Scheme & Syllabus for B.Tech. in Electrical Engineering according to Choice Based Credit System (CBCS)

(Semester III to Semester VIII)

Department of Electrical Engineering

School of Engineering & Technology

CENTRAL UNIVERSITY OF HARYANA
MAHENDERGARH-123031
HARYANA

Scheme –B. Tech. (Electrical Engineering 2nd Year)

THIRD SEMESTER

CODE	SUBJECT	L	T	P	TOTAL Contact Hours	CREDIT	THEORY	INTERNAL ASSESSMENT	PRACTICAL	TOTAL MARKS
BT EE-301	Electrical Machine-I **(Core)**	3	1	0	4	4	70	30	-	100
BT EE 302	Electrical Machine-I Laboratory **(Core)**	-	-	2	2	1	-	15	35	50
BT EE 303	Network Analysis & Synthesis **(Core)**	3	1	0	4	4	70	30	-	100
BT EE 304	Network Analysis & Synthesis Laboratory **(Core)**	-	-	2	2	1	-	15	35	50
BT EE 307	Transmission And Distribution **(Core)**	3	0	0	3	3	70	30	-	100
BT EE 308	Transmission And Distribution Laboratory **(Core)**	-	-	2	2	1	-	15	35	50
	Generic Elective Course (GEC 1)*	3	1	2	6	5	70	30		100
								15	35	50
BT HS 310	Fundamentals of Business Management	3	0	0	3	3	70	30	-	100
	Innovation Laboratory				4					
TOTAL					30	22.0	350	210	140	700

* List of GEC-1 to be offered for other departments

CODE	GEC- 1 SUBJECTS
BT EE 301:	Electrical Machine-I
BT EE 302:	Network Analysis & Synthesis

FOURTH SEMESTER

CODE	SUBJECT	L	T	P	TOTAL Contact Hours	CREDIT	THEORY	INTERNAL ASSESSMENT	PRACTICAL	TOTAL MARKS
BT MS 401	Numerical Methods in Engineering**(GEC Physics /Mathematics Department)**	3	0	2	5	4	70	30	-	100
							-	15	35	50
BT EE 402	Electrical Machines-II	3	0	0	3	3	70	30	-	100
BT EE 403	Electrical Machines-II Laboratory	-	-	2	2	1	-	15	35	50
BT EE 404	Power Generation	3	0	0	3	3	70	30	-	100
BT EE 405	Electrical Measurements & Measuring Instruments	3	0	0	3	3	70	30	-	100
BT EE 406	Electrical Measurements & Measuring Instruments Laboratory	-	-	2	2	1	-	15	35	50

	Generic Elective Course (GEC 2)**	3	1	2	6	5	70	30	-	100
								15	35	50
BT HS 407	Economics	3	0	0	3	3	70	30	-	100
BT EV 408	Environmental Science ***	3	0	0	3	-	70	30	-	100
				TOTAL	**30**	**23**	490	270	140	900
	** GEC-2 to be taken from other department. ******* Environmental Science will be of qualifying nature.									

List of GEC offered for other departments

CODE	**GEC-ISUBJECTS**
BT EE 409	Smart Grid
BT EE 404	Power Generation

Scheme –B. Tech. (Electrical Engineering3rd Year)

FIFTH SEMESTER

CODE	SUBJECT	L	T	P	TOTAL Contact Hours	CREDIT	THEORY	INTERNAL ASSESSMENT	PRACTICAL	TOTAL MARKS
BT EE 501	Power Systems Analysis	3	1	0	4	4	70	30	-	100
BT EE 502	Control System Engineering	3	1	0	4	4	70	30	-	100
BT EE 503	Control System Engineering Laboratory	-	-	2	2	1	-	15	35	50
BT EE 504	Microprocessors and Interfacing	2	1	0	3	3	70	30	-	100
BT EE 505	Microprocessors and Interfacing Laboratory	-	-	2	2	1	-	15	35	50
BT EE 506	Analog and Digital Electronic	3	0	0	3	3	70	30	-	100
BT EE 507	Analog and Digital Electronic Laboratory	-	-	2	2	1	-	15	35	50
	DCEC 1#	3	0	0	3	3	70	30	-	100
	Innovation Laboratory				7					
TOTAL					**30**	**20**	**350**	**195**	**105**	**650**

#List of DCEC-1

One of the following two papers to be chosen by the students. The paper to be allotted on merit basis by the Department depending upon the specialization of available faculty.

CODE	DCEC-1 SUBJECTS
BT EE 508	Electromagnetic Field Theory
BT EE 509	Advance Power Electronics & Drives
BT EE 510	HVDC & FACTS

SIXTH SEMESTER

CODE	SUBJECT	L	T	P	TOTAL Contact Hours	CREDIT	THEORY	INTERNAL ASSESSMENT	PRACTICAL	TOTAL MARKS
BT EE 601	Switchgear And Protection	3	0	0	3	3	70	30	-	100
BT EE 602	Switchgear And Protection Laboratory	-	-	2	2	1	-	15	35	50
BT EE 603	Power Electronics	3	1	0	4	4	70	30	-	100
BT EE 604	Power Electronics Laboratory	-	-	2	2	1	-	15	35	50
BT EE 605	Signal and systems	3	0	0	3	3	70	30	-	100
	DCEC 2##	3	1	0	4	4	70	30	-	100
	DCEC 3##	3	1	0	4	4	70	30	-	100
	Innovation Laboratory				8					

TOTAL	**30**	**20**	**350**	**180**	**70**	**600**

Note: The students shall devote 4 weeks to Survey Camp after 6th Semester Examination.

##List of DCEC2 and DCEC 3

Two of the following two papers to be chosen by the students. The paper to be allotted on merit basis by the Department depending upon the specialization of available faculty.

CODE	**DCEC-2 DCEC 3 SUBJECTS**
BT EE 606	Advanced Instrumentation
BT EE 607	Advanced control System Engineering
BT EE 608	Advanced Microprocessor & Microcontroller
BT EE 609	Electrical Machine Design
BT EE 610	Optimization Techniques in Power System

Scheme –B. Tech. (Electrical Engineering 4th Year)

SEVENTH SEMESTER

CODE	SUBJECT	L	T	P	TOTAL Contact Hours	CREDIT	THEORY	INTERNAL ASSESSMENT	PRACTICAL	TOTAL MARKS
BT EE 701	Computer aided Power System analysis	3	1	0	4	4	70	30	-	100
BT EE 702	Computer aided Power System analysis Laboratory	-	-	2	2	1	-	15	35	50
BT EE 703	High Voltage Engineering	3	0	0	3	3	70	30	-	100
BT EE 704	Power system Operation & Control	3	1	0	4	4	70	30	-	100
	DCEC 4###	3	0	0	3	3	70	30	-	100
BT EE 705	Industrial Summer Training #	-	-	-		2	-	15	35	50
BT EE 706	Design Project	0	0	6	6	3		30	70	100
	Innovation Laboratory				8					
TOTAL					**30**	**20**	**280**	**180**	**140**	**600**

###List of DCEC 4

One of the following two papers to be chosen by the students. The paper to be allotted on merit basis by the Department depending upon the specialization of available faculty.

CODE	DCEC- 4
BT EE 707	Nonconventional Energy sources

BT EE 708	Fuzzy Logic and Neural Networks
BT EE 709	Power Quality & Management

EIGHTH SEMESTER

CODE	SUBJECT	L	T	P	CREDIT	THEORY	INTERNAL ASSESMENT	PRACTICAL	TOTAL MARKS
BT EE 801	Internship/ Major Project	-	-	-	**20.0**	-	350	150	500
					20.0	-	350	150	500
				TOTAL	**20.0**	-	350	150	500

Detailed Contents of the Syllabus of B.Tech in Electrical Engineering

EE courses of Semester III:

BT EE 301 Electrical Machine-I

Total Credit: 4
Max. Marks: 100
Theory: 70
Internal: 30
Time Allowed: 3Hrs

Course Objective:

To acquaint students with the theory and principles of electromagnetism and electromechanical energy conversion devices and systems. To make them learn the basic principle, construction and working of DC Generator and DC motor, learning the characteristics and applications of DC Generators and DC Motors, the basic speed control techniques of DC motors, learning the Transformer theory and practices including routine tests, its efficiency and regulation etc.

UNIT-I Transformers: Principle, Construction of Core, Winding & Tank, Operation, Testing of Single Phase Transformer, Equivalent Circuit, Phasor Diagram, Parameters Determination, P.U. Representation of Parameters, Regulation, Losses & Efficiency, Separation of Iron Losses. Parallel Operation of Single Phase Transformers. Auto-Transformer: Principle, Construction, Comparison With Two Winding Transformers, Application.

UNIT-II: Various Types of Connection of Three Phase Transformer, Their Comparative Features, Zig-Zag Connection. Parallel Operation of Single Phase & Three Phase Transformers. Auto-Transformer: Principle, Construction, Comparison With Two Winding Transformers, Applications. Nature of Magnetizing Current, Plotting of Magnetising Current From B-H Curve, Inrush Current, Harmonics, Effect of Construction on Input Current, Connection of Three Phase Transformer. Phase-Conversion: Three to Two Phase, Three to Six Phase and Three To Twelve Phase Conversions. Introduction To Three Winding, Tap-Changing & Phase-Shifting Transformers.

UNIT-III Energy Conversion: Principle of Electromechanical Energy Conversion, Energy Stored In A Magnetic Field System, Singly and Doubly Excited Systems. Basic Concepts of Rotating Electrical Machines: Constructional Details of Various Rotating Machines, Introduction to Lap and Wave Windings, EMF Generation, Effect of Chording and Distribution of Winding On EMF, Harmonics In Generated Emf, MMF of Distributed Winding.

UNIT-IV D.C. Machines: Elementary DC Machine, Principle & Construction of D.C. Generator, Simplex Lap and Wave Windings, E.M.F. Equation, Armature Reaction, Compensating Winding, Commutation, Methods of Excitation, Load Characteristics, Parallel Operation.
Principle of DC Motors, Torque and Output Power Equations, Load Characteristics, Starting, Speed Control, Braking, Testing, Efficiency & Applications. Crossfield Machines: Principle of Operation of Rosenberg Generators, Amplidyne and Metadyne Brushless D. C. Motors: Constructional Features, Principle of Operation, Applications.

Text books:

1. Nagrath & Kothari, Electrical Machines, TMH, 2010, 4th edition.
2. A.S Langsdrof, Theory of A.C Machinery, TMH, 2004, 2nd edition.
3. Ashfaq Husain, Electric Machines, Dhanpat Rai, 2012.

Reference books:

1. I. L. Kosow – Electrical Machinery and Transformers – Prentice – Hall of India Pvt. Ltd.,2nd edition, 2010.
2. Stephen Chapman – Electric Machinery Fundamentals – McGraw-Hill, 2003, 4th edition.

BT EE 302 Electrical Machine-I Laboratory

Total Credit: 1
Max. Marks: 50
External Marks: 35
Internal Marks: 15
Time Allowed: 3Hrs

1. Open circuit characteristic of DC shunt generator. Determination of critical field resistance and critical speed.
2. Load test on DC shunt motor. Determination of characteristics.
3. Speed control of DC shunt motor by field and armature control.
4. Load test on DC series motor. Determination of characteristics.
5. Hopkinson's test on DC shunt machines. Predetermination of efficiency.
6. Swinburne's test and speed control of DC shunt motor. Predetermination of efficiencies.
7. Retardation test on DC shunt motor. Determination of losses at rated speed.
8. O.C. & S.C. tests on single phase transformer
9. Load test on single phase transformer
10. Parallel operation of Single phase Transformers
11. Sumpner's back-to-back test on a pair of single phase transformers

BT EE 303

Network Analysis & Synthesis

Total Credits: 4
Max. Marks: 100
Theory Marks: 70
Internal Marks: 30
Time Allowed: 3Hrs

Course Objectives:

To make the students understand the basic concepts of network analysis and their sysnthesis. After undergoing this course the students will have the knowledge of circuit fundamentals and their solutions, Laplace transform, Synthesis and analysis of circuits, Transfer functions etc.

UNIT-I: Nodal and Mesh Analysis, Solution by Classical Method and Laplace Transform, Duality of Networks, Superposition and Reciprocity Theorem, Thevenin's and Norton's Theorem, Millman's Theorem, Maximum Power Transfer Theorem, Compensation, Analysis of Circuits Using Theorems.

UNIT-II: Transient Analysis of Networks: Network Elements, Transient Response of R-L, R-C, R-L-C For DC and Sinusoidal Excitation, Initial & Final Condition, Solution Using Differential Equation Approach and Laplace Transform Method.
Coupled Circuit: Self Inductance, Coefficient of Coupling, Dot Convention Analysis of Coupled Circuits.

UNIT-III: Two-Port Network: Introduction, Different Parameters and Relationship between Different Parameters, Inter-Connections of Two Port Networks.
Graph Theory: Definition, Graph, Tree, Basic cut- set & tie-set matrices for planer networks-loop and nodal method of analysis of networks with independent and dependent Voltage & current source, Duality & dual networks.

UNIT-IV: Hurwitz polynomials, positive real functions. Properties of real immittance functions, Synthesis of LC driving point immittances, Properties of RC, RL & LC networks, Synthesis of RC driving point impedances, Synthesis of RC impedances or RL admittances, properties of RL impedances and RC admittances. Network realizability, Positive real functions, Foster and Cauer forms of realization
Filters: Low pass, High pass, Band pass & Band reject filter design concepts. Design of constant-K, m derived filters. , Types of frequency selective filters, Linear phase filters, active filter concept.

