KAMLA NEHRU INSTITUTE OF TECHNOLOGY, SULTANPUR (U. P.)

(An Autonomous Institute under U.P.T.U. Lucknow)

Syllabus

B. Tech. 2nd, 3rd, and 4th year

Electrical Engineering

[Effective from the session 2014-15]

KAMLA NEHRU INSTITUTE OF TECHNOLOGY, SULTANPUR (U. P.)

(An Autonomous Institute under U.P.T.U. Lucknow)

BACHELOR OF TECHNOLOGY

Electrical Engineering

STUDY & EVALUATION SCHEME

(Effective from the session 2014-15)

SEMESTER – III

Sr. No.	COURSE CODE	SUBJECT(s)	PERIODS			EVALUATION SCHEME				SUBJECT TOTAL
						SESSIONAL EXAM.			ESE	
			L	T	P	CT	TA	TOTAL		
THEORY										
1.	KAS-301	Mathematics-III	3	1	0	30	20	50	100	150
2.	KEE-301	Basic System Analysis	3	1	0	30	20	50	100	150
3.	KEE-302	Electrical Measurements and Measuring Instruments	3	1	0	30	20	50	100	150
4.	KEC-307	Analog and Digital Electronics	3	1	0	30	20	50	100	150
5.	KME-309	Thermal and Hydraulic Machines	3	1	0	30	20	50	100	150
PRACTICAL										
6.	KEE-351	Numerical Technique Lab	0	0	2	10	10	20	30	50
7.	KEE-352	Electrical Measurement Lab	0	0	2	10	10	20	30	50
8.	KEE-353	Electrical Workshop	0	0	2	10	10	20	30	50
9.	KEC-357	Analog Integrated Circuits Lab	0	0	2	10	10	20	30	50
10.	GP-301	General Proficiency	-	-	-	-	-	50	-	50
		TOTAL	**15**	**05**	**08**			**380**	**620**	**1000**

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BACHELOR OF TECHNOLOGY

Electrical Engineering

STUDY & EVALUATION SCHEME

(Effective from the session 2014-15)

SEMESTER – IV

Sr. No.	COURSE CODE	SUBJECT(s)	PERIODS			EVALUATION SCHEME				SUBJECT TOTAL
						SESSIONAL EXAM.			ESE	
			L	T	P	CT	TA	TOTAL		
THEORY										
1.	KEE-401	Electromechanical Energy Conversion-I	3	1	0	30	20	50	100	150
2.	KEE-402	Network Analysis & Synthesis	3	1	0	30	20	50	100	150
3	KEE-403	Microprocessors	3	1	0	30	20	50	100	150
4.	KEE-404	Electrical & Electronics Engineering Materials	3	1	0	30	20	50	100	150
5.	KEC-407	Electromagnetic Field Theory	3	1	0	30	20	50	100	150
6.	AUC-001	Human Values & Professional Ethics*	2	0	2	-	-	25*	50*	75*
PRACTICAL										
7.	KEE-451	Electro-mechanical Energy Conversion-I Lab	0	0	2	10	10	20	30	50
8.	KEE-452	Network & Synthesis Lab	0	0	2	10	10	20	30	50
9.	KEE-453	Microprocessor Lab	0	0	2	10	10	20	30	50
10.	KEC-458	Digital Electronics Lab	0	0	2	10	10	20	30	50
11.	GP-401	General Proficiency	-	-	-	-	-	50	-	50
		TOTAL	**17**	**05**	**10**			**380**	**620**	**1000**

*Compulsory Audit-course. Candidate has to secure minimum 40% marks.

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BACHELOR OF TECHNOLOGY

Electrical Engineering

STUDY & EVALUATION SCHEME

(Effective from the session 2015-16)

SEMESTER – V

Sr. No.	COURSE CODE	SUBJECT(s)	PERIODS			EVALUATION SCHEME				SUBJECT TOTAL
						SESSIONAL EXAM.			ESE	
			L	T	P	CT	TA	TOTAL		
THEORY										
1.	KAS-501	Engineering & Managerial Economics	3	1	0	30	20	50	100	150
2.	KEE-502	Electro-mechanical Energy Conversion-II	3	1	0	30	20	50	100	150
3.	KEE-503	Control System	3	1	0	30	20	50	100	150
4.	KEE-504	Elements of Power System	3	1	0	30	20	50	100	150
5.	KEC-507	Communication Engineering	3	1	0	30	20	50	100	150
PRACTICAL / TRAINING										
6.	KAS-551	Communication Skills and Personality Development Lab	0	0	3	10	10	20	30	50
7.	KEE-552	Electro-mechanical Energy Conversion-II Lab	0	0	2	10	10	20	30	50
8.	KEE-553	Control System Lab	0	0	2	10	10	20	30	50
9.	KEC-557	Communication Engineering Lab	0	0	2	10	10	20	30	50
10.	KEE-558	Industrial Training Presentation-I*	0	0	2	-	-	50*	-	50*
11.	GP-501	General Proficiency	-	-	-	-	-	50	-	50
		TOTAL	**15**	**05**	**11**			**380**	**620**	**1000**

*4 week training after IV semester to be evaluated in V semester. Audit-training course. Candidate has to secure minimum 40% marks.

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BACHELOR OF TECHNOLOGY

Electrical Engineering

STUDY & EVALUATION SCHEME

(Effective from the session 2015-16)

SEMESTER – VI

Sr. No.	COURSE CODE	SUBJECT(s)	PERIODS			EVALUATION SCHEME				SUBJECT TOTAL
						SESSIONAL EXAM.			ESE	
			L	T	P	CT	TA	TOTAL		
THEORY										
1.	KAS-601	Industrial Management	3	1	0	30	20	50	100	150
2.	KEE-601	Electrical Systems Simulation	3	1	0	30	20	50	100	150
3.	KEE-602	Power System Analysis	3	1	0	30	20	50	100	150
4	KEE-603	Power Electronics	3	1	0	30	20	50	100	150
5.	KEE-604	Power Station Practice	3	1	0	30	20	50	100	150
PRACTICAL / SEMINAR										
6.	KEE-651	Electrical Simulation Lab	0	0	2	10	10	20	30	50
7.	KEE-652	Power System-I Lab	0	0	2	10	10	20	30	50
8.	KEE-653	Power Electronics Lab	0	0	2	10	10	20	30	50
9.	KEE-657	Seminar	-	-	2	-	-	50	-	50
10.	GP-601	General Proficiency	-	-	-	-	-	50	-	50
		TOTAL	**15**	**05**	**08**			**410**	**590**	**1000**

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BACHELOR OF TECHNOLOGY

Electrical Engineering

STUDY & EVALUATION SCHEME

(Effective from the session 2016-17)

SEMESTER – VII

Sr. No.	COURSE CODE	SUBJECT(s)	PERIODS			EVALUATION SCHEME				SUBJECT TOTAL
						SESSIONAL EXAM.			ESE	
			L	T	P	CT	TA	TOTAL		
THEORY										
1.	KEE-701	Electric Drives & Control	3	1	0	30	20	50	100	150
2.	KEE-702	Power System Operation & Control	3	1	0	30	20	50	100	150
3.	KEE-703	Switch Gear & Protection	3	1	0	30	20	50	100	150
4.	KEE-01	Elective - I	3	1	0	30	20	50	100	150
5.	KEE-02	Elective - II	3	1	0	30	20	50	100	150
PRACTICAL / TRAINING / PROJECT										
6.	KEE-751	Electric Drives Lab	0	0	2	10	10	20	30	50
7.	KEE-752	Power System –II Lab	0	0	2	10	10	20	30	50
8.	KEE-754	Project (Phase-I) #	-	-	4	-	-	50	-	50
9.	KEE-758	Industrial Training-II**	-	-	2	-	-	50	-	50
10.	GP-701	General Proficiency	-	-	-	-	-	50	-	50
		TOTAL	**15**	**05**	**10**			**440**	**560**	**1000**

Project should be initiated in the beginning of VII semester and should be completed by the end of VIII semester.

