Flow Measurement - head type-orifice, venturi; area type-rotameter; mass flow meter.

Level Measurement - capacitive sensors; ultrasonic; DP transmitters.

Analytical:

Gas Analysis - Oxygen - zirconium sensor, paramagnetic; SO_x; NO_x; CO, CO_2
Liquid Analysis - pH; conductivity; dissolved oxygen
Coal Analysis - moisture, carbon, ash

Control:
Boiler Control - Steam pressure control, combustion control, Furnace Draft control, Steam temperature control, Feed water control

Data logger and computer control, supervisory control and monitoring system.

Books:

1. Deobelin E O: Measurement System - Application and Design; TMH.
2. Arora S C & Domkundwar S: Power Plant Engg.; Dhanpat Rai & Co. (P) Ltd.
3. Johnson C: Process Control Instrumentation Technology; PHI/Pearson Education
4. Shawney A K: The Electrical and Electronic Measurement and Instrumentation Dhanpat Rai & Co.
5. Watt Boyes (Editor): Instrumentation Reference Book, 3rd ed.; Butterworth Heineman
6. Douglas M. Considine: Process / Industrial Instruments & Controls Handbook, 4th Ed.; McGraw Hill International Edition.
7. Modern Power Station Practice (Control & Instrumentation), Vol-F; Pergamon Press.

Non conventional energy sources
Code: EE-704E
Contacts: 3L
Credits: 3

Classification of Energy Sources (2)
Advantages of Non Conventional Energy Sources over Conventional Sources Economics, Impact on Environment
Electricity Generation from Non Conventional Energy Sources:
Solar Energy: (12)
Solar radiation and its Characteristics, Solar Collector: flat Plate, focusing, Solar Energy use for water heating, Solar thermal power generation, Hybrid solar power
Principle of energy conversion in solar cells, Photovoltaics, Different types of PV Cells, Mono-poly crystalline and amorphous Silicon solar cells. Design of PV array. Efficiency and cost of PV systems.
Wind Energy: (7)
Wind as energy source, Design of Wind turbine, Selection of site of Wind farm, characteristics of different types of wind generators used with wind turbines
Hydel Energy: (2)
Electricity generation from micro hydel plants, location, auxiliaries and associated problems.
Bio Energy: (4)
Resources and conversion process: bio gas conversion, bio gas plant, bio mass gasifier. co generation
Bio diesel; (2)
Sources, usability and advantages over mineral product,
Tidal Energy: Principle, selection of site, Economics and future prospect (2)
Wave Energy: Principle , selection of site and future prospect (2)
Geo thermal Energy: Principle , location , economics and prospect (2)
Fuel Cells: (5)
Principle of fuel cells, Different types of fuel cells, advantages and limitations
Magneto hydrodynamics energy conversion: (2)
Principle, Economics and environmental aspect of MHD generation

West Bengal University of Technology
BF-142, Salt Lake City, Kolkata-700064

Revised & Final Syllabus of B.Tech in EE upto 8th Semester(To be followed from the academic session,July 2007 ,i.e. for the students who were admitted in Academic Session 2006-2007).The syllabi of other semesters will be published soon.

EIGHTH SEMESTER SYLLABUS

VALUES & ETHICS IN PROFESSION
HU-801
Contracts:3L
Credits- 3

Science, Technology and Engineering as knowledge and as Social and Professional Activities

Effects of Technological Growth:

Rapid Technological growth and depletion of resources, Reports of the Club of Rome. Limits of growth: sustainable development
Energy Crisis: Renewable Energy Resources
Environmental degradation and pollution. Eco-friendly Technologies. Environmental Regulations, Environmental Ethics
Appropriate Technology Movement of Schumacher; later developments
Technology and developing notions. Problems of Technology transfer, Technology assessment impact analysis.
Human Operator in Engineering projects and industries. Problems of man, machine, interaction, Impact of assembly line and automation. Human centered Technology.

Ethics of Profession:

Engineering profession: Ethical issues in Engineering practice, Conflicts between business demands and professional ideals. Social and ethical responsibilities of Technologists. Codes of professional ethics. Whistle blowing and beyond, Case studies.

Profession and Human Values:

Values Crisis in contemporary society
Nature of values: Value Spectrum of a good life
Psychological values: Integrated personality; mental health
Societal values: The modern search for a good society, justice, democracy, secularism, rule of law, values in Indian Constitution.
Aesthetic values: Perception and enjoyment of beauty, simplicity, clarity
Moral and ethical values: Nature of moral judgements; canons of ethics; ethics of virtue; ethics of duty; ethics of responsibility.