Text Books:

- Choudary D Roy, Network and Systems, New Age International
- Soni and Gupta, A Course in Electrical Circuit Analysis, Dhanpat Rai & Sons.
- Chakraborty

Reference Books:

- Bird - Electric Circuit theory & technology, Elsevier
- Van Valkenberg M E, Network Analysis, Prentice Hall of India Ltd
- Franklin F Kuo, Network Analysis and synthesis, Wiley India Pvt Ltd

BT EE 304 Network Theory Laboratory

Total Credit: 1
Max. Marks: 50
External Marks: 35
Internal Marks: 15
Time Allowed: 3Hrs

EXPERIMENTS

1. To calculate and verify “Z” & “Y” parameters of a two port network.
2. To determine equivalent parameter of parallel connections of two port network and study loading effect.
3. To calculate and verify "ABCD" parameters of a two port network.
4. To synthesize a network of a given network function and verify its response.
5. To plot the frequency response of low pass filter and determine half-power frequency.
6. To plot the frequency response of high pass filter and determine the half-power frequency.
7. To plot the frequency response of band-pass filter and determine the band-width.
8. To plot transient response of RC circuit.
9. To plot transient response of RL circuit.
10. To plot transient Response of RLC Circuit

BT EE 307 Transmission And Distribution

Total Credits: 3
Max. Marks: 100
Theory Marks: 70
Internal Marks: 30
Time Allowed: 3Hrs

Course Objective:
To make the students understand the basic concepts of transmission and distribution systems. After undergoing this course the students will have the knowledge of transmission and distribution systems parameters calculations, Transmission system efficiency, Mechanical design of lines, Insulators, Their types, Corona and cables etc.

UNIT-I Introduction: Structure of a power system, Indoor and outdoor substations, Equipment for substations, Layout, Auxiliary supply.
Distribution Systems: Radial, Ring mains and network distribution system, Comparison of various types of ac and dc systems. Different types of bus bar schemes, Layouts.

UNIT-II Transmission Lines: Calculation of line parameters, Line Inductance, Line Capacitance, C, Different configurations, Ferranti effect, Proximity effect.
Performance of Lines: models of short, Medium and long transmission lines, Performance of transmission lines, Circle diagram, Capacity of synchronous condenser, Tuned lines, Voltage control.

UNIT-III Mechanical Design: Sag and stress calculations, Effect of ice and wind, Dampers.
Insulators: Types, Insulating materials, Types of Insulators, Voltage distribution over insulator string, Equalizer ring.

UNIT-IV Cables: Types of LV and HV cables, Grading of cables, Capacitance calculations, Heating of cables, Ratings.
Corona: Phenomenon, Critical voltage, Power loss, Reduction in losses, Radio-interference. Basic principles of HVAC and Applications.

Text Books:

- Nagrath I J and Kothari D P, Power System Engg, TMH
- Gupta, Soni & Bhatnagar, A Course in Electrical Power, Dhanpat Rai & Sons
- Guptra B R, Power System Engineering, Wheeler
- Wadhwa C L, Power Systems Analysis, Wiley India Ltd
- Gupta J B, Electrical power, S K Kataria & Sons

Reference Books:

- Bayliss, Transmission and generation of power, Elsevier
- Stevenson W D, Elements of power system analysis, MCH

- Faulkenberry L M and Coffer W, Electrical Power Distribution and Transmission, PHI
- Weedy B M, Electric Power System, John Wiley & Sons
- Transmission & Distribution of Electrical Engineering, Westing House & Oxford Univ. Press, New Delhi.

BT EE 308 Transmission And Distribution Laboratory

Total Credit: 1
Max. Marks: 50
External Marks: 35
Internal Marks: 15
Time Allowed: 3Hrs

Experiments:

1. Set up on experiment to study the performance of a long transmission line under no load and under light load condition.
2. Set up on experiment kit to study the performance of a long transmission line under load at different power factors.
3. Set up on experiment kit to find out the ABCD and hybrid parameters of given transmission model.
4. Set up on experiment kit to study the performance characteristics of a typical dc distribution system (radial configuration).
5. To measure direct axis and quadrature axis reactance of synchronous machine.
6. To measure direct axis and quadrature axis subtransient reactance of synchronous machine.
7. Condition Monitoring of Distribution Transformer
   Oil Testing: Determine the strength of the given transformer oil.
8. Partial Discharge Testing: Determine the partial discharge level of the given distribution transformer as a function of voltage.
9. Voltage Regulation of a long transmission line with resistive inductive and capacitive loads.

BT HS 310 Fundamentals of Business Management

Total Credit: 3
Max. Marks: 100
Theory: 70
Internal: 30
Time Allowed: 3Hrs

Course Objective:
To provide the students a basic understanding of Business and Economics which are vital constituents of the overall professional environment of an Engineer.

UNIT-I

Nature and Significance of Human Resource Management, Functions of Human Resource Management, Manpower Planning, Job Analysis, Job Description & Job Specification, Recruitment, Selection, Training & Development, Compensation Management, Performance Appraisal, Employee Welfare, Safety and Health, Human Resource Development.

UNIT-II

Meaning, Scope and Goals of Financial Management, Investment Decision, Nature, Importance, Evaluation Criteria, Financing Decision, Long Term Sources of Funds, Cost of Capital, Capital structure, Leverage, Dividend Decision, Models and determinants of dividend decision, Working Capital Management, Theories and determinants, Forecasting of working capital, Management of Cash.

UNIT-III

Concepts of market, Marketing and marketing management, Marketing Environment-Analyzing needs & trends in macro environment, Economic environment, Technical environment, Political environment, And socio-cultural environment, Market Segmentation, Targeting and positioning strategies, Marketing mix, Product, Meaning, Product mix, Levels of product, Product life cycle, Price, Meaning, Importance, Pricing objectives and strategies, Place, Importance, Functions of distribution channels, Promotional mix-advertising, Sales promotion, Personal selling, Public relations, Direct marketing.

UNIT-IV

Meaning and significance of Economics, Role of economics in engineering and technology, Basic economic terms, Utility, Saving, Investment, Equilibrium, Micro and macro economics, Economic policies, Globalization, Privatization, Liberalization, Demand &Supply Analysis, Meaning of demand and supply, Law of demand and supply, Elasticity of demand and its measurement,

Production, Factors of production, Law of variable production, Production function, Cost Analysis, Types of costs and shapes of different cost curves, Theory of Firm and Pricing, Types of markets, Equilibrium of firm and industry under perfect, Monopoly and imperfect competition.

Text Books:

- Dessler, Human Resource Management, Pearson
- Rao V S P, Human Resource Management, Excel
- Khan M Y and Jain P K, Financial Management, Tata McGraw Hill
- Pandey I M, Financial Management, Vikas
- Kotler Philip , Marketing Management , Pearson
- Kotler Philip & Armstrong Gary, Principles of Marketing ,Pearson
- Ahuja H L, Micro Economic Theory, S Chand
- Ruder Dutt & Sundharam, Indian Economy, S Chand

Semester – IV

BT MS 401 Numerical Methods in Engineering

Total Credit: 3
Max. Marks: 100
Theory: 70
Internal: 30
Time Allowed: 3Hrs

Unit I

Introduction and Classical Optimization Techniques: Statement of an Optimization problem – design vector – design constraints – constraint surface – objective function – objective function surfaces – classification of Optimization problems. Classical Optimization Techniques: Single variable Optimization – multivariable Optimization without constraints – necessary and sufficient conditions for minimum / maximum – multivariable Optimization with equality constraints. Solution by method of Lagrange multipliers – multivariable Optimization with inequality constraint – Kuhn – Tucker conditions.

Unit II

Linear Programming: Standard form of a linear programming problem – geometry of linear programming problems – definitions and theorems, linear simultaneous equations: Elimination method, Gauss and Gauss-Jordan method, Jacobi's method, Gauss-Seidal method. Relaxation method solution of a system of – pivotal reduction of a general system of equations, simplex method. Transportation problem finding initial basic feasible solution by north - west corner rule, least cost method and vogel's approximation method.

Unit III

Unconstrained Nonlinear Programming: One – dimensional minimization methods: Classification, Fibonacci method and Quadratic interpolation method Unconstrained Optimization Techniques: Univariate method, Powell's method and steepest descent method.

Unit IV

Constrained Nonlinear Programming: Characteristics of a constrained problem, Classification, Basic approach of Penalty Function method, Introduction to convex Programming Problem. Numerical Solution of Ordinary & Partial Differential Equations: Taylor series method, Euler and modified Euler method, Runge-Kutta methods, Milne's method, Adams-Moulton method, Power method for Eigen values by iteration, Finite difference approximations of partial derivatives, solution of Laplace equation.

Recomended Books:

1. “Engineering optimization: Theory and practice” – by S. S. Rao, New Age International (P) Limited, 3rd edition, 1998

Reference Books:

1. “Optimization Methods in Operations Research and system Analysis” – K. V. Mital and C. Mohan, New Age International (P) Limited, 3rd edition, 1996

2. Operations Research – by Dr. S. D. Sharma

3. “Operations Research: An Introduction” – by H. A. Taha, PHI Pvt. Ltd., 6th editio

BT EE 402 Electrical Machines-II

Total Credits: 3
Max. Marks: 100
Theory Marks: 70
Internal Marks: 30
Time Allowed: 3Hrs

Course Objective:
To make the students understand the basic concepts of synchronous generator, Motor, Induction motor, Single phase and three phase. After undergoing this course the students will have the knowledge of operation and analysis of AC machines, And their applications.

UNIT-I
Synchronous Generator: Constructional Features of Salient Pole and Non-Salient Pole Machines, Arrangement of Field Winding in the two types of Machines. Cylindrical Rotor Theory: Phasor Diagram, Synchronous Reactance from O.C. and S.C. Characteristics, Load Characteristics, Z.P.F. Characteristics, Voltage Regulation by different methods, Power Angle Characteristics. Salient-Pole Theory: Blondels Two-Reaction Concept, Direct Axis and Quadrature Axis Synchronous Reactance, Power Angle Characteristics, Slip Test. Parallel Operation.

UNIT-II
Synchronous Motor: Constructional features, Phasor Diagram, Torque and Power Relations in Non-Salient Pole and Salient Pole Motors, V-Curves, Various Types of Excitation, Synchronous Condenser, Methods of Starting, Applications.

UNIT-III
Three Phase Induction Motor: Constructional Features of Slip Ring and Squirrel Cage Type Motors, Principle of Operation, Flux and MMF Wave, No-Load Speed and Slip, Rotor Quantities Referred to Stator, Relationship Between Input Voltage and Current, Equivalent Circuit, Analysis of Equivalent Circuit, Torque Speed Characteristics, Starting, Maximum and Full Load Torque, Condition for Maximum Torque, Regions of Stable and Unstable Operations, Effect of rotor resistance and supply frequency on Speed Torque Characteristics, Losses, Efficiency, Performance Characteristics, The Circle Diagram, Starting of Slip Ring and Squirrel Cage Motors, High Starting Torque Motors. Speed Control: Various methods.

UNIT-IV
Single phase induction motor: Constructional features, Various types, Rotating magnetic field theory, Equivalent circuit, Determination of constants, Methods of starting, Applications. Single Phase Series Motor: Construction, Principle of Operation, Phasor Diagram, Operation with AC and DC supplies, The universal Motor, Performance Characteristics, Effect of Compensation, Repulsion motor, Applications. Stepper Motor: Construction and Principle of Operation of Variable Reluctance Type and Permanent Magnet Type, Performance and Applications.

Special Machines: High torque induction motor, double cage and deep bar rotor construction. Mains operated and self-excited induction generators. Hysteresis motor, Reluctance motor and Stepper

motor, Doubly Fed Induction Generator, Permanent Magnet Alternators, Brushed DC Motor, Switched-Reluctance Motor: Constructional features, Principle of operation and applications.

TEXT BOOKS:

1. Electric Machines: I.J.Nagrath and D.P.Kothari, TMH, New Delhi.
2. Performance & Design of D.C. Machines: A.E. Clayton & N.N. Hancock; ELBS

REFERENCE BOOKS:

1. Electric Machinery, Fitzgerald & Kingsley, MGH.
2. Theory of alternating current machinery, A.S. Langsdorf , TMH.
3. Electrical Machines, P.S.Bhimbra, Khanna Publishers Delhi
4. Electric Machinery and Transformers, Irving Kosow
5. Electric Machinary and Transformers, Bhag S.Guru, Huseyin R.Hiziroglu, Oxford Press.

BT EE 403 Electrical Machines-II Laboratory

Total Credit: 1
Max. Marks: 50
External Marks: 35
Internal Marks: 15
Time Allowed: 3Hrs

Experiments:

1: No-load & Blocked rotor tests on three phase Induction motor
2: Speed control and load test on 3 phase slip ring induction motor
3: Determination of sequence impedance of alternator.
4: Regulation of a three –phase alternator by synchronous impedance (emf) & Ampere-turn (mmf) methods
5: V and Inverted V curves of a three—phase synchronous motor.
6: Circle diagram of three phase induction motor from no load and SC test.
7: Study of Multisim software and application to IM and Synchronous machine.
8: To perform the parallel operation of synchronous generators
9: To perform load test on a universal motor and determine the performance with dc/ ac supply voltage.
10: To draw Voltage Vs load Characteristics of 3 phase synchronous generator, and draw input vs. Output power.