** 4-6 week training after VI semester to be evaluated in VII semester.

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BACHELOR OF TECHNOLOGY

Electrical Engineering

STUDY & EVALUATION SCHEME

(Effective from the session 2016-17)

SEMESTER – VIII

Sr. No.	COURSE CODE	SUBJECT(s)	PERIODS			EVALUATION SCHEME				SUBJECT TOTAL
						SESSIONAL EXAM.			ESE	
			L	T	P	CT	TA	TOTAL		
THEORY										
1.	KEE-801	Instrumentation and Process Control	3	1	0	30	20	50	100	150
2	KEE-802	Advance Control System	3	1	0	30	20	50	100	150
3.	KEE-03	Elective - III	3	1	0	30	20	50	100	150
4.	KEE-04	Elective - IV	3	1	0	30	20	50	100	150
PRACTICAL / PROJECT										
5.	KEE-851	Virtual Instrumentation Lab	0	0	2	10	10	20	30	50
6.	KEE-854	Project (Phase-II)	0	0	12	-	-	100	200	300
7.	GP-801	General Proficiency	-	-	-	-	-	50	-	50
		TOTAL	**12**	**04**	**14**			**370**	**630**	**1000**

DEPARTMENTAL ELECTIVES

KEE-01: ELECTIVE - I

KEE- 011: Special Electrical Machine

KEE- 012: High Voltage Engineering

KEE- 013: ANN & Fuzzy System

KEE-02: ELECTIVE – II

KEE- 021: Computer Aided Power System Analysis

KEE- 022: Advanced Power Semiconductor Devices

KEE- 023: Electrical Machine Design

KEE-03: ELECTIVE – III

KEE- 031: Non Conventional Energy Resources

KEE- 032: Utilization of Electrical Energy and Traction

KEE- 033: EHV AC & DC Transmission Systems

KEE-04: ELECTIVE - IV

KEE- 041: Power Quality

KEE- 042: Bio Instrumentation

KEE- 043: Power Converters Applications

SEMESTER III

KAS-301: MATHEMATICS-III

L T P
3 1 0

Unit-I: Function of Complex variable

Analytic function, C-R equations, Harmonic Functions, Cauchy's integral theorem, Cauchy's integral formula, Derivatives of analytic functions, Taylor's and Laurent's series, Singularities, Zeroes and Poles, Residue theorem, Evaluation of real integrals of the type $\int_0^{2\pi} f(\cos\theta, \sin\theta)d\theta$ and $\int_{-\infty}^{+\infty} f(x)dx$. **08**

Unit-II: Integral Transforms

Fourier integral, Complex Fourier transform, Fourier sine and cosine transform, Applications of Fourier transform to simple one dimensional heat transfer equations, wave equations and Laplace equations

Z-transform and its applications to solve difference equations. **08**

Unit-III: Statistical Techniques

Moments, Moment generating functions, Skewness, Kurtosis, Correlation, Linear, non-linear and multiple regression analysis, Binomial, poisson and Normal distributions, Test of significances: Chi-square test, t-test. **08**

Unit-IV: Numerical Techniques-I

Zeroes of transcendental and polynomial equations using Bisection method, Regula-falsi method and Newton-Raphson method, Rate of convergence of above methods.

Interpolation: Finite differences, Newton's forward and backward interpolation, Lagrange's and Newton's divided difference formula for unequal intervals.

Curve fitting, Method of least squares, Fitting of straight lines, Polynomials, Exponential curves **08**

Unit-V: Numerical Techniques-II

Solution of system of linear equations, Matrix decomposition methods, Jacobi method, Gauss-Seidal method,

Numerical differentiation, Numerical integration, Trapezoidal, Simpson's one third and three-eight rules,

Solution of ordinary differential equations (first order, second order and simultaneous) by Euler's, Picard's and forth-order Runge-Kutta methods. **08**

Test Books:

1. Peter V. O'Neil, "Advance Engineering Mathematics", Thomson (Cengage) Learning, 2007.

2. Jain, Iyenger & Jain, “Numerical Methods for Scientific and Engineering Computation”, New Age International, New Delhi, 2003.
3. J. N. Kapur, “Mathematical Statistics”, S. Chand & company Ltd., 2000.
4. A. C. Srivastava & P. K. Srivastava, “Engineering Mathematics”, Vol. III, PHI Learning Private Limited, New Delhi, 2011.

Reference Books:

5. R. K. Jain & S. R. K. Iyenger, “Advance Engineering Mathematics”, Narosa Publication House, 2002.
6. Chandrika Prasad, “Advanced Mathematics for Engineers”, Prasad Mudralaya, 1996.
7. S. S. Sastry, “Introductory method of Numerical Analysis”, PHI Learning Private Limited, New Delhi
8. E. Balagurusamy, “Numerical Methods”, Tata McGraw-Hill Publishing Company Limited, New Delhi.
9. E. Kreysig, “Advanced Engineering Mathematics”, John Wiley & Sons, 2005.
10. B. S. Grewal, “Higher Engineering Mathematics”, Khanna Publishers, 2005.
11. Devi Prasad, “An introduction to Numerical Analysis”, Narosa Publication house, New Delhi 2006.
12. T. Veerajan & T. Ramchandrandran, “Theory & Problems in Numerical Methods”, TMH, New Delhi, 2004.
13. S. P. Gupta, “Statistical Methods”, Sultan and Sons, New Delhi, 2004
14. Devore, “Probability and Statistics”, Thomson (Cengage) Learning, 2007.
15. Walpole, Myers, Myers & Ye, “Probability and Statistics for Engineers & Scientists”, Pearson Education, 2003.

KEE-301: BASIC SYSTEM ANALYSIS

L T P
3 1 0

UNIT - I:

Introduction to continuous time signals and systems: Basic continuous time signals, unit step, unit ramp, unit impulse and periodic signals with their mathematical representation and characteristics, Introduction to various types of systems.

Analogous System: Linear mechanical elements, force-voltage and force-current analogy. **08**

UNIT- II:

Fourier Transform Analysis: Exponential form and Trigonometric form of Fourier series, Drichlet’s conditions, Fourier Symmetry, Fourier Integral and Fourier Transform. Transform of common functions and Periodic wave forms: Applications of Fourier Transform to network analysis. **08**

UNIT- III:

Laplace Transform Analysis: Review of Laplace Transform, Laplace Transform of periodic Functions, Initial and Final Value Theorems, Inverse Laplace Transform, Convolution Theorem, Application of Laplace Transform to analysis of networks, waveform Synthesis and Laplace Transform of complex waveforms. **08**

UNIT- IV:

State-Variable analysis: Introduction, State Space representation of linear systems, Transfer Function and State variables, State Transition Matrix, Solution of state equations for Homogeneous and non-homogeneous systems, Applications of State-Variable technique to the Analysis of linear systems, similarity transformation. **08**

UNIT-V:

Z-Transform Analysis: Concept of z-Transform, z-Transform of common functions, Inverse z-Transform, Initial and Final Value theorems, Applications to solution of difference equations, Pulse Transfer Function. **08**

Text Books:

1. David K. Cheng; "Analysis of Linear System", Narosa Publishing Co.
2. ME Van-Valkenberg; "Network Analysis", Prentice Hall of India.
3. C. L. Wadhwa, "Network Analysis and Synthesis", New Age International Publishers, 2007.
4. Samarajit Ghosh, "Network Theory: Analysis and Synthesis", Prentice Hall of India, 2008
5. Saurabh Mani Tripathi, "Analysis of Basic Systems", University Science Press, New Delhi, 2009.

Reference Books:

6. Choudhary D. Roy, "Network & Systems", Wiley Eastern Ltd.
7. Donald E. Scott, "Introduction to circuit Analysis", Mc. Graw Hill
8. B. P. Lathi, "Linear Systems & Signals", Oxford University Press, 2008.
9. I. J. Nagrath, S. N. Saran, R. Ranjan and S. Kumar, "Signals and Systems", Tata Mc. Graw Hill, 2001.
10. Taan S. Elali & Mohd. A. Karim, "Continuous Signals and Systems with MATLAB", 2nd Edition, CRC Press.

KEE-302: ELECTRICAL MEASUREMENT & MEASURING INSTRUMENTS

L T P
3 1 0

UNIT-I:

Philosophy Of Measurement: Methods of Measurement, Measurement System**,** Classification of instrument system, Characteristics of instruments & measurement system**,** Errors in measurement & its analysis, Standards.

Analog Measurement of Electrical Quantities: Electrodynamic, Thermocouple, Electrostatic & Rectifier type Ammeters & Voltmeters, Electrodynamic Wattmeter, Three Phase Wattmeter, Power in three phase system, errors & remedies in wattmeter and energy meter. **10**

UNIT-II:

Instrument Transformer and their applications in the extension of instrument range, Introduction to measurement of speed, frequency and power factor. **06**

UNIT-III:

Measurement of Parameters: Different methods of measuring low, medium and high resistances**,** measurement of inductance & capacitance with the help of AC Bridges, Q Meter. **08**

UNIT-IV:

AC Potentiometer: Polar type & Co-ordinate type AC potentiometers, application of AC Potentiometers in electrical measurement.

Magnetic Measurement: Ballistic Galvanometer, flux meter**,** determination of hysteresis loop, Measurement of iron losses**.** **06**

UNIT-V:

Digital Measurement of Electrical Quantities: Concept of digital measurement, block diagram Study of digital voltmeter, frequency meter Power Analyzer and Harmonics Analyzer; Electronic Multimeter.

Cathode Ray Oscilloscope: Basic CRO circuit (Block Diagram), Cathode ray tube (CRT) & its Components, **a**pplication of CRO in measurement, Lissajous Pattern.; Dual Trace & Dual Beam Oscilloscopes. **10**

Text Book:

1. E. W. Golding & F.C. Widdis, "Electrical Measurement &Measuring Instrument", A. W. Wheeler & Co. Pvt. Ltd. India.
2. A. K. Sawhney, "Electrical & Electronic Measurement & Instrument", Dhanpat Rai & Sons, India.

Reference Books:

3. Forest K. Harries, "Electrical Measurement", Willey Eastern Pvt. Ltd. India.
4. M. B. Stout, "Basic Electrical Measurement", Prentice Hall of India.
5. W. D. Cooper, "Electronic Instrument & Measurement Technique", Prentice Hall International.
6. Rajendra Prashad, "Electrical Measurement & Measuring Instrument", Khanna Publisher.
7. J. B. Gupta, "Electrical Measurements and Measuring Instruments", S. K. Kataria & Sons.