Books:

1. Stephen H Unger, Controlling Technology: Ethics and the Responsible Engineers, John Wiley & Sons, New York 1994 (2nd Ed)
2. Deborah Johnson, Ethical Issues in Engineering, Prentice Hall, Englewood Cliffs, New Jersey 1991.
3. A N Tripathi, Human values in the Engineering Profession, Monograph published by IIM, Calcutta 1996.

INDUSTRIAL MANAGEMENT
Code: HU-802
Contacts : 3L
Credit: 3

Basic concepts of management, objectives, classification and hierarchy, different schools of management thought, principal functions of management, Management as an organizing and directing force, Structure of the management decision making process, Organization structure, authority and responsibility, Organisation dynamics, Managerial leadership, communication systems, Managing human factors in business and industry, Industrial relation, Union activities, trade union acts, collective bargaining, disciplinary procedure.

Organizational objectives and long range forecasting, planning, organizing, programming and controlling process, managerial control strategies; quantity and quality control, cost benefit analysis, present work and breakeven analysis, budgetary control, use of management science for the efficient administration of economic units, production, financial and marketing management.

Adoption of statistical and computer methods and techniques to managerial research and managerial decision making and general management.

Books:

1. Industrial Management - S C Jain, W S Bawa, Dhanpat Rai & Co. (P) Ltd.
2. Industrial Management, Vol.1 L.C. Jhamb, EPH,
3. Industrial Engineering & Production Management - Martand Telsang, S. Chand
4. Industrial & Business Management - Martand T. Telsang, S. Chand
5. Introduction to Materials Management - J Tony Arnold & Stephen N. Chapman, Pearson Education Asia
6. Production & Operations Management – Adam, Pearson Education /PHI
7. Industrial Relations, Trade Unions & Labour Legislation - Sinha, Pearson Education Asia
8. Business Organisation & Management - Tulsian, Pearson Education Asia.

Elective-II

Advanced High Voltage Engineering[New]
EE801A
Contacts: 3L
Credit: 3

Module 1 **12**

Electric Stress and its estimation
Field sketching: Effect of asymmetry, Effect of multi dielectric
Field Computation Techniques: Electrolytic tank method, Numerical Methods
Electric Stress control techniques.
Mechanism of Spark Breakdown in gases:
Charge generation in gases and from solids , Review of Townsend's Theory and Streamer Theory. Time lags : Formitive time lag, Atatistical time lag.
Breakdown in Vacuum, Breakdown of Electronegative gases

Module 2 **8**

Partial Discharge: Breakdown of gaseous medium in non uniform field. Effect of polarity on corona inception and breakdown process.
Partial discharge development in solid dielectric under d.c and a.c voltage applications. Measurement of Partial Discharges, different techniques , Electrical method : apparent charge, straight method , balanced method

Module 3 **12**

Multistage Impulse Generator, Representation of multistage impulse generator by single stage generator, analysis of single stage impulse generator circuit, triggering of impulse generator, triggering techniques.
Impulse current generator
Generation of switching surge
D.C High Voltage Generation:
Multistage Cockcroft Walton Voltage doubler Circuit , Determination of optimum stage , Regulation

Measurement of Impulse voltage and impulse current.

Module 4 **8**

Non destructive testing: Measurement of Dielectric constant and loss angle. Measurement of resistivity. Voltage distribution in a transformer under under impulse voltage. Tests on a transformer. Impulse voltage test. Interpretation of test result. Short circuit tests ,Testing of Lightning Arrestors, Circuit Breakers

Reference Books

1. Kuffel,E, Zaengel, W.S, . Highvoltage Engineering Fundamentals(2nd edn) Butterworth-Heinmann(2000)
2. High voltage Engineering- E.Kuffel & M.Abdullah (Oxford Pergamon Press)
3. An Introduction to High Voltage Engineering- Subir Ray (PHI Learning)
4. High Voltage Engineering- M.S Naidu & V.Kamaraju (Tata Mcgraw Hills)
5. High Voltage measurement techniques- A.J Schwab (MIT Press, Cambridge)
6. High Voltage Engineering : C.L. Wadhwa. New Age International(p) Ltd, publishers

Power system dynamics & Control[New]
EE801B
Contacts: 3L
Credit: 3

Module-1

Modeling of Power System Components: Modeling of a synchronous generator along with its components(exciter and turbine), Modeling of a regulating transformer, three phase modeling, modeling of three phase single circuit transmission line, modeling of a pair of three phase mutually coupled transmission line, modeling of shunt capacitor and inductor, modeling of a series capacitor, modeling of an induction motor, modeling of a series capacitor, modeling of a SVC, power network modeling, modeling of a load. [8]