BT EE 404 Power Generation

Total Credit: 3
Max. Marks: 100
Theory: 70
Internal: 30
Time Allowed: 3Hrs

Course Objective:
To make the students understand the basic concepts of electrical power generation using hydro, Nuclear, Thermal, Non-conventional energy sources and their economic operation. After undergoing this course the students will have the knowledge of various power plants, Their economic operation, Tariff structure, And power factor improvement etc.

UNIT-I

Generation of electrical energy by conventional methods, Comparison of different sources of power. Non conventional sources of energy. Thermal Power Plant: Line diagram of the plant. Boilers: working and classification. Super-heaters, Reheaters, Economizers, Air-heaters, Draft system, Feed water heaters and evaporators, Cooling water supply and cooling towers. Speed governing and governors. Station auxiliaries. Generator cooling and exciters.

UNIT-II
Hydro Electric Generation: Classification of hydro plant, Selection of site, Estimation of power available, Selection of turbine and modeling of turbine. Plant layout, Governors and Hydro plant auxiliaries. Specifications of hydro generators, Characteristics of hydro generators, General arrangement of water wheel generators: large horizontal shaft generators, Vertical and reversible generators, Low speed generators, Umbrella type, Brakes and jacks, losses, Insulation and temperature limits, Testing of generators, Generator cooling and ventilation, Economics of the hydro power plant
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UNIT-III
Nuclear Power Generation: Principle of energy production by nuclear fission, Schematic of nuclear power plant, Nuclear fuels and fertile materials, Nuclear reaction construction. Chain reaction, Moderator, Coolants, Control of fission, Reactor operation, Different types of reactors, Problem of nuclear power plants.

UNIT-IV
Economics of Power Generation: Cost of electrical energy, Methods of determining depreciation, Straight line, Diminishing value and sinking found method. Types of Tariffs influence of load and power factor on tariff, Economics of power factor improvement.
Commissioning and Testing of Transformers and Alternators: Transformer connections, Arrangement of transformer, Commissioning and testing of transformers and alternators, Supply system to station auxiliaries.

Text books:

1. Transmission and generation of power by bayliss, Elsevier.
2. Power System Engg: I.J.Nagrath and D.P.Kothari (TMH)
3. A Course in Electrical Power: Gupta, Soni & Bhatnagar (Dhanpat Rai & Sons).
4. Skrotzki B G A &Vopat W A, Power Station Engineering & Economy, McGraw Hill

Reference books:

1. Elements of power system analysis: W.D.Stevenson (MGH)
2. Electric Power: S.L.Uppal (Khanna Pub.)
3. Electrical power: J.B.Gupta (S.K.Kataria & Sons).
4. Power System Engineering: B. R. Gupta.
5. Electric Power System: B.M.Weedy, John Wiley & Sons.
6. Transmission & Distribution of Electrical Engineering: H.Cotton.
7. Transmission & Distribution of Electrical Engineering: Westing House & Oxford Univ. Press, NewDelhi.

BT EE 405 Electrical Measurements & Measuring Instruments

Total Credit: 3
Max. Marks: 100
Theory: 70
Internal: 30
Time Allowed: 3Hrs

Course Objective:
To make the students understand the basic concepts of measurements and instruments, Their operating principles, And applications. After undergoing this course the students will have the knowledge of various measuring instruments, Their types, Measurements of various quantities, Applications etc.

UNIT-I Measuring System Fundamentals: Classification of Instruments (Absolute & Secondary Instruments; Indicating, Recording & Integrating Instruments; Based Upon Principle of Operation), Measuring Instruments: Construction, Operating Principle, Torque Equation, Shape of Scale, Use As Ammeter Or As Voltmeter (Extension of Range), Use On AC/DC or Both, Advantages & Disadvantages, Errors (Both on AC/DC) of PMMC Types, Electrodynamic Type, Moving Iron Type (Attraction, Repulsion & Combined Types), Hot Wire Type & Induction Type, Electrostatic Type Instruments.

UNIT-II Wattmeters & Enegry Meters: Construction, Operating Principle, Torque Equation, Shape of Scale, Errors, Advantages & Disadvantages of Electrodynamic & Induction Type Wattmeters; & Single Phase Induction Type Energy Meter, Compensation & Creep in Energy Meter.
Power Factor & Frequency Meters: Construction, Operation, Principle, Torque Equation, Advantages & Disadvantages of Single Phase Power Factor Meters (Electrodynamic & Moving Iron Types) & Frequency Meters (Electrical Resonance Type, Ferrodynamic & Electrodynamic Types).

UNIT-III Measurement of resistance: Classification of R, Kelvin double bridge, Measurement of medium R: VA method, Wheatstone bridge, Errors, Limitations and sensitivity. Measurement of high R: Loss of charge method, Direct deflection method, Insulation resistance of cable. Measurement of earth resistance, Factors affecting earth resistance. Cable fault location types of faults and methods. Insulation R with line on. Measurement of L, C and M using ac bridges. Shielding in bridges, Wagner earthing device, A.C. Bridges: General Balance =N, Ckt. Diagram, Phasor Diagram, Advantages, Disadvantages, Applications of Maxwell's Inductance, Inducance-Capacitance, Hays, Anderson, Owens, De-Sauty's, Schering & Weins Bridges, Shielding & Earthing. DC Potentiometer: Student type, Brooks deflection type, Applications. AC Potentiometers: Theory, Application of coordinate and polar type potentiometer.

UNIT-IV Instrument transformers: CT's PT's construction, Operation for metering and protections, Applications. Testing: Silsbee's method, Comparative deflection method. Transducers: Strain gauges, LVDT, Thermistors, Capacitive transducers, Piezoelectric transducers. Speed

measurements: Tachometers and stroboscopic method. Torque measurement: Magnetostrictive and inductive torque transducers (qualitative analysis).

Text Books:

- Sawhney A K, A Course in Elect. & Electronic Measurement & Instrumentation, Khanna Pub.
- Gupta J B, Electronic & Elect. Measurment & Instrumention, Kataria & Sons

Reference Books:

- Morris, Electronic Measurements & Instrumentation, Elsevier
- Golding E W, Electrical Measurement & Measuring Instruments, PHI
- Cooper W D & Helfric A D, Electronic Instrumentation & Measurement Wiley
- Doeblin E O, Measuring Systems, TMH

BT EE 406 Electrical Measurements & Measuring Instruments Laboratory

Total Credit: 1
Max. Marks: 50
External: 35
Internal: 15
Time Allowed: 3Hrs

EXPERIMENTS

1. To Study construction of different types of meters & study how to connect them in a circuit.
2. To calibrate a voltmeter & an ammeter using a potentiometer.
3. To study the working of a electronic energy meter (LCD/Digital display type).
4. To measure power & p.f. by 3-ammeter & 3 Voltmeter methods.
5. To study star to delta & delta to star in a Three phase system for balanced & unbalanced load.
6. To measure power & p.f in 3-phase circuit by 2-wattmeter method.
7. To measure capacitance by De Sauty's bridge.
8. To measure inductance by Maxwell's bridge.
9. To measure frequency by Wien's bridge.
10. To study ballistic type galvanometer & calculation of ballistic constant
11. Determination of unknown inductance & Q factor by Hays Bridge.
12. To Measure resistance using Wheatstone bridge /Post office box.
13. To measure low resistance by Kelvin's double bridge.
14. To measure high resistance by loss of charge/Leakage method.

BT HS 407 **Economics**

Total Credit: 3
Max Marks: 100
Theory: 70
Internal Assessment: 30
Time Allowed: 3 hrs.

Unit-I

Definition of Economics-various definitions, circular flow of economic activity, Production possibility curve Economic laws and their nature. Relation between Science, Engineering, Technology and Economics. Concepts and measurement of utility, Law of Diminishing Marginal Utility, Law of equi-marginal utility - its practical application and importance, the concept of equilibrium

Unit-II

Meaning of Demand, Individual and Market demand schedule, Law of demand, shape of demand curve, Elasticity of demand, measurement of elasticity of demand, factors effecting elasticity of demand, practical importance & applications of the concept of elasticity of demand, the indifference curve theory, consumers surplus

Unit-III

Objective of business firm, Meaning of production and factors of production; Law of variable proportions, Returns to scale, Internal and External economics and diseconomies of scale. Various concepts of cost - Fixed cost, variable cost, average cost, marginal cost, money cost, real cost opportunity cost. Shape of average cost, marginal cost, total cost etc. in short run and long run.

Unit-IV

Meaning of Market, Types of Market - Perfect Competition, Monopoly, Oligoply, Monoplistic Competition (Main features of these markets) Supply and Law of Supply, Role of Demand & Supply in Price Determination and effect of changes in demand and supply on prices.
Nature and characteristics of Indian economy (brief and elementary introduction), national income concept, Privatization - meaning, merits and demerits, Balance of payment, Globalisation of Indian economy - merits and demerits. Elementary Concepts of VAT, WTO, GATT & TRIPS agreement, IMF, World Bank.

Text Books:

1. Principles of Economics: P.N. Chopra (Kalyani Publishers).
2. Modern Economic Theory – K.K. Dewett (S.Chand)

Reference Books:

1. A Text Book of Economic Theory Stonier and Hague (Longman's Landon)
2. Micro Economic Theory – M.L. Jhingan (S.Chand)
3. Micro Economic Theory - H.L. Ahuja (S.Chand)
4. Modern Micro Economics: S.K. Mishra (Pragati Publications)
5. Economic Theory - A.B.N. Kulkarni & A.B. Kalkundrikar (R.Chand & Co.)
6. Indian Economy: Rudar Dutt & K.P.M. Sundhram
7. Indian Economy-Mishra &Puri

BT EV 408 Environmental Science

Total Credit: 0
Max. Marks: 100
Theory: 70
Internal: 30
Time Allowed: 3Hrs

UNIT – I

The Multidisciplinary nature of environmental studies, Definition, scope and importance.

Natural Resources:

Renewable and non-renewable resources:

Natural resources and associated problems.

a) Forest resources: Use and over-exploitation: deforestation, case studies, Timber exploitation, mining, dams and their effects and forests tribal people.

b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.

c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.

d) Food resources: World food problems, changes, caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.

e) Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources; case studies.

f) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification.

Role of an individual in conservation of natural resources.

Equitable use of resources for sustainable lifestyles.

UNIT- II

Ecosystems:

Concept of an ecosystem.

Structure and function of an ecosystem.

Producers, consumers and decomposers.

Energy flow in the ecosystem.

Ecological succession.

Food chains, food webs and ecological pyramids.

Introduction, types, characteristic features, structure and function of the following eco-system:

a) Forest ecosystem.

b) Grassland ecosystem.
c) Desert ecosystem.
d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).

UNIT- III Biodiversity and its conservations:
Introduction – Definition: Genetic, species and ecosystem diversity.
Biogeographically classification of India.
Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values.
Biodiversity at global, National and local levels.
India as a mega-diversity nation.
Hot-spots of biodiversity.
Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts.
Endangered and endemic species of India.

UNIT – IV Environmental Pollution:
Definition, causes, effects and control, measures of:
a) Air pollution
b) Water pollution
c) Soil pollution
d) Marine pollution
e) Noise pollution
f) Thermal Pollution
g) Nuclear hazards
Solid waste management: Causes effects and control measures of urban and industrial wastes.
Role of an individual in prevention of pollution.
Pollution case studies.
Disaster management: Floods, earthquake, cyclone and landslides.

Social issues and the Environment:
a) From unsustainable to sustainable development
b) Urban problems related to energy
c) Water conservation, rain water harvesting, watershed management
d) Resettlement and rehabilitation of people; its problems and concerns, case studies
e) Environmental ethics: Issues and possible solutions
f) Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, Case studies
g) Wasteland reclamation
h) Consumerism and waste products

Text Books:

1. Bharucha, Franch, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad – 380013, India.
2. Brunner R.C. 1989, Hazardous Waste Incineration, Mc. Graw Hill Inc. 480pp.
3. Clark R.S., Marine Pllution, Slanderson Press Oxford (TB).
4. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. 2001, Environmental
5. Encyclopedia, Jaico Pub. House, Mumbai. 1195p.
6. De A.K., Environmenal Chemistry, Wiley Eastern Ltd. Down to Earth, Centre for Science and Environment ®.

Reference Books:

1. Gleick, H.P., 1993. Water in Crisis, Pacific Institute for Studies in Dev., Environment & Security, Stockholm Env. Institute, Oxford Univ., Press 473p.
2. Hawkins R.E. Encyclopedia of Indian Natural History, Bomaby Natural History Scociety,
3. Bombay (R).
4. Heywood, V.H. & Watson, R.T. 1995. Global Biodiversity Assessment. Cambridge Univ. Press
5. 1140p.
6. Jadhav, H & Bhosale, V.M. 1995, Environmental Protection and Laws, Himalaya Pub. House,
7. Helhi 284p.
8. Mckinney, M.L. & Schoch, RM 1996, Environmental Sciences Systems & Solutions, Web
9. enhanced Edition 639p

BT EE 409 Smart Grids

Total Credit: 4
Max. Marks: 100
Theory: 70
Internal: 30
Time Allowed: 3Hrs

Course Objective:

Introduction to the new multi-disciplinary field of Smart Grid, ICT integration in modern power system, IoTs, Renewable Energy Systems and Microgrids.