KEC-307: ANALOG AND DIGITAL ELECTRONICS

L T P
3 1 0

ANALOG ELECTRONICS:

UNIT-I:

Special Diodes:

LED, Varactor diode, Photo diode, Schottky diode, Tunnel diode; their characteristics and applications, Transistors as a switch. **06**

UNIT-II:

Frequency Response:

Amplifier transfer function, low and high frequency response of common emitter and common source amplifiers.

Feedback:

General feedback structure; properties of negative feedback; series-series, series-shunt, shunt-series and shunt-shunt feedback amplifiers. **08**

UNIT-III:

Basic principle of sinusoidal oscillator, R-C Phase Shift and Wein Bridge oscillators, tuned oscillators-Collpits and Hartley; Crystal oscillator **06**

DIGITAL ELECTRONICS:

UNIT-IV:

Combinational Logic Circuits: Multiplexers/Demultiplexures, Encoders/Decoders.

Sequential Logic Circuits: latches, flip-flops- S-R, T, D, J-K.

Shift Registers: Basic principle, serial and parallel data transfer, shift left/right registers, universal shift register.

Counters: Mode N Counters, ripple counters, synchronous counters, ring/Johnson counters. **10**

UNIT-V:

OP-AMP applications: Astable, Monostable and Bistable multivibrators, Schmitt trigger, IC-555 Timer, A/D and D/A converters.

Voltage Regulators: Series, shunt and switching regulators, op-amp based configurations.

Memories: Introduction to ROM, RAM; Sequential Memory, Memory organization. **10**

Text Books:

1. A. S. Sedra and K.C. Smith, "Microelectronics Circuits", Oxford University Press (India)
2. Malvino & Leach, "Digital Principles and applications", Tata Mc. Graw Hill
3. R. A. Gayakwad, "Op amps and Linear Integrated Circuits", Prentice Hall of India.
4. Balbir Kumar and Shail B. Jain, "Electronic Devices and Circuits", Prentice Hall of India, 2007.

Reference Books:

5. Taub & Schilling "Digital Electronics", Tata Mc Graw Hill
6. Anil K. Maini, "Digital Electronics: Principles and Integrated circuits", Wiley India Ltd, 2008.
7. Millman, J. and Grabel A, "Microelectronics", Mc Graw Hill
8. Anand Kumar, "Switching Theory and Logic Design", Prentice Hall of India, 2008.
9. Aloke. K. Dutta, "Semiconductor Devices and circuits", Oxford University Press, 2008

KME-309: THERMAL AND HYDRAULIC MACHINES

L T P
3 1 0

Unit-I:

Fundamental Concepts and definitions: Introduction and definition of thermodynamics, Dimensions and units, Microscopic and macroscopic approaches, Systems, surrounds and universe, Concept of continuum. Control system boundary, control volume and control surface, properties and state, Thermodynamic properties, Thermodynamic path, process and cycle, Thermodynamic equilibrium, Reversibility and irreversibility, Quasi static process, Energy and its forms, work and heat, Gas law, Property of mixture of gases.

Zeroth and First law of thermodynamics: Zeroth law of Thermodynamics, Temperature and its measurement, Temperature scales. Thermodynamic equilibrium, cyclic process, enthalpy, Zero, first an carnot cycle, concept of entropy, properties of steam, processes involving steam in closed and open systems, Enthalpy. **10**

Unit-II:

Second law of Thermodynamics and Entropy: Devices converting heat to work, Thermal reservoir, Heat engines, Efficiency, Devices converting work to heat, Heat pump, refrigerator, Coefficient of Performance, Reversed heat engines, Kelvin Planck statement of second law of thermodynamics, Clausius statement of second law of Thermodynamics, Equivalence of two statements of second law of thermodynamics, Reversible and irreversible processes, Carnot cycle and Carnot engines, Carnot theorem and it's corollaries, thermodynamic temperature scale.

Availability and Irreversibility: Available and unavailable energy, Availability and Irreversibility, Second law efficiency. **10**

Unit-III:

Vapour Pressure Cycles: Rankine cycle, reheat cycle, Regenerative cycle.

Steam Turbine: Classification, impulse and reaction turbines their velocity diagrams and related calculations, work done and efficiencies, reheat factor, staging, bleeding and governing of turbines. **06**

Unit-IV:

Gas Turbine: Classification, Brayton cycle, working principle of gas turbine, gas turbine cycle with intercooling, reheat and regeneration, stage and polytrophic efficiencies.

I.C. Engines: Otto, Diesel, and Dual cycles, introduction to 2-stroke and 4-stroke SI and CI engines, indicator diagram and power measurement. **08**

Unit-V:

Impact of Jet: Introduction to hydrodynamic thrust of jet on a fixed and moving surface (flat and curve), effect of inclination of jet with the surface.

I.C. Engines: Classification, heads and efficiencies, construction, working, work done and efficiency of impulse and reaction turbines. **06**

Text Books:

1. P. K. Nag, "Basic and Applied Thermodynamics", Tata MC Graw Hill Publications.
2. Onkar Singh, "Applied Thermodynamics", New Age International (P) Publishers Ltd.
3. P. L. Ballany, "Thermal Engineering", Khanna Publishers.
4. R. K. Bansal, "A Text Book of Fluid Mechanics and Hydraulic Machines", Laxmi Publications.

KEE-351: NUMERICAL TECHNIQUE LAB

L T P
0 0 2

MATLAB Based Experiments

1. Solution of linear equations for under damped and over damped cases.
2. Determination of eigen values and eigenvectors of a square matrix.
3. Determination of roots of a polynomial.
4. Determination of polynomial using method of least square curve fitting.
5. Determination of polynomial fit, analyzing residuals, exponential fit and error bounds from the given data.
6. Solution of differential equations using 4th order Runge-Kutta method.
7. Solution of differential equation using revised Euler method.
8. Solution of difference equations.
9. Determination of time response of an R-L-C circuit.

Text/Reference Books:

1. Almos Gilat, "MATLAB: An Introduction with Applications", Wiley India Ltd., 2004.
2. William J Palm III, "Introduction to MATLAB for Engineers", McGraw-Hill Professional Publishing.
3. R. P. Singh, "Getting Started with MATLAB", Oxford University Press.

KEE-352: ELECTRICAL MEASUREMENT LAB

L T P
0 0 2

1. Calibration of ac voltmeter and ac ammeter
2. Measurement of form factor of a rectified sine wave and determine source of error if r. m. s. value is measured by a multi-meter
3. Measurement of phase difference and frequency of a sinusoidal ac voltage using C.R.O.

4. Measurement of power and power factor of a single phase inductive load and to study effect of capacitance connected across the load on the power factor
5. Measurement of low resistance by Kelvin's double bridge
6. Measurement of voltage, current and resistance using dc potentiometer
7. Measurement of inductance by Maxwell's bridge
8. Measurement of inductance by Hay's bridge
9. Measurement of inductance by Anderson's bridge
10. Measurement of capacitance by Owen's bridge
11. Measurement of capacitance by De Sauty bridge
12. Measurement of capacitance by Schering bridge
13. Study of Frequency and differential time counter
14. College may add any two experiments in the above list

KEE-353: ELECTRICAL WORSHOP

L T P
0 0 2

1. To study the working and Control of two lamps in series and in parallel
2. To perform the stair case working and it's testing.
3. To study the working principle and wiring of fluorescent lamp.
4. To study and wiring of distribution board including power plug using isolator, MCB, ELCB.
5. To study and estimate a typical, BHK house wiring.
6. Familiarization, soldering, testing and observing the wave forms on CRO of a HW and FW uncontrolled rectifier (using diodes) with capacitor filter..
7. Visit your college substation and familiarize the supply system, Transformer, HT Panned and Distribution etc.
8. To study construction, working and application of workshop tools. Also study the Electrical and Electronics Symbols.
9. To study the wires, cables and their gauges, Domestic Electrical Accessories.
10. Mini Project on PCB.
11. To study fault, Remedies in Domestic Installation and Indian Electricity Rules
12. To study the different types of earthing system and measure the earth resistance. .

KEC-357: ANALOG INTEGRATED CIRCUIT LAB

L T P
0 0 2

1. To Plot V-I characteristics of junction diode and zener diode.
2. To draw wave shape of the electrical signal at input and output points of the half wave, full wave and bridge rectifiers.
3. To Plot input / output characteristics for common base transistor.
4. To Plot input /output characteristics of FET and determine FET parameters at a given operating point.

5. To determine voltage gain, current gain, input impedance and output impedance of common emitter amplifier.
6. To determine voltage gain, current gain, input impedance and output impedance and frequency response of R-C coupled common emitter amplifier.
7. To design R-C Phase shift / Wein Bridge oscillator and verify experimentally the frequency of oscillation.
8. To study transistor as a switch and determine load voltage and load current when the transistor is ON.