Module-2

Reactive Power Flow and Voltage Control Problems: Reactive power-voltage coupling concept, reactive power and voltage regulation, load bus reactive power sensitivity, effect of series reactive loss, reactive power requirement for control of voltage in long lines, concept of voltage stability and system voltage expression, stability margins, fundamental aspects of analysis of power system voltage stability-static and dynamic analysis, QV operation of on load tap changer in voltage stability, load flow and voltage stability, voltage security, magnitude and power angle of receiving end bus voltage at voltage stability limit. [10]

Module-3

Power System Compensation and FACTs Devices; Load compensation, line compensation, passive compensation – static shunt capacitor and reactor, uniformly distributed shunt compensation, shunt compensation at middle of the line using dynamic compensator, series capacitor compensator, comparison between shunt and series compensation, FACTs controllers, (series type, shunt type, combined shunt and series type FACTs controller), advantages of FACTs devices. [12]

Module-4

Small Signal Stability and Subsynchronous Resonance: Introduction, stability of a dynamic system, modes of oscillation, mechanism of tie line oscillator, small signal stability of a single machine on infinite bus (SMIB), modeling of small signal stability, effect of exciter on small signal stability, SSR in series compensated systems, modeling and analysis of mechanical system and analogy with electrical system, countermeasures to SSR. [10]

Books

1. Power system analysis, operation and control. A.Chakrabarti and S. Halder, PHI publication, (3rd Edn.)
2. Power system dynamics, stability and control. K.R. Padiyar, BS publication. (2nd Edn.)
3. Reactive power control and voltage stability of EHV power transmission system. A. Chakrabarti, D,P Kothari,. A.K Mukhapadhyay and A.De, PHI publication. (1st Edn.)

ENERGY MANAGEMENT AND AUDIT[New]
EE801C
Contacts: 3L
Credit: 3

Module - 1:(9 Lectures)
Introduction: Energy Scenario, Energy Analysis of Fuels, Energy Needs of Growing Economy, Long Term Energy Scenario, Energy Pricing, Energy Sector Reforms,
Energy and Environment: Air Pollution, Climate Change, Energy Security, Energy Conservation and its Importance, Energy Strategy for the Future, Energy Conservation Act-2001 and its Features.
Module-2 (9 Lectures):
Basics of energy and it's various forms: (a) thermal (b) Electricity (c) Non-Conventional Sources
Thermal: Different Fuels & its Energy Contents, Temperature & Pressure, Heat Capacity. Steam and Moist Air.
Electricity: AC & DC, Load Management, Maximum Demand Control, Aggregated Technical & Commercial Losses (ATC), Electricity Tariffs.

Non-Conventional: Concept of Renewable Energy and its Various Forms (Solar energy, Wind Energy, Bio energy, Hydro energy, geothermal energy, Wave and tidal energy.). Some Applications related to Non-Conventional Energy Sources.

Module-3 (9 Lectures):

Energy Management: Need for Energy Management, Various Approaches, Cost Effectiveness, Bench Marking, Optimization of Energy Requirements and Maximization of System Efficiencies. Fuel and Energy Substitution.. A Few Case Studies of Real Systems.

Module-4 (9Lectures):

Energy Audit: Definition, Requirements for Energy Audit, Different Approaches viz, Preliminary and Detailed Energy Audit, Case Studies for Real Systems.

Books:

!. Albert : Plant Engineers & Managers Guide to Energy Conservation.

2. Wayne C. Turner Energy management handbook, John Wiley and Sons.

3. www.bee.org

REFERENCES:

1. NPC energy audit manual and reports
2.. Guide to Energy Management, Cape Hart, Turner and Kennedy
3.. Cleaner Production – Energy Efficiency Manual for GERIAP, UNEP, Bangkok prepared by National Productivity Council
4. M.K.Lahiri : Saving of Electricity by System Management. M.K. Lahiri Publication

Non linear Control systems[New]
EE801D
Contacts: 3L
Credit: 3

Module-I:(9 Lectures)

Introduction: Block diagram and State Variable representations of Nonlinear Systems; Behavior of Nonlinear Dynamic Systems: (Multiple Equilibria, Limit Cycles, bifurcation); Examples of Simple Nonlinear Models: Pendulum Equation , Tunnel-Diode Circuit , Mass–Spring System , Negative-Resistance Oscillator; Common Nonlinearities. (6)

Small perturbation Linearization of nonlinear systems in state variable form: Linearization about equilibrium point , about nominal trajectory, Jacobian of simple nonlinear systems, Stability analysis by Lyapunov's First Theorem.(3)