Course Topics:

Unit I

• Smart Grid:

- Definition
- Applications
- Government and Industry
- Standardization

• Smart Grid Communications:

- Two-way Digital Communications Paradigm
- Network Architectures
- IP-based Systems
- Power Line Communications
- Advanced Metering Infrastructure

Unit II

• Demand Response

- Definition, Applications, and State-of-the Art
- Pricing and Energy Consumption Scheduling
- Controllable Load Models, Dynamics, and Challenges
- Electric Vehicles and Vehicle-to-Grid Systems (V2G), G to V Systems
- Demand Side Ancillary Services (Internet of Things, communication infrastructure and protocols)

• Renewable Generation:

- Carbon Footprint
- Renewable Resources: Wind, Solar, Biogas.
- Microgrid Architecture
- Tackling Intermittency (Control Hierarchy, MGCC, Load Side Control)
- Stochastic Models, Forecasting and microgrid optimization
- Distributed Storage and Reserves (Fuel cell, Battery, Flywheel, Supercapacitor etc.)

Unit III

• Wide Area Measurement:

- Sensor Networks
- Phasor Measurement Units, their optimal placement
- Communications Infrastructure
- Fault Detection and Self-Healing Systems
- Applications and Challenges

• Security and Privacy:

- Cyber Security Challenges in Smart Grid (NIST regulations etc.)
- Load Altering Attacks
- False Data Injection Attacks
- Defense Mechanisms
- Privacy Challenges

Unit IV

• Economics and Market Operations

- Energy and Reserve Markets
- Smart Grid Regulatory Policies Globally
- Generation Firms
- Locational Marginal Prices
- Financial Transmission Rights.

Books:

1. T. Berger, Smart Grid (Applications, communication and security), Wiley, 2015.
2. J. Zhu, Optimization of Power System Operation, 2nd Edition, Wiley, IEEE Press, 2015.
3. The additional reference material for the students is the set of handouts provided by the instructor. The students will also need to read several recent papers in the field of smart grid, e.g., in the IEEE Transactions on Smart Grid, the IEEE Innovative Smart Grid

Technologies Conference, and the IEEE Conference on Smart Grid Communications, IEEE Standards on Smart grids.

Smart Grid Lab:

1. Hybrid Renewable Energy System Prototype Demonstration.
2. Smart Metering/Net Metering system Study and Demo.
3. Demand Response Analysis.
4. Centralized and Localized Control via BESS, Super capacitors
5. Cyber security and Communication Protocols Simulation,

Semester V

BT EE 501 Power Systems Analysis

Total Credit: 4
Max. Marks: 100
Theory: 70
Internal: 30
Time Allowed: 3Hrs

Course Objective:

To make the students understand the concepts of advanced power systems analysis. After undergoing this course the students will have the knowledge of computer applications to power systems problems and applications etc.

UNIT-I Topological Analysis of Power Networks: Review of matrix operations, Graph theory, And various circuit incidence matrices, Primitive network and matrices, Formation of various network matrices by singular transformation/non-singular transformation and interrelations, Per unit system, advantages of pu system, single line diagram, reactance diagram.
Bus Impedance Algorithm: Partial network, Building algorithm for bus impedance matrix, Addition of links, Addition of branches, (considering mutual coupling) removal of links, Modification of bus impedance matrix for network changes, Formation of bus admittance matrix and modification, Gauss elimination, Node elimination (Kron reduction), LU factorization, Schemes of Ordering, Sparsity, Calculation of Z bus elements for Y bus, Numerical examples.

UNIT-II Balanced and unbalanced network elements: Representation of three phase network elements, Representation under balanced and unbalanced excitation, Transformation matrices, Symmetrical components, Sequence impedances, Unbalanced elements, Three phase power invariance.
Short circuit studies: Network representations for single line to ground fault, Line to line fault, LL-G fault, And 3-phase faults, Network short circuit studies using Z bus, Short circuit calculations for various types of faults in matrix form, Numerical examples.

UNIT-III Load flow studies: Load flow and its importance. classification of buses, Load flow techniques, Iterative solutions and computer flow charts using Gauss-Seidel and Newton-Raphson methods, Decoupled and fast decoupled methods, Representation of regulating and off nominal ratio transformers and modification of Y-bus, Comparison of methods, Numerical examples.
Introduction to AC-DC load flow problems: formation and solutions.
Optimal Power Flow: Solution of Optimal Power Flow (OPF) – The gradient method, Newton's method, Linear Sensitivity Analysis; LP methods – With real power variables only – LP method with AC power flow variables and detailed cost functions; Security constrained Optimal Power Flow; Interior point algorithm; Bus Incremental costs.
Transient Stability Analysis

UNIT-IV Stability Analysis: steady state, transient stability, dynamic stability, rotor dynmamics and swing curve, swing curve equation representation with different units, equal area criteria and its applications with different cases, step by step method of analysis of transient stability, factors affecting transient stability, role of AVR on transient stability of system, numerical methods of transient analysis. Voltage Stability: fundamentals.Factors influencing transient stability, Numerical stability and implicit Integration methods.
Power system security: Power system security, Adding removing multiple lines, Peace-wise solution of interconnected systems, Analysis of single and multiple contingencies using Z bus, Analysis with sensitivity factors, System reduction for contingency and fault analysis.

Text Books:

- Stagg G W & EI-Abaid A H, Computer methods in Power system analysis, McGraw Hill, New York
- Pai M A, Computer Techniques in Power System Analysis, TMH-New Delhi.
- Kusic, Computer-Aided Power System Analysis, Prentice Hall of India, New Delhi
- Grainger John J and Stevenson W D, Power System Analysis, McGraw Hill, New York

Reference Books:

- Wood A J & Wollenberg W F, Power Generation, Operation, and Control, John Wiley & Sons, New York
- Elgerd O I, Electric Energy Systems Theory: An Introduction, McGraw Hill, New York
- Arrillaga J, Arnold C P & Harker, Computer Modeling of Electrical Power Systems, John Wiley & Sons.
- Acha Enrique et al., FACTS: Modeling and Simulation in Power Networks, John Wiley and Sons Ltd.
- Kothari and Dhillon, Power Systems Optimization, PHI

BT EE 502 Control System Engineering

Total Credit: 3
Max. Marks: 100
Theory: 70
Internal: 30
Time Allowed: 3Hrs

Course Objective:
To make the students understand the basic concepts of control system theory and its engineering applications. After undergoing this course the students will have the knowledge of control system components, Time domain and frequency domain analysis of systems, Root locus techniques and Nyquist criterion etc.

UNIT-I Introduction: Control System, Servo-Mechanism, Open Loop and Closed Loop Systems, Mathematical Modeling of Physical Systems, Mechanical and Electrical System Analogy, Signal Flow Graphs, Block Diagram Representation and Reduction Techniques, Feedback and Non Feedback Systems, Regenerative and Degenerative Feedback, Effect of Variation of System Parameters On System Performance, Advantages of Feedback.
Control Components: General Block Diagram of A Control System, A.C. and D.C. Servomotors, A.C. Tachometer, Synchro Transmitter and Receiver, Synchro Pair As Control Transformer, A.C Position Control System, Stepper Motor.

UNIT-II Time Domain Analysis: Introduction, Standard Input Signals, Response of 1st and 2nd Order Systems, Time Domain Specifications I.E. Rise Time, Peak Time, Delay Time, Peak Overshoot, Settling Time Steady State Error Etc., Different Types of Feedback Systems, Steady State Errors for Unit Step, Unit Ramp and Unit Parabolic Inputs, Effect of A Dition of Zero to The System.
Stability Analysis: Introduction, Concept of Stability, Conditions For Stable System, Asymptotic, Relative and Marginal Stability, Routh-Hurwitz Criterion For Stability and Various Difficulties With Routh-Hurwitz Criterion.

UNIT-III Root Locus Technique: Introduction, Concepts of Root Locus, Construction of Root Loci, And Various Rules Pertaining To Locus Diagram Development.
Frequency Domain Analysis and Stability: Introduction, Relation Between Time and Frequency Response For 2nd Order System, Bode Plot, Construction Procedure For Bode Plot, Gain Cross

Over and Phase Cross Over Frequency, Gain Margin and Phase Margin, Nyquist Plot and Nyquist Stability Criterion.

UNIT-IV Control System Design: Introduction, Selection and Realization of Basic Compensators Like Lead, Lag and Lag-Lead Compensators Etc.
PID Controller: Introduction, Various Control actions like Proportional, Derivative and Integral Control and Their Combinations, Derivative Feedback Control.

Text Books:

- Gopal M, Control Systems Theory, PHI
- Ogata K, Discrete time control system, PHI
- Nagrath I J and Gopal M, Control System Engineering, New Age

Reference Books:

- Dorf R C and Bishop R H, Modern Control Systems, Prentice-Hall
- Nise N S, Control Systems Engineering
- Kuo B C, Digital Control Systems, TMH
- Slotine J E, & W P Li; Prentice Applied non-linear control, Prentice Hall, USA.
- Isidari, Nonlinear Control Systems, Springer-Verlag

BT EE 503 Control System Engineering Laboratory

Total Credit: 1
Max. Marks: 50
External Marks: 35
Internal Marks: 15
Time Allowed: 3Hrs

EXPERIMENTS

1. To study A.C. servo motor and to plot its torque speed characteristics.
2. To study D.C. servo motor and to plot its torque speed characteristics.
3. To study the magnetic amplifier and to plot its load current v/s control current characteristics for: series connected mode parallel connected mode.
4. To plot the load current v/s control current characteristics for self exited mode of the magnetic amplifier.
5. To study the synchro & to: Use the synchro pair (synchro transmitter & control transformer) as an error detector.
6. Plot stator voltage v/s rotor angle for synchro transmitter i.e. to use the synchro transmitter as position transducer.

7. To use the synchro pair (synchro transmitter & synchro motor) as a torque trans mitter. -To demonstrate simple motor driven closed loop position control system. -To study and demonstrate simple closed loop speed control system.
8. To study the lead, Lag, Lead-lag compensators and to draw their magnitude and phase plots.
9. To study a stepper motor & to execute microprocessor or computer-based control of the same by changing number of steps, Direction of rotation & speed.
10. To implement a PID controller for level control of a pilot plant.
11. To implement a PID controller for temperature control of a pilot plant.
12. To study the MATLAB package for simulation of control system design.

BT EE 504 Microprocessors and Interfacing

Total Credit: 3
Max. Marks: 100
Theory: 70
Internal: 30
Time Allowed: 3Hrs

Course Objective:
To make the students understand the basic concepts of microprocessors, Architecture, Peripheral devices, Interfacing and types. After undergoing this course the students will have the knowledge of various microprocessors, Types, Architecture, Programming, Interfacing etc.

UNIT-I Introduction to Microprocessors and Microcomputers: Evolution of microprocessors and digital computers, Single-chip microcomputers, Large and small computers, Microprocessor applications.
Microprocessor Architecture: Intel 8085, ALU, Timing & control unit, Registers, Opcode & operands, Instruction cycle: fetch operation, Execute operation, Machine cycle and state, Instruction & data flow. Timing diagram: for op-code fetch cycle, Memory read, I/O read, Memory write & I/O write, RISC & CISC processors.

UNIT-II Serial I/O and Interrupts: Interrupts in 8085, RST instructions, Multiple interrupts and priorities. Instruction set of 8085: Instruction and data formats, Addressing modes: direct, Register, Register indirect, Immediate and implicit addressing mode, Status flags, Classification of instructions: Data transfer group, Arithmetic group, Logical group, Branch, Stack, I/O and Machine control group.

UNIT-III Assembly Language programming: assembly language programs using 8085 instruction set, Such as addition, Subtraction, Shift left, Shift right, Multiplication, Division and involving loops, Arrays, Subroutines and stacks.
Memories and their Interfacing: Types of memory, ROM & its types, RAM & its types, Address decoding, Interfacing of memories.

UNIT-IV Peripheral Devices and Interfacing: Data transfer schemes: synchronous data transfer, Asynchronous data transfer, Interrupt driven data transfer, DMA transfer, Cycle stealing and burst mode of DMA, 8257 DMA controller, Programmable interrupt controller (PIC) Intel

8259, Programmable peripheral interface (PPI) Intel 8255, Programmable interval timer Intel 8253, Programmable communication interface Intel 8251.

Text Books:

- Gaonkar Ramesh S, Microprocessor Architecture, Programming & Applications with 8085/8086 A, Wiley Eastern Ltd
- Badri Ram, Fundamentals of Microprocessors & Microcomputers, Dhanpat Rai & Sons, Delhi
- Mathur A P, Introduction to Microprocessor, PHI
- Grover Naresh, Microprocessors Comprehensive Studies

Reference Books:

- Mukhopadhyay A K, Microprocessor Microcomputer and their Applications
- Andrew Michael, Programming Microperocessor Interfaces for control & instrumentation, Prentice Hall Inc.,
- Engle Wood Clifs, Microprocessors with Application in Process Control, TMH, New Delhi

BT EE 505 Microprocessors and Interfacing Laboratory

Total Credit: 1
Max. Marks: 50
External: 35
Internal: 15
Time Allowed: 3Hrs

EXPERIMENTS

1. Study architecture of 8085 & familiarization with its hardware, Commands & operation of Microprocessor kit.
2. Write a well-documented program for: addition of two 8-bit numbers (provision for carry)addition of two 8-bit numbers.
3. Write a well-documented program for: subtraction of two 8-bit numbers (display of borrow) subtraction of two 16-bit numbers (display of borrow)
4. Write a well documented program for: Multiplication of two 8-bit numbers by repeated addition method. Check for minimum number of addition and also test for typical data.
5. Write a well-documented program for: Multiplication of two 8-bit numbers by bit rotation method.
6. Write a well-documented program for: Division of two 8-bit numbers by repeated subtraction method. Test for typical data.
7. Write a well-documented program for Dividing two 8-bit numbers by bit rotation method. Test for typical data.
8. Write a well-documented program for: Finding a largest number from an array. Finding a smallest number from an array.
9. Write a well-documented program for arranging an array of numbers in descending order.
10. Write a well-documented program for arranging an array of numbers in ascending order.
11. Write a well-documented program for finding square of a number using Look-up table.
12. Identification of input & output pins of port 8255, For various control words.
13. To measure an electrical quantity using microprocessor & 8255.