SEMESTER IV

KEE-401: ELECTRO-MECHANICAL ENERGY CONVERSION-I

L T P
3 1 0

UNIT-I:

Principles of Electro-mechanical Energy Conversion - Introduction, Flow of Energy in Electromechanical Devices, Energy in magnetic systems (defining energy & Co-energy), singly Excited Systems; determination of mechanical force, mechanical energy, torque equation, Doubly excited Systems; Energy stored in magnetic field, electromagnetic torque. **08**

UNIT-II:

D.C. Machines:-Construction of DC Machines, Armature winding, emf and torque equation, Armature Reaction, Commutation, Interpoles and Compensating Windings, Performance Characteristics of DC generators. **08**

UNIT-III:

D.C. Machines (Contd.):-Performance Characteristics of D.C. motors, Starting of D. C. motors ; 3point and 4 point starters, Speed control of D.C. motors: Field Control , armature control and Voltage Control (Ward Lenonard method); Efficiency and Testing of D.C. machines (Hopkinson's and Swinburne's Test). **08**

UNIT-IV:

Single Phase Transformer: Phasor diagram, efficiency and voltage regulation, all day efficiency.

Testing of Transformers: O.C. and S.C. tests, Sumpner;s test, polarity test.

Auto Transformer: Single phase and three phase auto transformers, volt-amp, relation, efficiency, merits & demerits and applications. **08**

UNIT-V:

Three Phase Transformers: Construction, three phase transformer phasor groups and their connections, open delta connection, three phase to 2 phase, 6 phase or 12 phase connections, and their applications, parallel operation and load sharing of single phase and three phase transformers, excitation phenomenon and harmonics in transformers, three winding transformers. **08**

Text Books:

1. I. J. Nagrath & D. P. Kothari, "Electrical Machines", Tata McGraw Hill
2. Husain Ashfaq ," Electrical Machines", Dhanpat Rai& Sons
3. A. E. Fitzgerald, C. Kingsley Jr and Umans, "Electric Machinery", 6th Edition McGraw Hill, International Student Edition.

4. B. R. Gupta & Vandana Singhal, "Fundamentals of Electrical Machines", New Age International.

Reference Books:

5. Irving L. Kosow, "Electric Machine and Transformers", Prentice Hall of India.
6. M. G. Say, "The Performance and Design of AC machines", Pit man & Sons.
7. Bhag S. Guru and Huseyin R. Hizirogulu, "Electric Machinery and Transformers", Oxford University Press, 2001.

KEE-402: NETWORK ANALYSIS AND SYNTHESIS

L T P
3 1 0

Unit-I:

Graph Theory: Comparisons between conventional and graph theory approach, Graph of a Network, definitions, tree, co tree, link, basic loop and basic cut set, Incidence matrix, cut set matrix, Tie set matrix Duality, Loop and Nodal methods of analysis. **08**

Unit-II:

Network Theorems (Applications to ac networks): Concept of linearity, and homogeneity principle, Super-position theorem, Thevenin's theorem, Norton's theorem, maximum power transfer theorem, Reciprocity theorem. Millman's theorem, compensation theorem, Tellegen's theorem. **08**

Unit-III:

Network Functions : Concept of Complex frequency , Transform Impedances Network functions of one port and two port networks, concept of poles and zeros, properties of driving point and transfer functions, time response and stability from pole zero plot. **08**

Unit-IV:

Two Port Networks: Characterization of LTI two port networks ZY, ABCD and h parameters, reciprocity and symmetry. Inter-relationships between the parameters, inter-connections of two port networks, Ladder and Lattice networks. T & Π Representation, Concepts of multi-port networks and their practical examples. **08**

Unit-V:

(a) Network Synthesis : Positive real function; definition, properties, and limitations; properties of LC, RC and RL driving point functions, synthesis of LC, RC and RL driving point immittance functions using Foster and Cauer first and second forms, similarities and dissimilarities between Foster's and Cauer's forms

(b) Filters:

Image parameters and characteristics impedance, passive and active filter fundamentals, low pass, high-pass, (constant K type) filters, and introduction to active filters. **08**

Text Books:

1. M. E. Van Valkenburg, "Network Analysis", Prentice Hall of India
2. A. Chakrabarti, "Circuit Theory", Dhanpat Rai & Co.
3. C.L Wadhwa, "Network Analysis and Synthesis", New Age International Publishers, 2007.
4. D. Roy Choudhary, "Networks and Systems", Wiley Eastern Ltd.
5. Donald E. Scott: "An Introduction to Circuit analysis: A System Approach", McGraw Hill.

Reference Books:

6. M. E. Van Valkenburg, "An Introduction to Modern Network Synthesis", Wiley Eastern Ltd.
7. N. C. Jagan and C. Lakshminarayana, "Network Analysis", B. S. Publications, 2008.
8. K. S. Suresh Kumar, "Electric Circuits and Networks", Pearson Education, 2009.
9. A Ramakalyan, "Linear Circuits: Analysis and Synthesis", Oxford University Press, 2005.

KEE-403: MICROPROCESSORS

L T P
3 1 0

UNIT-I:

Introduction: Function of microprocessor, advances in microprocessors general organization of microprocessor based system, introduction to programming languages, memory map and addresses, memory classification, tri-state devices, buffers, decoder and encoder. **06**

UNIT-II:

8-bit Microprocessors:

8085 microprocessor: pin configuration, internal architecture, Timing & Signals: control and status, interrupt: ALU, machine cycles.

Instruction Set of 8085:

Addressing Modes: Register addressing, direct addressing; register indirect addressing, immediate addressing, and implicit addressing. Instruction format, op-codes, mnemonics, no. of bytes, RTL, variants, no. of machine cycles and T states, addressing modes.

Instruction Classification: Data transfer, arithmetic operations, logical operations, branching operation, machine control; Writing assembly Language programs, Assembler directives. **10**

UNIT-III:

16-bit Microprocessors:

Architecture:

Architecture of INTEL 8086 (Bus Interface Unit, Execution unit), register organization, memory addressing, memory segmentation, Operating Modes

Instruction Set of 8086: Addressing Modes**,** Instruction format, instruction Set, Groups, data transfer, arithmetic, logic string, branch control transfer, processor control.

Interrupts: Hardware and software interrupts, responses and types. **10**

UNIT-IV:

Fundamental of Programming: development of algorithms, flowcharts in terms of structures,(series, parallel, if-then-else etc.)

Assembler Level Programming: memory space allocation (mother board and user program) Assembler level programs (ASMs) **06**

UNIT-V:

Peripheral Interfacing:

I/O programming: Programmed I/O, Interrupt Driven I/O, DMA I/O interface: serial and parallel Communication, memory I/O mapped I/Os. Peripheral Devices: 8237 DMA controller, 8255-Programmable peripheral interface, 8253/8254 Programmable timer/counter. 8259 programmable Interrupt Controller. **08**

Text Books:

1. Gaonkar, Ramesh S, "Microprocessor Architecture, programming and applications with the 8085", Pen ram International Publishing 5th Ed.
2. Uffenbeck, John, "Microcomputers and Microprocessors", PHI/ 3rd Edition.
3. Ray, A. K. & Burchandi, K. M., "Advanced Microprocessors and Peripherals: Architecture, Programming and Interfacing", Tata Mc. Graw Hill.
4. Krishna Kant, "Microprocessors and Microcontrollers", PHI Learning.

Reference Books:

5. Brey, Barry B. "INTEL Microprocessors", Prentice Hall (India)
6. A. Ditya P Mathur, "Introduction to Microprocessor", Tata McGraw Hill
7. M. Rafiquzzaman, "Microprocessors-Theory and applications", PHI
8. B. Ram, "Advanced Microprocessor & Interfacing", Tata McGraw Hill
9. Renu Singh & B. P. Singh, "Microprocessor and Interfacing and applications", New Age International
10. Hall D. V., "Microprocessors Interfacing", Tata McGraw Hill
11. Liu and Gibson G. A., "Microcomputer Systems: The 8086/8088 Family", Prentice Hall India

KEE-404: ELECTRICAL & ELECTRONICS ENGINEERING MATERIALS

L T P
3 1 0

UNIT- I:

Crystal Structure of Materials:

A. Bonds in solids, crystal structure, co-ordination number, atomic packing factor, Miller Indices, Bragg's law and x-ray diffraction, structural Imperfections, crystal growth
B. Energy bands in solids, classification of materials using energy band. **08**

UNIT-II:

Conductivity of Metals: Electron theory of metals, factors affecting electrical resistance of materials, thermal conductivity of metals, heat developed in current carrying conductors, thermoelectric effect, superconductivity and super conducting materials, Properties and applications of electrical conducting and insulating materials, mechanical properties of metals. **08**

UNIT-III:

Mechanism of Conduction in semiconductor materials: Types of semiconductors, current carriers in semiconductors, Half effect, Drift and Diffusion currents, continuity equation, P-N junction diode, junction transistor, FET & IGFET, properties of semiconducting materials. **08**

UNIT-IV:

Magnetic Properties of Material: Origin of permanent magnetic dipoles in matters, Classification Diamagnetism, Para magnetism, Ferromagnetism, Anti-Ferro-magnetism and Ferrimagnetism, magnetostriction, properties of magnetic materials, soft and hard magnetic materials, permanent magnetic materials. **08**

UNIT-V:

Materials selection and Optic properties : Material properties and Engineering Design parameters; General effects of processing on parameters; selection of structural. Light interaction with solids; Absorption, Transmission and Reflection; Luminescence; Photoconductivity. **08**

Text Books:

1. L. H. Van Vlack, "Elements of Materials Science & Engineering", Addison-Wesley Publishing Company, New York.
2. V Raghavan, "Materials Science & Engineering", Prentice Hall of India Pvt. Ltd., New Delhi.
3. Murthy & Jena "Structure and properties of Engineering Materials" , TMH New Delhi
4. W D Callister, Jr., "Materials Science & Engineering – An Introduction", John Willey & Sons, Inc, New York.
5. J F Shackelford, "Introduction to Materials Science for Engineers", Maxwell Macmilan International Editions, Singapore.
6. C M Srivastava & C Srinivasan, "Science of Engineering materials", New Age International (P) Ltd. Publishers, New Delhi.
7. A. J. Dekker, "Electrical Engineering Materials", Prentice Hall of India
8. R. K. Rajput, " Electrical Engg. Materials", Laxmi Publications.
9. C. S. Indulkar & S.Triruvagdan, "An Introduction to Electrical Engg. Materials", S. Chand & Co.