Module-II: (7 Lectures)

Lyapunov Stability: Concept, Autonomous Systems , Stability and Asymptotic Stability The Invariance Principle , Nonautonomous Systems, Input-to-State Stability.(5)

Input-Output Stability : L Stability of State Models, L 2 Gain, Feedback Systems: The Small-Gain Theorem.(2)

Module-III: (11 Lectures)

Frequency Domain Analysis of Feedback Systems: Absolute Stability, Circle Criterion, Popov Criterion ,Closed loop Stability analysis and limit cycle prediction using Describing Function Method. (9)

Passivity: Memory-less Functions, State Models, Positive Real Transfer Functions, L 2 and Lyapunov Stability, Feedback Systems: Passivity Theorems (statements only).(2)

Module-IV: (9 Lectures)

Feedback Linearization: Motivation, Input–Output Linearization, Full-State Linearization, State Feedback Control and Stabilization. (5)

Sliding Mode Control: Overview of SMC**,** Motivating Examples: Stabilization of second order system; Advantages and disadvantages. (4)

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Text Book

1. H. K. Khalil. Nonlinear Systems. Prentice Hall, 3rd edition, 2002.

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Ref Books :

1. S. S. Sastry. *Nonlinear Systems: Analysis, Stability and Control*, Springer, 1999.
2. A. Isidori. Nonlinear Control Systems. Communications and Control Engineering Series. Springer, 3rd edition,1995
3. Jean-Jacques Slotine, Weiping Li, *Applied Nonlinear Control*, Pearson Education, 1990.
4. Graham C. Goodwin, Stefan F. Graebe, Mario E. Salgado, *Control System Design* (Chapter-19), Prentice Hall, 2000.
5. M. Gopal , *Digital Control and State Variable Methods*, 2nd edition, (chapter 10), Tata Mc Graw-Hill, 2003.
6. D. Roychoudhuri, *Modern Control Engineering*(Chapter 14), Prentice Hall of India,2005

Elective-II

COMMUNICATION ENGG
EE802A
Contacts: 3L
Credit: 3

Linear modulations - AM, DSB, SSB and VSB. Envelope and synchronous detection. Carrier recovery-different loops e.g. PLL etc. Circuits to generate linear modulated signals. Low and high power modulators. Exponential modulation. Frequency and phase modulations. Generation of FM & PM. Radio receivers-superheterodyne principle. AGC, Elements of antenna technology, wave guide and microwave technology.

Noise sources and their characteristics, noise temperature, noise figure and bandwidth. SNR, performance of AM, PM, FM and pulse modulation over different transmission channels.

Channel Capacity, Shannon's Theorem, Nyquist Criterion and Sampling. Pulse modulation types, detection of PAM, PWM & PPM, Pulse generation. Quantisation of analog signals - generation noise. A/D & D/A conversions. PCM, DM, ADM, DPCM, ADPCM for speech signals. Time division and Frequency division multiplexing. Digital modulations: SK, FSK, PSK, DPSK, QPSK & MQAM. Modems. Elements of information theory. Error control and coding Data transmission-synchronization, data protection, error detection and corrections - protocol. Elements of optical communication - optical fibre and sources. Photo-detectors, optical connectors and couplers. Analog and digital transmission using opto - devices.

Elements of satellite communications - tracking and control, launching. Propagation characteristics. Satellite transponders and antennas. Modern trends in communications systems.

Books:

1. B P Lathi, Holt - Modern Digital and Analog Communication System -,OUP
2. G. Kennedy - Electronic communication Systems - TMH
3. R Coolen - Electronic Communication - PHI (1989)

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4. Hancock - An introduction to the Principles of Communication Theory - TMH
5. Taub and Schilling - Principles of Communication systems – TMH
6. Roddy, Electronic Communication, Pearson Education/PHI
7. S. Haykin - Communication systems - Pearson Education/PHI
8. Dungan, Electronic Communication Systems, Vikas
9. Carlson - Communication Engg.