14. Write a program to interface a 2-digit number using seven-segment LEDs. Use 8085 microprocessor and 8255 PPI chip.
15. Write a program to control the operation of stepper motor using 8085 microprocessor & 8255 PPI chip.

BT EE 506 Analog and Digital Electronic

Total Credit: 3
Max. Marks: 100
Theory: 70
Internal: 30
Time Allowed: 3Hr

Course Objective:
To make the students understand the basic concepts of electronic devices and their engineering applications. After undergoing this course the students will have the knowledge of various amplifiers, OPAM circuits, oscillators, and wave shaping circuits etc. number systems, Logic gates, Sequential circuits and memories. After undergoing this course the students will have the knowledge of Boolean algebra, Logic gates, Sequential circuits, Memory and A/D and D/A converters etc.

UNIT-I BJT: Method of biasing, Bias stability, Bias compensation, Small signal analysis of single stage BJT amplifiers, Choice of transistors configuration in cascade amplifier, RC coupled amplifier, Transformer coupled amplifier, Frequency response of amplifiers, Classification of amplifiers (Class A,B, AB & C), Push-pull arrangements.
FET: Types, Biasing of FET, MOSFET biasing, MOSFET as an amplifier, CMOS circuits, MOSFET as analog switch.

UNIT-II Oscillators: Concept of feedback, Classification of oscillators, Barkhausen.s criterion, RC oscillator, Wien bridge oscillator, LC oscillator (Hartley and Colpitts), Crystal oscillator, Biquad Phase shift oscillator.
OPAMP: Parameters of OPAMP, Open loop and closed loop configurations, Bandwidth with feedback, Linear OPAMP circuits and applications, Non linear OPAMP circuits and applications.

UNIT-III Universal Active filter, Biquad configuration for LPF, HPF,BPF, BRF. Butterworth, Voltage controlled filter, Self tuning filters, Switched capacitor filters. Wave shaping and Multivibrators circuits: Clippers and Clampers, Astable, Monostable and Bistable Multivibrators, Schmitt Trigger circuits.
Digital Electronics I: Number System, Boolean Algebra: Basic theorems, commutative, associative, distributive laws, SOP and POS form of Boolean expressions, minimization techniques up to six variables using K maps.

UNIT-IV Digital Electronics II: Logic gates and Logic Families, design of Half adder & full adder, subtractor circuits, multiplexers, demultiplexers, comparators, ROM, Flip-flops, bistable circuits: RS, JK, D, T, Master/Slave Flip-flop, synchronous and asynchronous counters up & down counters, shift registers, Semiconductor Memory: Basics of memory, memory addressing, ROM, PROM, EPROM, static and dynamic RAM.
A/D & D/A Converters: D/A converter, accuracy, resolution and precision, variable resistor network, binary ladder, FPGA.

Text Books:

- Jain R P, Modern Electronics, TMH
- Floyd, Digital Circuits, TMH
- Charles Roth, Fundamentals of Logic Design
- Bell D A, Electronic Devices and Circuits, Oxford University Press
- Salivahanan S, Kumar N S and Vallavaraj A, Electronic Devices and Circuits, TMH
- Floyd Thomas L, Electronic devices, Pearson Education

Reference Books:

- Graeme J G, Tobey G E, and Huelsman L P, OPAMP: Design and applications, McGraw Hill, Digitized on Dec. 2007.
- Taub and Shilling, Pulse and Wave Shaping Circuits, McGraw Hill
- Sedra A S & Smith K C, Microelectronic Circuits, Oxford Univ. Press
- Malvino A P and Leach D P, Digital Principles and applications, PHI
- Taub and Schilling, Digital Integrated Electronics, TMH
- Gothman, Digital Electronics, TMH.
- Spencer R R and Ghausi M S, Introduction to Electronic Circuit Design, Pearson

BT EE 507 Analog and Digital Electronic Laboratory

Total Credit: 1
Max. Marks: 50
External: 35
Internal: 15
Time Allowed: 3Hrs

Experiments:

1. Study of lab equipments and components: CRO, Multimeter, Function Generator, Power supply- Active, Passive Components & Bread Board.
2. P-N Junction Diode: Characteristics of PN Junction diode-Static and dynamic resistance measurement from graph.
3. Applications of PN junction diode: Half & Full wave rectifier- Measurement of Vrms, Vdc, And ripple factor-use of filter- ripple reduction (RC Filter)-Clipper & Clamper
4. Properties of junctions Zener diode characteristics. Heavy doping alters the reverse characteristics.
5. Graphical measurement of forward and reverse resistance.
6. Application of Zener diode: Zener diode as voltage regulator. Measurement of percentage regulation by varying load resistor.
7. Characteristic of BJT: BJT in CB and CE configuration- Graphical measurement of h parameters from input and output characteristics. Measurement of A v, AI, Ro and Ri of CE amplifier with potential divider biasing.
8. Characteristic of FET: FET in common source configuration.
9. Introduction to digital electronics lab- nomenclature of digital ICs, Specifications, Study of the data sheet, Concept of Vcc and ground, Verification of the truth tables of logic gates using TTL ICs.
10. Implementation of the given Boolean function using logic gates in both SOP and POS forms.
11. Verification of state tables of RS, JK, T and D flip-flops using NAND & NOR gates.
12. Implementation and verification of Decoder/De-multiplexer and Encoder using logic gates.
13. Implementation of 4x1 multiplexer using logic gates.
14. Implementation of 4-bit parallel adder using 7483 IC.
15. Design, And verify the 4-bit synchronous counter.
16. Design, And verify the 4-bit asynchronous counter.

Static and Dynamic Characteristic of NAND and Schmitt-NAND gate(both TTL

Recommended Books:

- Arora and Jain, Lab course in Power Electronics

BT EE 508 Electromagnetic Field Theory

Total Credit: 3
Max. Marks: 100
Theory: 70
Internal: 30
Time Allowed: 3Hrs

Course Objective:
To make the students understand the basic concepts of electromagnetic fields theory and their behaviour. After undergoing this course the students will have the knowledge of electrostatics, Magnetostatics, and waves and applications etc.

UNIT-I Coordinate systems and transformation: Cartesian coordinates, Circular cylindrical coordinates, Spherical coordinates Vector calculus: Differential length, Area and volume, Line surface and volume integrals, Del operator, Gradient of a scalar, Divergence of a vector and divergence theorem, Curl of a vector and Stoke's theorem, Laplacian of a scalar.

UNIT-II Electrostatics: Electrostatic fields, Coulombs law and field intensity, Electric field due to charge distribution, Electric flux density, Gausses's Law – Maxwell's equation, Electric dipole and flux lines, Energy density in electrostatic fields. Electric field in material space: Properties of materials, Convection and conduction currents, Conductors, Polarization in dielectrics, Dielectric constants, Continuity equation and relaxation time, Boundary condition. Electrostatic boundary value problems: Poission's and Laplace's equations, General procedures for soling Poission's or Laplace's equations, Resistance and capacitance, Method of images.

UNIT-III Magnetostatics: Magneto-static fields, Biot-Savart's Law, Ampere's circuit law, Maxwell's equation, Application of ampere's law, Magnetic flux density- Maxwell's equation, Maxwell's equation for static fields, Magnetic scalar and vector potential.
Magnetic forces, Materials and de vices: Forces due to magnetic field, Magnetic torque and moment, a magnetic dipole, Magnetization in materials, Magnetic boundary conditions, Inductors and inductances, Magnetic energy.

UNIT-IV Waves and applications: Maxwell's equation, Faraday's Law, Transformer and motional electromotive forces, Displacement current, Maxwell's equation in final form. Electromagnetic wave propagation: Wave propagation in lossy dielectrics, Plane waves in lossless dielectrics, Plane wave in free space, Plain waves in good conductors, Power and the pointing vector, Reflection of a plain wave in a normal incidence. Transmission lines: Transmission line parameters, Transmission line equations, Input impedance, Standing wave ratio and power.

Text Books:

- Sadiku M N O, Elements of Electromagnetic, Oxford University Press
- Balmein and Jordan, Electromagnetic Field theory, TMH
- Hayt W H and Buck J A, Electromagnetic field theory, TMH

Reference Books:

- Cheng D K, Field and Wave Electromagnetics, Pearson Education
- Hayt Jr. W H, Engineering Electromagnetics, Tata Mc-Graw- Hill
- Ryder R J D, Networks lines and fields, PHI
- Jordan E C, EM waves and radiating systems, PHI

BT EE 509 Advance Power Electronics & Drives

Total Credit: 3
Max. Marks: 100
Theory: 70
Internal: 30
Time Allowed: 3Hrs

Course Objective:
To make the students understand the basic concepts of electric drives their operation and control. After undergoing this course the students will have the knowledge of DC drives, IM drives, Synchronous drives, Operation, Control, Etc.

UNIT-I Power Supplies: Switched mode D.C. and A.C. power supplies. Resonant D.C. and A.C. power supplies. Applications: Dielectric and induction heating. Block diagram of D.C. and A.C. motor speed control. Classifications of Electric Drives, Components of Electric Drives, Advantages of Electric Drives, Review of Characteristics and Speed Control of D.C. and A.C. Motors. Dynamics of Electric Drives: Fundamental Torque Equation, Speed-Torque Conventions and Multiquadrant Operation, Equivalent Values of Drive Parameters, Components of Load Torques, Nature and Classification of Load Torques, Calculation of Time and Energy-Loss In Transient Operations, Criteria For Steady State Stability, Load Equalization. Rating and Heating of Motors:-Thermal Model of Motor for Heating and Cooling, Classes of Motor Duty, Determination of Motor Rating, Frequency of Operation of Motors subjected to Intermittent Loads.

UNIT-II Rectifier Control of D.C. Drives: Controlled Rectifier Circuits, 1-Phase Fully Controlled Rectifier-Fed Separately Excited D.C. Motor, 1-Phase Half-Controlled Rectifier-Fed Separately Excited D.C. Motor, 3-Phase Fully Controlled Rectifier-Fed Separately Excited D.C. Motor, Multiquadrant Operation of Fully-Controlled Rectifier-Fed D.C. Motor.

UNIT-III Chopper Control of D.C. Drives: Principle of Operation and Control Techniques, Motoring Operation of Separately Excited and Series Excited Motors, Multiquadrant Control of Chopper-Fed Motors.
Induction Motor (IM) Drives: 3-Phase A.C. Voltage Controller-Fed IM Drive, Voltage Source Inverter (VSI) and Current Source Inverter (CSI) Variable Frequency Drives, Comparison of VSI

and CSI Drives, Cycloconverter-Fed IM Drive, Static Rotor Resistance Control of 3-Phase Slipring IM.

UNIT-IV Synchronous Motor Drives: VSI Drive, CSI Drive, CSI Drive With Load Commutation, Cycloconverter Drive, Braking Methods:- Various Methods of Braking D.C. and A.C. Motors, Regenerative Braking of D.C. Motors During Chopper Control, Static Scherbius Drive, Commutatorless Kramer Drive.
Microprocessor Control of Electric Drives:-Dedicated Hardware Systems Versus Microprocessor Control, Application Areas and Functions of Microprocessor In Drive Technology, Control of D.C. Drives Using Microprocessors, Vector Control of IM Drive Using Microprocessor, Some Aspects of Control System Design of Microprocessor Based Variable Speed Drives

Text Books:

- Dubey G K, Fundamentals of Electrical Drives, Narosa Publishing House
- Pillai S K, A First course on Electrical Drives, Wiley Eastern Ltd

Reference Books:

- Subrahmanyam V, Electric Drives: Concepts and Applications, Tata Mc Graw Hill Publishing Co. Ltd.
- Dubey G K, Power semiconductor Controlled Drives, Prentice Hall, Englewood cliffs, New Jersey
- EL- Sharkawi & Mohamad A, Fundamental of Electric Drive, Vikas Publishing House

BT EE 510 HVDC & FACTS

Total Credit: 3
Max. Marks: 100
Theory: 70
Internal: 30
Time Allowed: 3Hrs

Course Objective:
To make the students understand the basic concepts of concepts of high voltage engineering, breakdown phenomenon in gases, liquids, solids, generation of DC/AC/impulse waves, measurements etc., FACTS technology. After undergoing this course the students will have the knowledge of various FACTS devices, Their operation, Control schemes and applications etc.

UNIT-I Analysis of HVDC Converters ; Pulse Number, Choice of converter configuration, Simplified analysis of graetz circuit, Convertor bridge characteristics, Characteristics of a twelve pulse converters, Detailed analysis of converters. ; Converter and HVDC system Control: General, Principles of DC Link control, Converter control characteristics, System control hierarchy Firing angle control, current and extinction angle control, Starting and stopping of DC link. Converter Faults and Protection: Introduction, Converter Faults, Protection against over currents over voltages in a converter station, Surge arrests, Protection against over voltages. Multiterminal DC systems; Introduction, Potential applications of MTDC systems, Types of MTDC systems

UNIT-II Introduction and FACTS general concepts: Reactive power control in electrical power transmission lines, Uncompensated transmission line, series compensation and shunt compensation, Basic concepts of series, Shunt, And combination of series and shunt compensators,

Static Shunt Compensator (SVC), SVC, Voltage control by SVC, Advantages of slope in dynamic characteristics, Influence of SVC on system voltage, Design of SVC voltage regulator, Modelling of SVC for power flow and transient stability.