Reference Books:

10. Solymar, "Electrical Properties of Materials", Oxford University Press.
11. Ian P. Hones, "Material Science for Electrical and Electronic Engineering", Oxford University Press.
12. G. P. Chhalotra & B. K. Bhat, "Electrical Engineering Materials", Khanna Publishers.
13. T. K. Basak, "Electrical Engineering Materials", New age International.

14. J W Mayer and S S Lau, "Electronic Materials Science", Maxwell Macmilan International Editions, Singapore.
15. R E Hummel, "Electronic Properties of Materials", Narosa Publishing House, New Delhi

KEC-407: ELECTROMAGNETIC FIELD THEORY

L T P
3 1 0

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. **08**

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. **10**

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 devices: Forces due to magnetic field, magnetic torque and moment, a magnetic dipole, magnetization in materials, magnetic boundary conditions, inductors and inductances, magnetic energy. **08**

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. **08**

Unit-V:

Transmission lines: Transmission line parameters, Transmission line equations, input impedance, standing wave ratio and power, The Smith chart, some applications of transmission lines. **06**

Text Books:

1. M. N. O. Sadiku, "Elements of Electromagnetics", 4th Ed, Oxford University Press.
2. Hayt, W. H. and Buck, J.A., "Engineering Electromagnetic", Tata Mc.Graw Hill Publishing.

Reference Books:

3. Jordan E.C. and Balmain K.G., "Electromagnetic Wave and radiating Systems", Prentice Hall International , 2nd Edition.
4. Kraus, F. "Electromagnetic", Tata Mc. Graw Hill 5th Edition
5. Ramo S, Whinnery T.R. and Vanduzer T, "Field and Waves in Communication Electronics", John Wiely and Sons 3rd Edition.

KEE-405: ELECTRICAL MACHINES & AUTOMATIC CONTROL

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UNIT-I:

Single phase Transformer: Efficiency Voltage regulation, O.C. & S.C. Tests.

Three Phase Transformer: Three phase transformer connections, 3-phase to 2-phase or 6-phase connections and their applications.

Auto Transformer: Volt-Amp relations, efficiency, advantages & disadvantages, applications.

D.C. Motors: Concept of starting, speed control, losses and efficiency. **08**

UNIT-II:

Three phase Induction Motor: Construction, equivalent circuit, torque equation and torque-slip characteristics, speed control.

Alternator: Construction, e. m. f. equation, Voltage regulation and its determination by synchronous impedance method.

Synchronous Motor: Starting, effect of excitation on line current (V-curves), synchronous condenser.

Servo Motor: Two phase a. c. servo motor & its application. **08**

UNIT-III:

Modeling of Mechanical System: linear mechanical elements, force-voltage and force current analogy, electrical analog of simple mechanical systems; concept of transfer function & its determination for simple systems.

Control System: Open loop & closed loop controls, servo mechanisms; concept of various types of system.

Signals: Unit step, unit ramp, unit impulse and periodic signals with their mathematical representation and characteristics**.** **08**

UNIT-IV:

Time Response Analysis: Time response of a standard second order system and response specifications, steady state errors and error constants.

Stability: Concept and types of stability, Routh-Hurwitz Criterion and its application for

determination of stability, limitations; Polar plot, Nyquist stability Criterion and assessment of stability. **08**

UNIT-V:

Root Locus Techniques: Concept of root locus, construction of root loci.

Frequency Response Analysis: Correlation between time and frequency responses of a second order system; Bode plot, gain margin and phase margin and their determination from Bode and Polar plots.

Process control: Introduction to P, PI and PID controllers their characteristics, representation and applications. **08**

Text Books:

1. J. Nagrath & D. P. Kothari, "Electrical machines", Tata McGraw Hill.
2. B.R. Gupta & Vandana Singhal, "Fundamentals of Electrical Machines", New Age International.
3. K. Ogata, "Modern Control Engineering", Prentice Hall of India.
4. B. C. Kuo, "Automatic Control systems", Wiley India Ltd.

Reference Books:

5. Irvin L. Kosow, "Electric Machinery and Transformers", Prentice Hall of India.
6. D. Roy Choudhary, "Modern Control Engineering", Prentice Hall of India.
7. M. Gopal, Control Systems: Principles and Design", Tata McGraw Hill.

KEE-451: ELECTROMECHANICAL ENERGY CONVERSION-I LAB

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0 0 2

1. To obtain magnetization characteristics of a d. c. shunt generator
2. To obtain load characteristics of a d. c. shunt generator and compound generator (a) Cumulatively compounded (b) differentially compounded
3. To obtain efficiency of a dc shunt machine using Swinburne's test
4. To perform Hopkinson's test and determine losses and efficiency of DC machine
5. To obtain speed-torque characteristics of a dc shunt motor
6. To obtain speed control of dc shunt motor using (a) armature resistance control (b) field control
7. To obtain speed control of dc separately excited motor using Conventional Ward-Leonard/Static Ward –Leonard method.
8. To study polarity and ratio test of single phase and 3-phase transformers
9. To obtain equivalent circuit, efficiency and voltage regulation of a single phase transformer using C. C. and S. C. tests.
10. To obtain efficiency and voltage regulation of a single phase transformer by Sumpner's test.
11. To obtain 3-phase to 2-phase conversion by Scott connection.
12. To determine excitation phenomenon (B. H. loop) of single phase transformer using C. R. O.

KEE-452: NETWORK & SYNTHESIS LAB

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1. Verification of principle of superposition with dc and ac sources.
2. Verification of Thevenin's, Norton and Maximum power transfer theorems in ac circuits
3. Verification of Tellegin's theorem for two networks of the same topology
4. Determination of transient response of current in RL and RC circuits with step voltage input
5. Determination of transient response of current in RLC circuit with step voltage input for under-damp, critically damp and over-damp cases
6. Determination of frequency response of current in RLC circuit with sinusoidal ac input
7. Determination of z and h parameters (dc only) for a network and computation of Y and ABCD parameters
8. Determination of driving point and transfer functions of a two port ladder network and verify with theoretical values
9. Determination of image impedance and characteristic impedance of T and Π networks, using O.C. and S.C. tests Write Demo for the following (in Ms-Power point)
10. Verification of parameter properties in inter-connected two port networks: series, parallel and cascade also study loading effect in cascade.
11. Determination of frequency response of a Twin - T notch filter.
12. To determine attenuation characteristics of a low pass / high pass active filters. to 15 College may add any three experiments in the above list.

KEE-453: MICROPROCESSOR LAB

L T P
0 0 2

A. Study Experiments:

1. To study 8085 based microprocessor system
2. To study 8086 and 8086A based microprocessor system
3. To study Pentium Processor

B. Programming based Experiments (any four):

4. To develop and run a program for finding out the largest/smallest number from a given set of numbers.
5. To develop and run a program for arranging in ascending/descending order of a set of numbers
6. To perform multiplication/division of given numbers
7. To perform conversion of temperature from 0F to 0C and vice-versa
8. To perform computation of square root of a given number
9. To perform floating point mathematical operations (addition, subtraction, multiplication and division)

C. Interfacing based Experiments (any four):

10. To obtain interfacing of RAM chip to 8085/8086 based system
11. To obtain interfacing of keyboard controller
12. To obtain interfacing of DMA controller
13. To obtain interfacing of PPI
14. To obtain interfacing of UART/USART
15. To perform microprocessor based stepper motor operation through 8085 kit
16. To perform microprocessor based traffic light control
17. To perform microprocessor based temperature control of hot water

KEC-458: DIGITAL ELECTRONICS LAB

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

EEE-455: ELECTRICAL MACHINES & AUTOMATIC CONTROL LAB

L T P
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A. Electrical Machines:

1. To obtain speed-torque characteristics and efficiency of a dc shunt motor by direct loading.
2. To obtain efficiency of a dc shunt machine by no load test.
3. To obtain speed control of dc shunt motor using (a) armature voltage control (b) field control.
4. To determine polarity and voltage ratio of single phase and three phase transformers.
5. To obtain efficiency and voltage regulation by performing O.C. and S.C. tests on a single phase transformer at full load and 0.8 p. f. loading.
6. To obtain 3-phase to 2-phase conversion using Scott connection.
7. To perform load test on a 3-phase induction motor and determine (a) speed- torque characteristics (ii) power factor v/s line current characteristics.
8. To study speed control of a 3-phase induction motor using (a) Voltage Control (b) Constant (Voltage/ frequency) control.
9. To perform open circuit and short circuit test on a 3-phase synchronous machine and determine voltage regulation at full load and unity, 0.8 lagging and 0.8 leading power factor using synchronous impedance method.
10. To determine V-curve of a 3-phase synchronous motor at no load, half load and full load.