Sensors & Transducers[New]
EE802B
Contacts: 3L
Credit: 3

Module I

Definition, principles of sensing and transduction, classification	1
Mechanical and Electromechanical sensors	
Resistive (potentiometric) type: resolution, accuracy, sensitivity	1
Strain Gauges: theory, types, sensitivity, gauge factor, variation with temperature,.	1
Inductive sensors: common types- reluctance change type, mutual inductance change type, transformer action type, magnetostrictive type.	1
LVDT: Construction, output-input relationship, I/O curve, discussion	1
Proximity sensor	1

Module II

Capacitive sensors: Variable distance- parallel plate type, Variable area- parallel plate, serrated plate/teeth type and cylindrical type, variable dielectric constant type: calculation of sensitivities	3
Stretched Diaphragm type: microphones, response characteristics	2
Piezoelectric elements: piezoelectric effects, charge and voltage coefficients, crystal model, materials, natural and synthetic types – their comparison, force and stress sensing, ultrasonic sensors	3

Module III

Thermal sensors:	
Material expansion type: solid, liquid, gas and vapour	2
Resistance change type: RTD, materials, construction, tip sensitive and stem sensitive type, Thermister materials, shapes, ranges, accuracy specifications.	3
Thermoemf sensors: types, thermoelectric powers, general consideration	1
Junction semiconductor type IC and PTAT type	2
Radiation sensors: types, characteristics and comparisons	2
Pyroelectric type	1

Module IV

Magnetic sensors: Sensors based on Villari effect for assessment of force, torque, proximity; Wiedemann effect for yoke coil sensors, Thomson effect. Hall effect and Hall drive, performance characteristics	4
Radiationsensors: LDR, photovoltaic cells, photodiodes, photo emissive cells- types, materials, construction, response	2
Geiger counters, Scintillation detectors	2
Introduction to Smart sensors	2
Humidity, pH, conductivity	1

Velocity, Acceleration: Electromagnetic velocity sensor; spring-mass-system, measurement of deflection principle of accelometers, sensitivity, noise Flow: Pressure gradient technique; (orifice, venture, pitot,) rotameter thermal transport technique; electromagnetic sensor, laser doppler anemometry;ultrasonic sensors	 1 1 4

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Books:

1. D Patranabis, Sensors and Transducers, PHI, 2nd ed.
2. E. A. Doebelin, Measurement Systems: Application and Design Mc Graw Hill, New York
3. H. K. P. Neubert, Instrument Transducers, Oxford University Press, London and Calcutta

AI and Soft computing
EE802C
Contacts: 3L
Credit: 3

Machine Learning & AI - Introduction, hierarchical perspective and foundations. Rote Learning, Learning by advice, Learning in problem solving inductive learning, explanation based learning, learning from observation and discovery, learning by analogy, introduction to formal learning theory.

Biological neurons and brain, models of biological neurons, artificial neurons and neural networks, Early adaptive nets Hopfield nets, back error propagation competitive learning lateral inhibition and feature maps, Stability - Plasticity and noise saturation dilemma, ART nets, cognition and recognition.

Neural nets as massively parallel, connectionist architecture, Application in solving problems from various are as e.g., AI, Computer Hardware, networks, pattern recognition sensing and control etc.

Books:

1. P H Winston - Artificial Intelligence - Pearson Education
2. Bishop, Neural Networks for Pattern Recognition, OUP
3. Cohen, Empirical Methods for AI, PHI
4. Haykin, Neural Network, Pearson Education/PHI
5. E Charniak and W Midermott - Introduction to Artificial Intelligence - Pearson Education.
6. Hagan, Neural Network Design , Vikas
7. Shivanandan, Artificial Neural Network, Vikas

Bose - Neural Network Fundamentals with graphs, Algorithms and Applications – TMH

Project Management & Operation Research
EE802D
Contacts: 3L
Credit: 3

Project formalities - feasibility study and economic evaluation; UNI DO, OECD and RBI guidelines. Network based project management-graph-theoretic applications. CPM, PERT, GERT and DCPM activities. Scheduling with limited resources, cash scheduling to multi projects situation. Project monitoring and control. Project management under risk and uncertainty.

Operations research-decision-making, development of OR. Linear programming; Formulating of LP models, graphical solution, simples method, duality theory and application. Transportation problem, Assignment problem. Waiting line models; elements of queuing models. Poisson arrival and exponential service time distribution, M/M/I Queue. Finite population models. Queuing art models. Applications. Simulation; modeling, use of random members, flow-chart development, Inventory Control-introduction, costs, deterministic and stochastic models, buffer stocks.

Books:

1. Hiller - Introduction to Operation Research 6th Edn. - TMH
2. A Ravindran - Introduction to Operation Research - John Wiley, 1993.
3. Panneerselvam, Production & Operations Management,PHI
4. Taha - Operation Research, Pearson Education/PHI
5. Kalavathy, Operation Research, Vikas
6. Patel,Project Management, Vikas
7. Juran - Quality Planning & Analysis 3rd End. - MGH
8. R Kapoor - Computer Assited Decision Models - TMH, 1991
9. P Iyer - Engineering Project Management - Wheeler
10. Adam & Ebert - Production & Operations Management: Concepts, Models and Behaviour 5th Edn. – PHI/ Pearson Education.