UNIT-III Static Series Compensators, TCSC and Applications: Objectives of series compensation, Operation of the TCSC, Different modes of operation, Modelling of TCSC and their comparison, Variable reactance model, Modelling for Power Flow and stability studies. Applications: Improvement of the system stability limit, Enhancement of system damping-SSR Mitigation.

UNIT-IV Voltage Source Converter Based FACTS Controllers: Static Synchronous Compensator (STATCOM), Principle of operation, V-I Characteristics. Comparison with SVC, Applications: Steady state power transfer, Enhancement of transient stability, Prevention of voltage instability. SSSC-operation of SSSC and the control of power flow, Modelling of SSSC in load flow and transient stability studies, Comparison with TCSC, Applications: SSR Mitigation-UPFC and IPFC operating principles and their characteristics, Control structure, Applications.
Co-Ordination of FACTS Controllers: Controller interactions, SVC, SVC interaction, Co-ordination of multiple controllers using linear control techniques, Control coordination using genetic algorithms.

Text Books:

- Arrillaga J, HVDC transmission, IET
- Padiyar K R, HVDC Power transmission System, New age International
- Padiyar K R, FACTS Controllers in Power Transmission and Distribution, New Age International (P) Limited, Publishers, New Delhi
- John A T, Flexible A.C. Transmission Systems, Institution of Electrical and Electronic Engineers (IEEE) .
- Sood V K, HVDC and FACTS controllers – Applications of Static Converters in Power System, Kluwer Academic Publishers

Reference Books:

- Hingorani Narain G, Understanding FACTS - Concepts and Technology of Flexible AC Transmission Systems, Standard Publishers Distributors, Delhi
- Song Y H, Flexible A C Transmission Systems (FACTS), (IEEE Series)
- Miller T J E, Reactive Power Control in Power Systems, Wiley
- Mathur R Mohan, Varma Rajiv K, Thyristor - Based Facts Controllers for Electrical Transmission Systems, IEEE press and John Wiley & Sons Inc.
- Uhlman E, Power Transmission by Direct Current
- Acha Enrique et al., FACTS modeling and Simulation in Power Networks, John Wiley and Sons
- Sen K K and Sen M L, Introduction of FACTS Controllers, Wiley IEEE

Semester – VI

BT EE 601 Switchgear And Protection

Total Credit: 3
Max. Marks: 100
Theory: 70
Internal: 30
Time Allowed: 3Hrs

Course Objective:
To make the students understand the basic concepts of relays, Protective devices, Circuit breakers fundamentals and protective schemes. After undergoing this course the students will have the knowledge of various protective devices, Their operation, CBs, Their types, Operating principles, Protective schemes, Applications etc.

UNIT-I
CIRCUIT BREAKERS: Requirement of circuit breakers, Characteristics of electric arc, Principle of A.C. and D.C. arc interruption, Recovery and restriking voltages and effect of current asymmetry upon them, Interruption of capacitive currents, Current chopping circuit breaker ratings, duties of switch gear, automatic switch,
Type: air circuit breaker, bulk oil,minimum oil, air blast, SF6 CB, vacuum and DC circuit breakers, Testing of Circuit breaker.

UNIT-II
PROTECTIVE RELAYS & APPLICATION: Essential qualities of relay, relay classification, principalvtypes of electromagnetic relays, i.e. attracted armature, induction disc, induction cup types, Overcurrent,
instantaneous over-current, IDMT, directional and differential relays, distance relays, plain impedance, mho, reactance relays, zone of protection, primary and backup protections, transmission line & feeder protection, pilot wire and carrier current protection,

UNIT-III

APPARATUS PROTECTION:
Power transformer protection: Differential protection and magnetic balance protection, restricted earth fault protection, Buchholz relay, protection of combined alternator and transformer. Bus bar protection: Frame leakage scheme, Translay scheme, circulating current scheme introduction to protection against surges.
All type of generator and motor protection

UNIT-IV

STATIC & DIGITAL RELAYS: Classification of static relays, amplitude and phase comparators, block-spike and block-average comparators, rectifier type relays.
Introduction to digital relay: basicprinciples. Application of microprocessors and computers – recent Trends. Travelling wave relay, relaying schemes based on microwave and optical fiber link.

Text books:

1. Power System Analysis- John J. Grainger, William D. Stevenson: McGraw-Hill
2. Power System Engineering: S K Gupta, Umesh Publication, Delhi
3. Power System protection and switchgear –B.Ram, D.N.Vishvakarma : TMH.
4. Switchgear and protection - S.S.Rao : Khanna Pub.

Reference books:

1. Protective Relays -Their Theory and Practice Vol.I & II: W.Van Warrington.
2. Electric Power Systems- B. M. Weedy, B. J. Cory: John Wiley& Sons.
3. Advanced power system analysis and dynamics: L.P.Singh, Wiley Eastern N.Delhi.
4. Power System Engg: I.J. Nagrath and D.P. Kothari(TMH).
5. Digital Protection: Protective relay from Electro Mechanical to Microprocessor-
L.P.Singh,Wiley Eastern.
7. A course in Electrical Power - Soni, Gupta and Bhatnagar - Dhanpat Rai & Sons.
8. Modern Power System Analysis, DP Kothari, I.J.Nagrath, Mc Graw Hill

BT EE 602 Switchgear And Protection Laboratory

Total Credit: 1
Max. Marks: 50
External: 35
Internal: 15
Time Allowed: 3Hrs

Experiments:

1. To study the power control by phase shifting transformer.
2. Power Factor Improvement by Static Condensors.

3. To determine fault current for L-G, L-L, L-L-G and L-L-L faults at the terminals of an alternator at very low excitation.
4. To study the IDMT over current relay and determine the time current characteristics.
5. To study percentage differential relay, Impedance, MHO and Reactance type distance relays.
6. To determine location of fault in a cable using cable fault locator.
7. To study Ferranti effect and voltage distribution in H.V. long transmission line using transmission line model.
8. To obtain steady state, transient and sub-transient short circuit currents in an alternator.

BT EE 603 **Power Electronics**

Total Credit: 4
Max. Marks: 100
Theory: 70
Internal: 30
Time Allowed: 3Hrs

Course Objective:
To make the students understand the basic concepts of power semiconductor devices and their classifications. After undergoing this course the students will have the knowledge of various power semiconductor devices. Types, Classifications and their operation etc.

UNIT-I

Role of power electronics, review of construction and characteristics of power diode, Shottky diode, power transistor, power MOSFET, SCR, DIAC, Triac, GTO, IGBT & SIT.
SCR:
Ratings and protections, series and parallel connections, R, RC and UJT firing circuit and other firing circuits based on ICs and microprocessors; pulse transformer and opto-coupler, commutation techniques.

Unit –II

AC REGULATORS:
Types of regulator, equation of load current, calculation of extinction angle, output voltage equation, harmonics in load voltage and synchronous tap changer, three phase regulator.
CYCLOCONVERTERS :
Basic principle of frequency conversion, types of cycloconverter, non-circulating and circulating types of cycloconverters.

Unit- III

CONVERTERS :
One, two, three, six and twelve pulse converters, fully and half controlled converters, load voltage waveforms, output voltage equation, continuous and discontinuous modes of operation, input power factor of converter, reactive power demand, effect of source inductance, introduction to four quadrant / dual converter, power factor improvement techniques, forced commutated converter, MOSFET and transistor based converters.

Unit – IV

INVERTERS :
Basic circuit, 120 degree mode and 180 degree mode conduction schemes, modified McMurray half bridge and full bridge inverters, McMurray -Bedford half bridge and bridge inverters, brief description of parallel and series inverters, current source inverter (CSI), voltage source inverter (VSI), PWM inverter, transistor and MOSFET based inverters.
CHOPPERS :

Basic scheme, output voltage control techniques, one, two, and four quadrant choppers, step up chopper, voltage commutated chopper, current commutated chopper, MOSFET and transistor based choppers.

Text book:

1. Power Electronics: P.S Bhimra
2. Power Electronics: MH Rashid; PHI
3. Bose - Power electronics, Elsevier

Reference books:

1. Rashid - Handbook of power electronics,Elsevier
2. Power Electronics : PC Sen; TMH
3. Power Electronics : HC Rai; Galgotia
4. Thyristorised Power Controllers : GK Dubey, PHI

BT EE 604 Power Electronics Laboratory

Total Credit: 1
Max. Marks: 50
External: 35
Internal: 15
Time Allowed: 3Hrs

EXPERIMENTS

1. Study of characteristics of diode, Thyristor and triac.
2. Study of characteristics of transistor and MOSFET.
3. Study of R and R-C firing circuits.
4. Study of UJT firing circuit.
5. Study of complementary voltage commutation using a lamp flasher.
6. Study of complementary voltage commutation using ring counter.
7. Study of thyristorised d-c circuit breaker.
8. Study of a.c. phase control.
9. Study of full wave converter.
10. Study of DC chopper.
11. Study of series inverter.
12. Study of bridge inverter.
13. Study of single phase cycloconverter.

BT EE 605 Signal and Systems

Total Credit: 3
Max. Marks: 100
Theory: 70
Internal: 30
Time Allowed: 3Hrs

Course Objective:
To make the students understand the basic concepts of signals an systems, Fourier series representation. After undergoing this course the students will have the knowledge of linear time invariant systems, Fourier, Continuous time, And discrete transforms and their applications etc.

UNIT-I

Introduction: Continuous time and discrete time signals, Periodic signals, Energy and power signal, Transformer of independent variables, Even and odd signals, Exponential and sinusoidal signal, Unit impulse and unit step functions, Interconnections of systems, Systems with and without memory, Causality, Stability, Linearity and time invariance.
Linear Time Invariant Systems: Introduction, Discrete LTI systems, Convolution continuous time unit impulse response and convolution integral representation of LTI systems, Properties of LTI systems, Stability, Causal LTI system described by difference equation, Singularity functions.

UNIT-II

Fourier Series representation: Introduction response of LTI systems to complex exponentials, Fourier series representation for continuous time periodic signals, Onvergence of Fouier series, Properties of continuous time Fourier series, Fourier series representation of discrete time periodic signals, Properties of discrete time Fourier series, Fourier series and LTI system, Frequency shaping and frequency selective filters, Discrete time filters.

UNIT-III

Continuous time Fourier Transform: Introduction, Representation for a periodic signals, Fourier series representation of a periodic signals, Convergence of Fourier transform, Fourier Transform for periodic, Properties of continuous time Fourier transform, Convolution and multiplication properties systems described by linear constant coefficient different equations.
Discrete time Fourier Transform: Introduction representation for a periodic signals, DTFT, Fourier transform for periodic signals, Convergence of the Fourier transform Gibbs phenomenon, Properties of discrete time Fourier transform convolution and mortification properties, System described by linear constant coefficient difference equations

UNIT-IV
Time and Frequency Characterization of signal and system: Introduction, Magnetic and phase representation of Fourier transform, Magnitude and phase representation of frequency response of

LTI system, Linear and nonlinear phase, Group delay, Log magnitude plot, Time domain and frequency domain aspects of non-ideal filters 1st and 2nd order continuous time and discrete time systems.
Sampling: Introduction, Sampling theorem, Sampling with zero order hold reconstruction of a signal from its samples, Aliasing, Sampling of discrete time signals, Decimation and interpolation.

Text Books:

- Oppenheim, Willsky & Hamid Nawab, Signals and Systems, McGraw Hill
- Sanjit K Mitra, Digital Siganl Processing, TMH
- Roberts M J, Signals and Systems, McGraw-Hill
- Philips C L, Parr J M and Riskin E A, Signals, Systems and Transforms, PHI

Reference books :

- Proakis and Manolakis, Digital Signal Processing, PHI
- Oppenhem A V, Willsky A S and Young I T, Signals and Systems, Prentice-Hall India
- Chellan Mc, Schafer R W & Yoder, Signal Processing First, Pearson
- Ambarkar, Analog and Digital Signal Processing, Brooks Cole

BT EE 606 Advanced Instrumentation

Total Credit: 4
Max. Marks: 100
Theory: 70
Internal: 30
Time Allowed: 3Hrs

Course Objective:
To make the students understand the basic concepts of fluids and fluid flow which are essential in majority of the engineering applications. After undergoing this course the students will have the knowledge of various pressure measuring instruments, Fluid statics, Types of fluid motion, Fluid dynamics, Pipe flow, The concept of boundary layer, Lift and drag etc.

UNIT-I

Introduction: Functional block diagram of generalized Instrumentation system. Input-output configuration, Specifications under steady & transient state & their performance characteristics.

UNIT-II

Sensors and Transducers: Temperature, Pressure, Displacement, Velocity, Acceleration, Strain and torque type. Signal Conditioning: Current & voltage sensitive bridges, Blumlein Bridges, Shielding & grounding, Instrumentation Amplifier & its Characteristics, Linearizing circuits, Wave form and frequency conversion, Acitve filters, A/D & D/A converters; Balanced modulators & demodulators.