B. Automatic Control System:

1. To determine transient response of a second order system for step input for various values of constant 'K' using linear simulator unit and compare theoretical and practical results.
2. To study P, PI and PID temperature controller for an oven and compare their performance.
3. To determine speed – torque characteristics of an a. c. 2-phase servo motor.
4. To study and calibrate temperature using Resistance Temperature Detector(RTD)
5. To study dc servo position control system within P and PI configurations.
6. To study synchro transmitter and receiver system and determine output V/s input characteristics.
7. To study open loop and closed loop control of a dc separately excited motor.

A Foundation Course

in

Human Values & Professional Ethics

Course Code: AUC-001

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2 0 2

Total no. of Lectures: 28
Total no. of Practice Sessions: 14 (of 2 hrs each)

Content for Lectures:

Module 1: Course Introduction-Need, Basic Guidelines, Content and Process for Value Education

1. Understanding the need, basic guidelines, content and process for Value Education
2. Self Exploration-what is it? Its content and process. Natural Acceptance and Experimental Validation-as the mechanism for self exploration
3. Continuous happiness and Prosperity-A look at basic Human Aspirations
4. Right understanding, Relationship and Physical Facilities-the basic requirements for fulfillment of aspirations of every human being with their correct priority
5. Understanding Happiness and Prosperity correctly-A critical appraisal of the current scenario
6. Method to fulfill the above human aspirations: understanding and living in harmony at various levels

Module 2: Understanding Harmony in the Human Being-Harmony in Myself

7. Understanding human being as a co-existence of the sentiment 'I' and the material 'Body'
8. Understanding the needs of self ('I') and 'Body'-Sukh and Suvidha
9. Understanding the Body as an instrument of 'I' (I being the doer, seer, and enjoyer)
10. Understanding the characteristics and activities of 'I' and harmony in 'I'.
11. Understanding the harmony of I with the Body: *Sanyam* and *Swasthya*: correct appraisal of physical needs, meaning of Prosperity in detail
12. Programs to ensure *Sanyam* and *Swasthya*

    -Practice Exercise and Case Studies will be taken up in Practice Sessions

Module 3: Understanding Harmony in the Family and Society-Harmony in Human-Human Relationship

13. Understanding harmony in the Family-the basic unit of human interaction
14. Understanding values in human-human relationship: meaning of *Nyaya* and Program for its fulfillment to ensure *Ubhay-tripti:*
    Trust (*Vishwas*) and Respect (*Samman*) as the foundational values of relationship
15. Understanding the meaning of *Vishwas*: Difference between intention and competence
16. Understanding the meaning of *Samman*, Difference between respect and differentiation: the other salient values in relationship
17. Understanding the harmony in the society (society being an extension of family):

Samadhan, Samridhi, Abhay, Sah-astitva as comprehensive human Goals

18. Visualizing a universal harmonious order in society, Undivided Society
    -Practice Exercise and case Studies will be taken up in Practice sessions

Module 4: Understanding Harmony in the Nature and Existence-Whole existence as Co-existence

19. Understanding the harmony in the Nature
20. Interconnectedness and mutual fulfillment among the four orders of nature-recyclability
21. Understanding Existence as Co-existence (*Sah-astitva*) of mutually interacting units in all pervasive space
22. Holistic perception of harmony at all levels of existence
    -Practice Exercise and Case Studies will be taken up in Practice Sessions

Module 5: Implications of above Holistic Understanding of Harmony on Professional Ethics

23. Natural acceptance of human values
24. Definitiveness of Ethical Human Conduct
25. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order
26. Competence in professional ethics:
    a) Ability to utilize the professional competence for augmenting universal human order
    b) Ability to identify the scope and characteristics of people-friendly and eco-friendly production systems.
    c) Ability to identify and develop appropriate technologies and management patterns for above productions systems.

27. Case studies of typical holistic technologies, management models and production systems
28. Strategy for transition from the present state to Universal Human Order:
    a) At the level of individual: as socially and ecologically responsible engineers, technologists and managers
    b) At the level of society: as mutually enriching institutions and organizations

Text Book:

1. P. R. Gaur, R. Sangal, G. P. Bgaria, 2009, "*A Foundation Course in Human Values and Professional Ethics"*, Excel Books Private Limited, New Delhi.

2. P. R. Gaur, R. Sangal, G. P. Bgaria, 2009, "*Teacher's Manual: A Foundation Course in Human Values and Professional Ethics"*, Excel Books Private Limited, New Delhi.

Reference Book:

1. Ivan Illich, 1974, *Energy & Equity, The Trinity Press*, Worcester, and Harper Collins, USA.

2. E. F. Schumacher, 1973, *Small is beautiful: a study of economics as if people mattered*, Blond & Briggs, Britain.

3. Sussan George, 1976, *How the Other Half Dies*, Penguin Press, Reprinted 1986, 19991.

4. Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, *Limits to growth-Club of Rome's report*, Universe Books.

5. A. Nagraj, 1998, *Jeevan Vidya ek Parichay*, Divya Path Sansthan, Amarkantak.

6. P. L. Dhar, R R Gaur, 1990, *Science and Humanism*, Commonwealth Publishers.

7. A N Tripathy, 2003, *Human Values*, New Age International Publishers.

8. Subhas Palekar, 2000, *How to practice Natural Farming*, Pracheen (Vaidik) Krishi Tantra Shodh, Amarvati.

9. E G Seebauer & Robert L. Berry, 2000, *Fundamentals of Ethics for Scientists & Engineers*, Oxford University Press.

10. M. Govindarajan, S Natarajan & V S Senthil Kumar, *Engineering Ethics (including Human Values)*, Eastern Economy Edition, Prentice Hall of India Ltd.

11. B P Banerjee, 2005, *Foundations of Ethics and Management*, Excel Books.

12. B. L. Bajpai, 2004, *Indian Ethos and Modern Management*, New Royal Book Co. Lucknow, Reprinted 2008.

Relevent websites, CDs, Movies and Documentaries:

1. Value Education website, www.uptu.ac.in

2. Story of Stuff, www.storyofstuff.com

3. Al Gore, *An Inconvenient Truth*, Paramount Classics, USA.

4. Chalie Chaplin, *Modern Times*, United Artists, USA.

5. IIT Delhi, *Modern Technology-the untold story*

6. Anand Gandhi, *Right here right now*, Cyclewala production

SEMESTER V

KAS-501: ENGINEERING & MANAGERIAL ECONOMICS

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3 1 0

Unit-I:

Introduction: Meaning, Nature and Scope of Economics, Meaning of Science, Engineering and Technology. Managerial Economics and its scope in engineering perspective. **08**

Unit-II:

Basic Concepts: Demand Analysis, Law of Demand, Determinates of Demand, Elasticity of Demand-Price, Income and cross Elasticity. Uses of concept of elasticity of demand in managerial decision. **08**

Unit-III:

Demand forecasting: Meaning, significance and methods of demand forecasting, production function, Laws of returns to scale & Law of Diminishing returns scale. An overview of Short and Long run cost curves-fixed cost, variable cost, average cost, marginal cost, Opportunity cost. **08**

Unit-IV:

Market Structure: Perfect Competition, Imperfect competition-Monopolistic, Oligopoly, duopoly sorbent features of price determination and various market conditions. **08**

Unit-V:

National Income, Inflation and Business Cycles: Concept of N.I. and Measurement. Meaning of Inflation, Type causes & prevention methods, Phases of business cycle. **08**

Reference Books:

1. Koutsoyiannis A, "Modern Microeconomics", ELBS.
2. "Managerial Economics for Engineering", Prof. D. N. Kakkar
3. "Managerial Economics", D. N. Dwivedi
4. "Managerial Economics", Maheshwari.

KEE-502:ELECTRO-MECHANICAL ENERGY CONVERSION-II

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3 1 0

UNIT-I:

Synchronous Machine I: Constructional features, Advantages and disadvantages of synchronous machines, Armature winding, EMF Equation, Winding coefficients, equivalent circuit and phasor diagram, Armature reaction, O. C. & S. C. tests, Voltage Regulation using Synchronous Impedance Method, MMF Method, Potier's Triangle Method, Parallel Operation of synchronous generators, operation on infinite bus, Advantages and disadvantages of parallel operation of synchronous generators, synchronizing power and torque co-efficient **10**

UNIT-II:

Synchronous Machine II: Two Reaction Theory, Power flow equations of cylindrical and salient pole machines, operating characteristics

Synchronous Motor:

Starting methods, Effect of varying field current at different loads, V- Curves, Hunting & damping, synchronous condenser **08**

UNIT-III:

Three phase Induction Machine-I: Constructional features, Rotating magnetic field, Principle of operation Phasor diagram, equivalent circuit, torque and power equations, Torque- slip characteristics, no load & blocked rotor tests, efficiency, Induction generator & its applications, industrial applications of induction motors, Comparisons between wound and slip ring type Induction Motors.

08

UNIT-IV:

Three phase Induction Machine-II: Starting, Deep bar and double cage rotors, Cogging & Crawling, Speed Control (with and without emf injection in rotor circuit.) **06**

UNIT-V:

Single phase Induction Motor: Concepts of pony motors and its limitations, Double revolving field theory, Equivalent circuit, No load and blocked rotor tests, Starting methods, repulsion motor, domestic applications of single phase IMs, Comparisons between methods of starting of single phase IMs on basis of performance and cost wise.