UNIT-III

Definition of transducer. Advantages of an electrical signal as out-put. basic requirements of transducers, Primary and Secondary Transducer. Analog or digital types of transducers. Resistive, Inductive, Capacitive, Piezoelectric, Photoelectric and, Hall effect. Tranducers. Measurement of displacement, Measurement of temperature, Measurement of velocity. Measurement of force.
Noise: Characteristics & Measurements of signal in the presence of noise.

UNIT-IV

Microcontroller Based Instrumentation System: Interfacing of 8051 Microcontroller with (a) ADC and DAC, (b) Alphanumeric Devices (Sixteen-segment Display, Dot Matrix Displays, LCD Display).

Text Books:

- Doeblin E O, Measurement System – Application & Design.TMH
- Sawhney A K, A Course in Electrical & Electronics, Dhanpat Rai & Sons, Delhi
- Measurement & Instrumentation. Pub.: Dhanpat Rai & Sons

Reference Books:

- Rangan C S, Sarma G R and Mani V S V, Instrumentation Devices & Systems, New Delhi, Tata McGraw-Hill Pub. Co. Ltd
- Oliver & Cage, Electronic Measurement & Instrumentation
- Kamal Raj, Microcontrollers: Architecture, Programming, Interfacing and System Design. Delhi: Pearson Education (Singpaore) Pte. Ltd., Indian Branch
- Ayala Kenneth J, The 8051 Microcontrollers – Architecture, Programming & Applications Mumbai: Penram International Publishing (India) Pvt. Ltd
- Mackenzie Scott, The 8051 Microcontrollers. Englewood Cliffs: Prentice Hall Pub. Co.
- Nakra B C, Chaudhry K K, Instrumentation Measurement and Analysis, Tata McGraw-Hill Publishing Company Limited, New Delhi
- Beckwith Thomas G, Mechanical Measurements (International Student Edition), Addison-Wesley Longman, Inc. England

BT EE 607 Advanced control System Engineering

Total Credits: 4
Max. Marks: 100
Theory Marks: 70
Internal Marks: 30
Time Allowed: 3Hrs

Course Objectives:
To make the students understand the basic concepts of state variable approach, Non-linear systems, Transforms. After undergoing this course the students will have the knowledge of state variable approach for solutions, Second order systems, Applications of transforms to systems, And sampled data systems etc.

UNIT-I
State Variable Techniques: State variable representation of systems by various methods. Solution of state equations-state transition matrix. Transfer function from state variable model. Controllability & observability of state variable model

UNIT-II
Second Order Systems & State Plane: Phase portrait of linear second systems. Method of isoclines, Phase portrait of second order system with non-linearities, Limit cycle, Singular points.

UNIT-III
Describing Function Analysis: Definition, Limitations, Use of describing function for stability analysis , Describing function of ideal relay, Relay with hysteresis & dead zone, Saturation/coulomb friction & backlash, Linear Approximation of Nonlinear Systems: Taylor series, Liapunov's 2nd method.

UNIT-IV
Sampled Data Systems: Sampling process, Impulse modulation, Mathematical analysis of sampling process, Application of Laplace transform, Shannon's theorem, Reconstruction of sampled signal zero order & first order hold, Z-transform, Definition, Evaluation of Z-transform, Inverse Z-transform, Pulse transfer function, Limitations of Z-transform, State variable formulation of discrete time systems. Solution of discrete time state equations, Stability, Definition, The Schur-Cohn stability criterion, Jury's test of stability of extension of Routh-Hurwitz criterion to discrete time systems.

Text Books:

- Ogata K, Modern Control Engineering, Pearson
- Gopla M, Modern Control Theory, Wiley International
- Gopal M, Digital Control & State Variable Methods, TMH
- Gopal M, Control Systems: Principles and Design, TMH

- Nise N S, Control Systems Engineering

Reference Books:

- Azzo D and Houpies C, Control Systems Theory, MCH
- Slotine J E & Li W P, Applied non-linear control :; Prentice Hall, USA
- Isidari, Nonlinear Control Systems:; Springer-Verlag
- Kuo B C, Automatic Control System, Prentice Hall
- Dorf R C and Bishop R H, Modern Control Systems, Prentice-Hall

BT EE 608 Advanced Microprocessor & Microcontroller

Total Credit: 4
Max. Marks: 100
Theory: 70
Internal: 30
Time Allowed: 3Hrs

Course Objective:
To make the students understand the basic concepts of advanced microprocessors and microcontrollers. After undergoing this course the students will have the knowledge of 8086 architecture, Instruction sets, Microcontrollers, Applications etc.

UNIT-I

The 8086 Architecture: Pin diagram of 8086 and description of various signals. Architecture block diagram of 8086 & description of sub-blocks such as EU & BIU & of various registers; Description of ad-dress computations & memory segmentation; Program relocation; Addressing models; Instruction formats.

UNIT-II

Instruction Set of 8086: Instruction execution timing, Assembler instruction format; Data transfer instructions, Arithmetic instructions, Branch instructions, Looping instructions, NOP & HLT instructions, Flag manipulation instructions, Logical instructions, Shift & Rotate instructions, Directives & operators, Simple example such as copying a block of data, Finding Maximum from an array of numbers, Using look up table technique etc.

UNIT-III

Microcontrollers: comparison between Microcontrollers & microprocessors. Block diagram of 8051, Pin diagram & details, I/O structure, Memory organization. Special function registers. External memory, 8032/8052 Enhancements, Reset operation. Instruction Set: Addressing modes, Arithmetic, Logical. Data transfer. Boolean variable, Program branch-ing instructions. Timer Operation: Timer Mode register, Timer Control register. Timer modes & Overflow flag, Clocking sources, Start, Stopping & controlling the timers. Programs for generating various frequecy. Square waves, FPGA based controllers.

UNIT-IV

Serial Port Operation: Serial port control register, Modes & operation. Serial port and rate. Multoproc-essor communication. Initialization & programming of serial port. Interrupt: Organization, Processing interrupts, Program design
using interrupts. Serial port interrupts, Ex-ternal interrupts

Text Books:

- Scott Mackenizie, The 8051 Microcontroller, Prentice Hall, Eagle wood Cliff
- Brey, Intel Microprocessors, 8086,8088,80186,80286/Pentium
- Chabra Bhupinder Singh, The Intel 8086/8088 Microprocessors architecture programming, Design & interfacing, Dhanpat Rai & Sons..
- Ram B, Fundamentals of microprocessors and microcomputers by B.Ram.
- Grover N, Microprocessors comprehensive studies, Dhanpat Rai & Co.

Reference Books:

- Yu-Chang Liu & Glenn A, Gibson Microcomputer systems: the 8086/8088 Family: Architecture, Programming & Design.
- Ram B, Fundamentals of microprocessors and microcomputers by B.Ram..
- Ahsan S I, Microprocessors with applications in process control, TMH..
- Grover N, Microprocessors comprehensive studies, Dhanpat Rai & Co.

BT EE 609 Electrical Design Machine

Total Credit: 4
Max. Marks: 100
Theory: 70
Internal: 30
Time Allowed: 3Hrs

Course Objective:
To make the students understand the basic concepts of electrical machine design. After undergoing this course the students will have the knowledge of design concepts of various types of electrical machines, Their design fundamentals etc.

UNIT-I Principles of design of Machines: Factors and limitations in design, Specific magnetic and electric loadings, Output, Real and apparent flux densities, Separation of main dimensions for D.C., Induction and synchronous machines. Heating, Cooling and Ventilation: Temperature rise calculation, Continuous, Short-time and intermittent ratings, Types of ventilation, Hydrogen cooling and its advantages.

UNIT-II Design of Transformers: General considerations, Output equation, Main dimensions, Leakage reactance, Winding design, Tank and cooling tubes, Calculation of magnetizing current, Losses, Efficiency and regulation.

UNIT-III Design Three- phase induction motors: General considerations, Output equation, Choice of specific electric and magnetic loadings, No. of slots in stator and rotor, Elimination of harmonic torques, Design of stator and rotor windings, Leakage reactance, Equivalent resistance of squirrel cage rotor, Magnetizing current, Temperature rise and efficiency.

UNIT-IV Design of Alternators: Classification and their comparison, Specific loadings, Output coefficient, Main dimensions, Short circuit ratio, Elimination of harmonics in generated EMF, Stator winding design. Introduction to computer aided electrical machine design. Application of MATLAB for design. PSIM software application for design implementation.

Recommended Books:

- Clayton A E, The performance and design of D.C. Machines, Pitman(ELBS)
- Say M G, The performance and design of A.C. Machines, Pitman(ELBS)
- Sawhney A K, Electrical Machine Design, Dhanpat Rai & Sons

BT EE 610 Optimization Techniques in Power System

Total Credit: 4
Max. Marks: 100
Theory: 70
Internal: 30
Time Allowed: 3Hrs

Unit 1:
Basic concept of optimization, Classification of optimization, Optimization techniques, Engineering applications of optimization, Classical optimization techniques, Unconstrained optimization single-variable optimization, Multivariable optimization, Multivariable optimization, Multivariable optimization with equality constraints, Solution by direct search method, Solution by Lagrange-multipliers method, Multivariable optimization with inequality constraints, Kuhn-Tucker conditions.

Unit 2:
General non-linear programming problem, Classification of non-linear programming problem, Unconstrained optimization techniques, Direct search method, Gradient method.
Dynamic programming, Multistage decision process, Representation of a multistage decision process, Conversion of nonserial system to a serial system, Types of multistage decision problems, Principle of optimality, Computational procedure in dynamic programming, Linear programming as a case of dynamic programming, Applications of dynamic programming.

Unit 3:

Genetic Algorithm: Basic concept of Genetic algorithm and detail algorithmic steps, adjustment of free parameters. Solution of typical control problems using genetic algorithm. Concept on some other search techniques like tabu search and anD-colony search techniques for solving optimization problems.
Applications: GA application to power system optimization problem, Case studies: Identification and control of linear and nonlinear dynamic systems using Matlab-Neural Network toolbox. Stability analysis of Neural-Network interconnection systems. Implementation of fuzzy logic controller using Matlab fuzzy-logic toolbox. Stability analysis of fuzzy control systems.

Unit 4:

Swarm Intelligence: Basic Concept and model, Evolutionary Computing, Models of swarm behavior- Boids, Self-propelled particles, Metaheuristics, Stochastic diffusion search, Ant colony optimization, Particle swarm optimization, Applications- Ant-based routing, Crowd simulation, Human swarming, Swarm grammars, Swarmic art.

Recommended Books:

- Rajasekharan S, Vijayalakshmi Pai G A, Neural Network, Fuzzy Logic and Genetic Algorithms Synthesis and Applications, Prentice Hall India
- Sivanandam S N & Deepa S N, Principles of Soft Computing, Wiley India.

Semester – VII

BT EE 701 Computer aided Power System analysis

Total Credit: 4
Max. Marks: 100
Theory: 70
Internal: 30
Time Allowed: 3Hrs

Course Objective:
To make the students understand the basic concepts of computer techniques to solve power systems problems. After undergoing this course the students will have the knowledge of faults analysis, Load flow analysis using computer techniques etc.

UNIT-I General: Review of matrices and matrix operations. Incidence and Network Matrices: Network graph, Various incidence matrices, Generalized element representation, Primitive network and primitive network matrices, Formation of various network matrices by singular transformations, Inter-relations between various incidence matrices and network matrices.

UNIT-II Bus impedance and admittance matrices: Building algorithm for bus impedance matrix, Modification of bus impedance matrix for change of reference bus and for network changes, Formation of bus admittance matrix and modification, Calculation of Z Bus elements from Y Bus. Three-phase Elements: Representation of three-phase network elements, Treatment under balanced and unbalanced excitation, Transformation matrices, Unbalanced elements.
UNIT-III Short-Circuit Studies: Introduction, Network short-circuit studies using Z bus, Short-circuit calculations using symmetrical components for various types of faults using Zbus building approach.
UNIT-IV Load-Flow Studies: Introduction, Importance of load-flow studies, Classification of buses, Load-flow equations, Iterative methods, Computer algorithm and load flow solutions using Gauss-Seidel and Newton-Raphson methods, Decoupled and fast decoupled load-flow solutions, Representation of regulating and off-nominal ratio transformers, Comparison of load-flow solution methods.
Power System Security: Introduction, Contingency analysis using Z Bus and various distribution factors.

Text Books:

- Glenn W Stagg and Ahmed El-Abiad, Computer Methods in Power System Analysis, McGraw-Hill
- George L Kusic, Computer-Aided Power Systems Analysis, PHI
- Rao Uma K, Computer techniques and Models in Power Systems, I. K. International

Reference Books:

- Grainger J J and Stevenson W D, Power System Analysis, McGraw-Hill
- Nagrath, I J and Kothari D P, Power System Engineering, Tata McGraw-Hill
- Pai M A, Advanced Power Systems Analysis, TMH.

BT EE 702 Computer aided Power System analysis Laboratory

Total Credit: 1
Max. Marks: 50
External: 35
Internal: 15
Time Allowed: 3Hrs

Experiments:

1. Draw the flow chart and develop the computer program for the formation of the Y Bus of a generalized network.
2. Develop Jacobian matrix using N-R based load flow approach.
3. Draw the flow chart and develop the computer program for the formation of the Z Bus of a generalized network.
4. To perform load flow study using newton raphson/fast decoupled method.
5. Perform short circuit study for any type of fault using Zbus.
6. To plot the swing curve and observe the stability.
7. To study the MATLAB Power System block set features and simulation of transmission lines with distributed parameters.
8. To study load frequency control of two area system using SIMULINK.
9. To study load frequency control of two area system using SIMULINK and with PSS and AVR.
10. To study Power World Simulator software and use for load flow study
11. To study the features of etap software and application to single machine infinite bus system.