AC Commutator Motors: Universal motor, Single phase a.c. series compensated motor, stepper motors. **08**

Text Books:

1. D. P. Kothari & I. J. Nagrath, "Electric Machines", Tata McGraw Hill
2. Ashfaq Hussain, "Electric Machines", Dhanpat Rai & Company
3. Fitzerald, A. E., Kingsley and S. D. Umans, "Electric Machinery", MC Graw Hill.

Reference Books:

4. P. S. Bimbhra, "Electrical Machinery", Khanna Publisher
5. P. S. Bimbhra, " Generalized Theory of Electrical Machines", Khanna Publishers
6. M. G. Say, "Alternating Current Machines", Pitman & Sons

KEE-503: CONTROL SYSTEM

L T P
3 1 0

UNIT-I:

The Control System: Open loop & closed control; servomechanism, Physical examples. Transfer functions, Block diagram algebra, Signal flow graph, Mason's gain formula Reduction of parameter variation and effects of disturbance by using negative feedback. **08**

UNIT-II:

Time Response analysis: Standard test signals, time response of first and second order systems, time response specifications, steady state errors and error constants

Design specifications of second order systems: Derivative error, derivative output, integral error and PID compensations, design considerations for higher order systems, performance indices. **08**

UNIT-III:

Control System Components: Constructional and working concept of ac servomotor, synchros and stepper motor Stability and Algebraic criteria concept of stability and necessary conditions, Routh-Hurwitz criteria and limitations.

Root Locus Technique: The root locus concepts, construction of root loci

08

UNIT-IV:

Frequency response Analysis: Frequency response, correlation between time and frequency responses, polar and inverse polar plots, Bode plots

Stability in Frequency Domain:

Nyquist stability criterion, assessment of relative stability: gain margin and phase margin, constant M&N circles **08**

UNIT-V:

Introduction to Design: The design problem and preliminary considerations lead, lag and lead-lag networks, design of closed loop systems using compensation techniques in time domain and frequency domain.

Review of state variable technique: Review of state variable technique, conversion of state variable model to transfer function model and vice-versa, diagonalization, Controllability and observability and their testing. **08**

Text Books:

1. Nagrath & Gopal, "Control System Engineering", 4th Edition, New age International.
2. K. Ogata, "Modern Control Engineering", Prentice Hall of India.
3. B.C. Kuo & Farid Golnaraghi, "Automatic Control System", Wiley India Ltd, 2008.
4. D. Roy Choudhary, "Modern Control Engineering", Prentice Hall of India.

Reference Books:

5. Norman S. Nise, "Control System Engineering", 4th edition, Wiley Publishing Co.
6. Ajit K Mandal, "Introduction to Control Engineering", New Age International, 2006.
7. R. T. Stefani, B. Shahian, C. J. Savant and G. H. Hostetter, "Design of Feedback Control Systems", Oxford University Press.
8. N.C. Jagan, "Control Systems", B.S. Publications, 2007.

KEE-504: ELEMENTS OF POWER SYSTEM

L T P
3 1 0

UNIT-I:

Power System Components: Single line Diagram of Power system, Brief description of power system Elements: Synchronous machine, transformer, transmission line, bus bar, circuit breaker and isolator

Supply System: Different kinds of supply system and their comparison, choice of transmission voltage

Transmission Lines: Configurations, types of conductors, resistance of line, skin effect, Kelvin's law. Proximity effect **08**

UNIT-II:

Over Head Transmission Lines: Calculation of inductance and capacitance of single phase, three phase, single circuit and double circuit transmission lines, Representation and performance of short, medium and long transmission lines, Ferranti effect. Surge impedance loading **08**

Unit-III:

Corona and Interference: Phenomenon of corona, corona formation, calculation of potential gradient, corona loss, factors affecting corona, methods of reducing corona and interference. Electrostatic and electromagnetic interference with communication lines

Overhead line Insulators: Type of insulators and their applications, potential distribution over a string of insulators, methods of equalizing the potential, string efficiency **08**

Unit-IV:

Mechanical Design of transmission line: Catenary curve, calculation of sag & tension, effects of wind and ice loading, sag template, vibration dampers

Insulated cables: Type of cables and their construction, dielectric stress, grading of cables, insulation resistance, capacitance of single phase and three phase cables, dielectric loss, heating of cables. **08**

Unit-V

Neutral grounding: Necessity of neutral grounding, various methods of neutral grounding, earthing transformer, grounding practices

Electrical Design of Transmission Line: Design consideration of EHV transmission lines, choice of voltage, number of circuits, conductor configuration, insulation design, selection of ground wires.

EHV AC and HVDC Transmission: Introduction to EHV AC and HVDC transmission and their comparison, use of bundle conductors, kinds of DC links, and incorporation of HVDC into AC system **08**

Text Books:

1. W. D. Stevenson, "Element of Power System Analysis", McGraw Hill,
2. C. L. Wadhwa, "Electrical Power Systems", New age international Ltd. Third Edition
3. Ashfaq Hussain, "'Power System", CBS Publishers and Distributors,
4. B. R. Gupta, "Power System Analysis and Design", Third Edition, S. Chand & Co.
5. M. V. Deshpande, "Electrical Power System Design", Tata McGraw Hill.

Reference Books:

6. M. V. Deshpandey, "Elements of Power System Design", Tata McGraw Hill,
7. Soni, Gupta & Bhatnagar, "A Course in Electrical Power", Dhanpat Rai& Sons,
8. S. L. Uppal, "Electric Power", Khanna Publishers
9. S. N. Singh, "Electric Power Generation, Transmission & distribution", PHI Learning

KEC-507: COMMUNICATION ENGINEERING

L T P
3 1 0

Unit-I:

Amplitude Modulation: Amplitude modulation, DSBSC, SSB and VSB modulation and demodulation schemes AM transmitters and receivers, super-hetrodyne receiver, IF amplifiers, AGC circuits Frequency division multiplexing. **08**

Unit-II:

Angle Modulation: Frequency modulation, phase modulation, Generation of frequency modulation, FM receivers and demodulators

Noise: External noise, internal noise, Noise calculations, signal to noise ratio Noise in AM and FM systems. **08**

Unit-III:

Pulse Communication: Sampling Process, PAM, PWM, PPM and PCM, Delta modulation and adaptive delta modulation

Digital Modulation: Introduction, brief description of phase shift keying (PSK), Differential phase shift keying (DPSK), frequency shift Keying (FSK), Quadrature amplitude modulation (QAM) and time division multiplexing (TDM). **08**

Unit-IV:

Radio Propagation: Ground waves, sky wave propagation, space waves, tropospheric scatter propagation, Satellite Communication- transponders, Geo-stationary satellite system, low earth and medium earth-orbit satellite system. Introduction to Cellular system Personal communication system (PCS), data communication with PCS. **08**

Unit-V:

Television: TV systems and standards, scanning and synchronizing, common video and sound circuits, vertical and horizontal deflections, colour transmission and reception.

Fibre Optical Communication: Optical fibre and fibre cables, fibre characteristics and classification, fibre optic components and systems. **08**

Text Books:

1. G. Kennedy and B. Davis , "Electronic Communication Systems", Tata McGraw Hill
2. Simon Haykin, " Communication Systems", John Wiley & Sons

Reference Books:

3. Roy Blake, " Wireless Communication Technology", Thomson Asia Pvt. Ltd. Singapore
4. B. P. Lathi, "Modern Analog and Digital Communication Systems", Oxford University Press.
5. Taub & Schilling, "Principles of Communication Systems", McGraw Hill.

KEE- 552: ELECTRO-MECHANICAL ENERGY CONVERSION – II LAB

L T P
0 0 2

1. To perform no load and blocked rotor tests on a three phase squirrel cage induction motor and determine equivalent circuit.
2. To perform load test on a three phase induction motor and draw:
3. Torque -speed characteristics
4. Power factor-line current characteristics
5. To perform no load and blocked rotor tests on a single phase induction motor and determine equivalent circuit.
6. To study speed control of three phase induction motor by Keeping V/f ratio constant
7. To study speed control of three phase induction motor by varying supply voltage.
8. To perform open circuit and short circuit tests on a three phase alternator and determine voltage regulation at full load and at unity, 0.8 lagging and leading power factors by (i) EMF method (ii) MMF method.
9. To determine V-curves and inverted V-curves of a three phase synchronous motor.
10. To determine Xd and Xq of a three phase salient pole synchronous machine using the slip test and draw the power-angle curve.
11. To study synchronization of an alternator with the infinite bus by using:
12. dark lamp method (ii) two bright and one dark lamp method

Software based experiments (Develop Computer Program in 'C' language or use MATLAB or other commercial software)

13. To determine speed-torque characteristics of three phase slip ring induction motor and study the effect of including resistance, or capacitance in the rotor circuit.
14. To determine speed-torque characteristics of single phase induction motor and study the effect of voltage variation.
15. To determine speed-torque characteristics of a three phase induction motor by (i) keeping v/f ratio constant (ii) increasing frequency at the rated voltage.
16. Draw O.C. and S.C. characteristics of a three phase alternator from the experimental data and determine voltage regulation at full load, and unity, 0.8 lagging and leading power factors.
17. To determine steady state performance of a three phase induction motor using equivalent circuit.