BT EE 703 High Voltage Engineering

Total Credit: 3
Max. Marks: 100
Theory: 70
Internal: 30
Time Allowed: 3Hrs

Course Objective:
To make the students understand the basic concepts of breakdown phenomenon, Concepts of high voltage engineering. After undergoing this course the students will have the knowledge of breakdown phenomenon in gases, Liquids, Solids, Generation of DC/AC/impulse waves, Measurements etc.

UNIT-I Conduction & Breakdown in Gases, Liquid & Solid Dielectrics: Gases - Ionization process, Town send's current growth equation. Ist & 2nd ionisation coefficients. Town send's criterion for breakdown. Streamer theory of breakdown. Paschen's law of gases. Gases used in practice.
Liquid Dielectrics- Conduction & breakdown in pure & commercial liquids, Suspended particle theory, Stressed oil volume theory, Liquid dielectrics used in practice.

UNIT-II Solid Dielectrics- Intrinsic, Electromechanical, & thermal breakdown, Composit dielectric, solid dielectrics used in practice.
Applications of Insulating Materials: Application of insulating materials in power transformers, Rotating machines, Circuit breakers, Cables & power capacitors.

UNIT-III Generation of High Voltages & Currents: Generation of high D.C., A.C., Impulse voltage & impulse currents. Tripping & control of impulse generators.

UNIT-IV Measurement of High Voltages & Currents: Measurement of high D.C., A.C. (Power frequency & high frequency) voltages, Various types of potential dividers, Generating voltmeter, Peak reading A.C. voltmeter, Digital peak voltmeter, Electrostatic voltmeter. Sphere gap method, Factors influencing the spark voltage of sphere gaps.
High Voltage Testing of Electrical Apparatus: Testing of insulators, Bushings, Circuit breakers power capaitors & power transformers.

Text Books:
- Kamaraju & Naidu, High Voltage Engineering TMH
- Rakesh Das Bagamudre, High Voltage Engineering, E.H.V. AC Transmission Engg.,TMH

Reference Books:
- Kuffel & Abdullah, High Voltage Engineering , TMH
- Chaurasia M P, High Voltage Engineering, Khanna Pub.

BT EE 704 Power system Operation & Control

- **Total Credit: 3**
- **Max. Marks: 100**
- **Theory: 70**
- **Internal: 30**
- **Time Allowed: 3Hrs**

Course Objective:
To make the students understand the advanced concepts of power system operation. After undergoing this course the students will have the knowledge power system operation and control and applications etc.

UNIT-I

AUTOMATIC GENERATION CONTROL: Single area load frequency control, load frequency Vs economic control, two area load frequency control, speed governor, dead band, digital load flow control, decentralized control, application to MATLAB.

UNIT-II

EXCITATION & VOLTAGE CONTROL: Exciters, boost buck excitation system, static excitation system, brushless excitation system, and development of excitation system and transfer function, first bench mark model.

UNIT-III

Power Systems Stability: Definitions: angular stability- steady state stability, dynamic stability, transient stability, mechanics of angular momentum, swing equation, equal area criteria, critical clearing angle, solution of swing equation, stability study in multi-machine system, application of MATLAB, technique of improving transient stability, Voltage stability, Voltage collapse, V-P and V-Q curves.

UNIT-IV

ECONOMIC LOAD DISPATCH: Generation operation cost, Economic dispatch problem, Economic Dispatch including transmission loss, derivation of transmission loss formula.

Text books:

1. Power Systems Engineering by S K Gupta, Umesh Publication, New Delhi
2. Power system analysis by O I Elgerd: TMH Publication New Delhi
3. Modern Power System by Nagrath Kothari: TMH Publication New Delhi
4. Power system analysis and Stability by S S Vadhera: Khanna Publication New Delhi
5. Power system analysis by Hadi Sadat: TMH Publication, New Delhi
6. Power System Dynamics & Stability by Sauer and M A Pai: Person Education

7. Power System Stability and Control: Parbha Kundur, Mc Graw Hill.

Reference books:

1. Power System Operation and Control by S Sivanagaraju & G Sreenivasan: PEARSON EDUCATION
2. Advanced Power System Analysis & Dynamics by L P Singh: Wiley Eastern LTD New Delhi
3. Elements of Power System Analysis by W D Stevenson: MGH Publication New Delhi
4. Power System Dynamics by M A Pai: Prentice Hall New Delhi
5. Dynamic control of Large Electric Power Systems by ILIC: Tbi pub,
6. Power Generation, operation and control by Alen J. Wood by Wiley.
7. Power System Analysis: T.K.Nagsarkar M.S.Sukjija, Oxford University Press

BT EE 707 Nonconventional Energy sources

Total Credit: 3
Max. Marks: 100
Theory: 70
Internal: 30
Time Allowed: 3Hrs

Course Objective: An undergraduate student taking this course will have foundation knowledge of various forms of non-conventional/renewable energy sources. Graguates will be able to learn about the solar energy and their utilization, wind energy and its applications, fuel cells, biomass, geothermal energy, MHD generation and ocean thermal energy, and hybrid renewable energy sources and technology.

This course includes:

UNIT I: Introduction to Non-conventional energy sources: Primary and secondary energy sources, limitations to primary sources, Indian Energy Scene, Conventional and non-conventional energy sources, Prospects of renewable energy sources, MNRE and various schemes for promotion of Renewable Energy utilization.

UNIT II: Solar Energy and its utilization: Solar constant, Solar Radiation-measurements, data, average solar radiation and solar radiation at tilted surfaces, solar energy collectors, Principle of conversion of solar energy, flat plate collectors and concentrating collectors, advantages and disadvantages, selective absorber coatings, Solar ponds and solar parks, applications of solar energy. Photovoltaic Energy Conversion Photovoltaic effect, equivalent circuit & V-I characteristics of PV cell, types of solar cell & their characteristics, effect of temperature, light intensity, cell-area & series resistance on PV cell, solar cell array & module and their configurations, specifications of PV module, PV system & their components, isolated & grid connected PV systems.

UNIT III: Wind Energy: Wind energy conversion – principle, Basic components of a WECS, Classification of WEC, Types of wind machines-horizontal and vertical axis wind turbines, aerodynamics of wind-machines, Performance of wind-machines, Wind energy generation systems, grid connected wind turbine, wind farms, site selection.

UNIT IV: Geothermal and Ocean Thermal Energy Sources: Sources and use of geo-thermal energy, geo-thermal power plants, advantages and disadvantages of geothermal energy over other forms of energy sources. Tidal power, components of tidal power plants, generation of tidal power, estimation of energy & power, site requirements, advantages and limitations, ocean thermal energy conversion (OTEC)- open cycle and closed cycle, site selection, prospects of tidal and ocean thermal energy in India, Small scale Hydroelectric (mini and microhydel) – classification, advantages and limitations of small scale hydro-electric plants.

UNIT V: Hybrid Energy sources: Introduction, Bio-mass conversion technologies, bio-gas generations, classifications of bio-gas plants, selection of site for bio-gas plant,

utilization of bio-gas, thermal gasification of bio-mass. Fuel Cells -Introduction, energy conversion principles, classification of fuel cells, Conversion efficiency of fuel cells, applications of fuel cells. Need for Hybrid Systems, Range and type of Hybrid systems, Case studies of Diesel-PV, Wind-PV, Microhydel–PV, Biomass-Diesel systems, electric and hybrid electric vehicles

Text books:

1.) G.D. Rai, "Non-Conventional Energy Sources", Khanna Publications, 1st Edition 2011
2.) B.K.Khan, "Non-Conventional Energy Resources", Tata McGraw-Hill Education. 2006

Reference books:

1.) L.E. Ferris and D. Infield , "Renewable Energy in Power Systems", Wiley, 1st Edition, 2008,
2.) M.R. Patel, "Wind and Solar Power System, Design, Analysis and Operation", CRC Press, 2nd Edition 2006,
3.) IEEE and IET journals on Renewable Energy Technologies.

BT EE 708 Fuzzy Logic and Neural Networks

Total Credit: 3
Max. Marks: 100
Theory: 70
Internal: 30
Time Allowed: 3Hrs

Course Objective:
To make the students understand the basic concepts of neural networks and fuzzy logic systems. After undergoing this course the students will have the knowledge of ANN models, Learning process, Fuzzy sets, And fuzzy control systems etc.

UNIT-I ANN Models & Architecture: Biological foundations, ANN models, Types of activation function, Introduction to network architecture, Multilayer feed forward network (MLFFN), Kohonen self-organizing map, Radial basis function network (RBFN), Recurring neural network.

UNIT-II Learning Processes: Supervised and unsupervised learning, Error-correction learning, Hebbian learning, Boltzman learning, Single layer and multilayer perception model, Least mean square algorithm, Back propagation algorithm, Application in forecasting and pattern recognition and other power engineering problems.

UNIT-III Fuzzy Sets and Theory: Fuzzy sets, Fuzzy set operations, Properties, Membership functions, Fuzzy to crisp conversion, Measures of fuzziness, Fuzzification and defuzzification methods, Application in engineering problems.

UNIT-IV Fuzzy Control System: Introduction, Simple fuzzy logic controllers with examples, Special forms of fuzzy logic models, Classical fuzzy control problems.

Text Books:

- Hagon M T, Howard B Demuth and Mark Beale, Neural Network Design, PWS Publishing Company
- Zurada Jacek M, Introduction to Artificial Neural Systems, Jaico Publishing House, Bombay
- Wasserman, Neural Computing: Theory and Practice, Van Nastrand Reinhold.

Reference Books:

- Freeman J A, Neural Networks-Algorithms, application and programming techniques, Addison Weley
- Ronald R Yager and Dimiyar P Filev, Essentials of Fuzzy Modeling and Control, John Wiley & Sons, Inc.
- Rajasekran S and Pai G A V, Neural Networks, Fuzzy logic and genetic Algorithm Synthesis and Applications, PHI New Delhi.

BT EE 709 Power Quality & Management

Total Credit: 3
Max. Marks: 100
Theory: 70
Internal: 30
Time Allowed: 3Hrs

Course Objective: To make the students understand the basic concepts of electrical power quality, voltage sags, transient overvoltages harmonics, grounding, power quality monitoring and evaluation.

UNIT 1:

Introduction to Electrical Power Quality: Power Quality, Concern in Power System, Power Quality Issues, Standards of Power Quality., Sources of voltage Sags and Interruptions, Fundamental Principles of Protection, Solutions at End User Level, Comparison of Different Ride-Through Alternatives, Sources of Transient Overvoltages, Principles of Overvoltage Protection, Devices for Overvoltage Protection, Strategies for Utility System Lightning Protection, Switching, Transient Problems with Loads.

UNIT-II:

Power Quality Monitoring and Evaluation: Power Quality Monitoring and its Objective, Power Quality Measurement Equipments, Power Quality Evaluation, Different Power Quality Indices used in Power Quality Evaluation.
Harmonics: Harmonics Distortion, Power System Quantities under Nonsinusoidal Conditions, Harmonic Indices, Harmonics Sources from Commercial and Industrial Loads, Effects of HarmonicDistortion on Power System Equipments.

UNIT-III:

Wiring and Grounding: Reasons for Grounding, Typical Wiring and Grounding Problems, Solutions to wiring and Grounding Problems.

Power Quality Conditioners: Passive Filters, Active Filters, Hybrid Filters, STATCOM, DSTATCOM, DVR, UPQC.
Distributed Generation and Power Quality: Distributed Generation and its Advantages and Disadvantages, Different Distributed Generation Technologies, Different Interfacing Electrical Systems, Power Quality Issues in Distributed Generation.

Unit IV:
Engineering: Engineering & General Layout of Equipments, Generator, Transformer and Switch Gear and Control Equipment, Construction Methods, Operation and Maintenance Principle,

Maintenance organization and planning, Availability, life cycle cost & future development. Visits to sites.

Power sector & station: Power sector structure in different states, Regulatory Regime in those states, Power utilities in Haryana, Grid management, Power financing, Visit to sites.
Management of Fuel, water Resource Electricity deviend scenario storage and handling, Pricing,Contract etc, Human resource management, Visit to sites.State and Central Power boards / Power corporations.

Text books:

1. Electric Power Systems Quality : R.C. Dugan, M. F. McGranaghan and H.W. Beaty, McGrawHill.
2. Electricity Bill, Safety & Conservation Act
3. Arora & Dom Kundwar, A Course in Power Plant Engineering, Pub.: Dhanpat Rai Pub, 2000.

Reference books:

1. Power System Harmonics: J. Arrillaga, D.A. Bradely and P.S. Bodger, Wiley.
2. Electric Power Quality: G.T. Heydt, Stars in a Circle.
3. Embedded Generation: N. Jenkins, R. Allan, P. Crossley, D. Kirschan and G. Strbac, IEEE Power and Energy Series.
4. Power Quality: C. Sankaran, CRC press.
5. IEEE Recommended Practices and Requirements for Harmonic Control in Electric Power Systems, IEEE Std. 519, 1992.
6. IEEE Recommended Practices on Monitoring Electric Power Quality, IEEE Std.1159, 1995..
7. Jain & Bala Subranmanyam, “Power Plant Engineering”, Dhanpat Rai Pub.