KEE-553: CONTROL SYSTEM LAB

L T P
0 0 2

1. To determine response of first order and second order systems for step input for various values of constant 'K' using linear simulator unit and compare theoretical and practical results.
2. To study P, PI and PID temperature controller for an oven and compare their performance.
3. To study and calibrate temperature using resistance temperature detector (RTD)
4. To design Lag, Lead and Lag-Lead compensators using Bode plot.
5. To study DC position control system
6. To study synchro-transmitter and receiver and obtain output V/S input characteristics
7. To determine speed-torque characteristics of an ac servomotor.
8. To study performance of servo voltage stabilizer at various loads using load bank.
9. To study behaviour of separately excited dc motor in open loop and closed loop conditions at various loads.
10. To study PID Controller for simulation proves like transportation lag.

Software based experiments (Use MATLAB, LABVIEW software etc.)

11. To determine time domain response of a second order system for step input and obtain Performance parameters.
12. To convert transfer function of a system into state space form and vice-versa.
13. To plot root locus diagram of an open loop transfer function and determine range of gain 'k' for stability.
14. To plot a Bode diagram of an open loop transfer function.
15. To draw a Nyquist plot of an open loop transfer functions and examine the stability of the closed loop system.

Reference Books:

1. K. Ogata, "Modern Control Engineering", Prentice Hall of India.
2. Norman S. Nise, "Control System Engineering", John Wiley & Sons.
3. M. Gopal, "Control Systems: Principles & Design", Tata McGraw Hill.

KEC-557: COMMUNICATION ENGINEERING LAB

L T P
0 0 2

1. To study amplitude modulation using a transistor and determine depth of modulation.
2. To study generation of DSB-SC signal using balanced modulator.
3. To study generation of SSB signal
4. To study envelop detector for demodulation of AM signal and observe diagonal peak clipping effect.
5. To study super heterodyne AM receiver and measurement of sensitivity, selectivity and fidelity.
6. To study frequency modulation using voltage controlled oscillator.
7. To detect FM signal using Phase Locked Loop.
8. To measure noise figure using a noise generator.
9. To study PAM, PWM and PPM.
10. To realize PCM signal using ADC and reconstruction using DAC and 4 bit/8bit system. Observe quantization noise in each case.
11. To study Delta Modulation and Adaptive Delta Modulation.
12. To study PSK-modulation system.
13. To study FSK-modulation system.
14. To study sampling through a Sample-Hold circuit and reconstruction of the sampled signal and observe the effect of sampling rate & the width of the sampling pulses.
15. To study functioning of colour television.

KEE-558: INDUSTRIAL TRAINING-I*

L T P
0 0 2

Students will go Industrial training of four weeks in any industry or reputed organization after the IVth semester examination in summer. They will also prepare an exhaustive technical report of the training which will be duly signed by the officer under whom training was taken in the industry/organization. They will have to present about the training before a committee consisting of faculty members constituted by the concerned Head of the Department.

SEMESTER VI

KAS-601: INDUSTRIAL MANAGEMENT

L T P
3 1 0

Unit-I:
Introduction: Concept, Development, application and scope of Industrial Management. **Productivity:** Definition, measurement, productivity index, types of production system, Industrial Ownership. **08**

Unit-II:
Management Function: Principles of Management- Management Tools-time and motion study, work simplification- process charts and flow diagrams, Production Planning, Specification of Production requirements. **08**

Unit-III:
Inventory control: Inventory, cost, Deterministic models, Introduction to supply chain management. **08**

Unit-IV:
Quality control: Meaning, process control, SQC control charts, single, double and sequential sampling, Introduction to TQM. **08**

Unit-V:
Environmental Issues: Environmental Pollution-various management techniques to control Environmental pollution-Various control acts for Air, Water, Solid waste and Noise pollution. **08**

Reference Books:

1. O. P., Khanna, "Industrial Engineering", Dhanpat Rai Publications.
2. T. R., Banga, "Industrial Engineering and Management", Tata McGraw Hill Publishing
3. B. R., Sharma., "Environmental and Pollution Awareness", Satya Prakashan, New Delhi.

KEE-601: ELECTRICAL SYSTEMS SIMULATION

L T P
3 1 0

Unit-I:

Basics: General overview & understanding of MATLAB and its interface-command window, workspace, data types, dimensions, case sensitivity, variables and assignments, vector and matrices, arithmetic / relational / logical operators;

08

Unit-II:

Matrix and differential equations: Basic matrix operations, Concatenation of Matrices, Eigen values and eigen vectors, Polynomial roots, Differentiation and integration, Complex arithmetic, Solution of linear equations, Solution of ordinary differential equations (ODE), Plotting of 2D and 3D curves, Subplot, Figure Editor, Data analysis and statistics.

08

Unit-III:

Programming: Flow control structures (if-else, for, while, switch and case, continue, break, return), Built-in and user-defined functions, MATLAB Programming in M-files, Script & Function files.

08

Unit-IV:

Simulink based Modeling and Simulation: Simulink-Simulink model editor, Simulink blocks library, concepts of blocksets, block diagram construction, subsystem, simulation parameters & solvers, Embedded MATLAB Functions, Introduction to Sim Power Systems blockset, Simulink based modeling & simulation of electrical circuits, Linear state-space modeling & simulation.

08

Unit-V:

Programming Applications: Applications of MATLAB programming in- interpolation, numerical computations & solutions, fitting a polynomial curve, signal analysis, electrical circuits analysis (RC, RL, RLC type) and frequency responses analysis of transfer functions.

08

Reference Books:

1. Stephen J. Chapman, "MATLAB Programming for Engineers", 3rd edition Cengage Learning,
2. Amos Gilat, "MATLAB & Introduction with application", Wiley India.
3. William J Palm III, "Introduction to MATLAB for Engineers", McGraw-Hill Professional Publishing.
4. Rudra Pratap, "Getting Started with MATLAB 7",
5. The Math Works Inc., "MATLAB: The Language of Technical Computing",
6. The Math Works Inc, "SIMULINK: Dynamic System Simulation",
7. The Math Works Inc., "Sim Power Systems : User's Guide",

8. B. R. Hunt, R. L. Lipsman & J. M. Rosenberg, "A Guide to MATLAB", Cambridge University Press, 2003.
9. O. Beucher and M. Weeks, "Introduction to MATLAB & SIMULINK-A Project Approach", Infinity Science Press LLC, Hingham, MA, Third Edition.

KEE-602: POWER SYSTEM ANALYSIS

L T P
3 1 0

UNIT-I:

Representation of Power System Components: Synchronous machines, Transformers, Transmission lines, one-line diagram, Impedance and reactance diagram, per unit System

Symmetrical components: Symmetrical Components of unbalanced phasors, power in terms of symmetrical components, sequence impedances and sequence networks.

Symmetrical fault analysis: Transient in R-L series circuit, calculation of 3-phase short circuit current and reactance of synchronous machine, internal voltage of loaded machines under transient conditions. **08**

UNIT-II:

Unsymmetrical faults: Analysis of single line to ground fault, line-to-line fault and Double Line to ground fault on an unloaded generators and power system network with and without fault impedance. Formation of Z-bus using singular transformation. **08**

UNIT-III:

Load Flows: Introduction, bus classifications, nodal admittance matrix (*BUS Y*), development of load flow equations, load flow solution using Gauss Siedel and Newton-Raphson method, approximation to N-R method, line flow equations and fast decoupled method. **08**

UNIT-IV:

Power System Stability: Stability and Stability limit, Steady state stability study, Swing equation, transient stability studies by equal area criterion and step-by-step method. Factors affecting steady state and transient stability and methods of improvement

UNIT-V

Traveling Waves: Wave equation for uniform Transmission lines, velocity of propagation, surge impedance, reflection and transmission of traveling waves under different line loadings. Bewlay's lattice diagram, protection of equipment's and line against traveling wave. **08**

Text Books:

1. W.D. Stevenson, Jr. "Elements of Power System Analysis", McGraw Hill.
2. C.L. Wadhwa, "Electrical Power System", New Age International.
3. Chakraborthy, Soni, Gupta & Bhatnagar, "Power System Engineering", Dhanpat Rai & Co.
4. T. K Nagsarkar & M. S. Sukhija, "Power System Analysis", Oxford University Press, 2007.

Reference Books:

5. L. P. Singh; "Advanced Power System Analysis & Dynamics", New Age International
6. Hadi Sadat; "Power System Analysis", Tata McGraw Hill.
7. D. Das, "Electrical Power Systems", New Age International, 2006.
8. J. D. Glover, M.S. Sharma & T .J. Overbye, "Power System Analysis and Design", Thomson, 2008.
9. P. S. R. Murthy, "Power System Analysis", B. S. Publications, 2007.
10. Stagg and El-Abiad, "Computer Methods in Power System Analysis", Tata McGraw Hill
11. Kothari & Nagrath, "Modern Power System Analysis", Tata Mc. Graw Hill.

KEE-603: POWER ELECTRONICS

L T P
3 1 0

UNIT-I:

Power semiconductor Devices: Power semiconductor devices, their symbols and static characteristics. Characteristics and specifications of switches, types of power electronic circuits.

Power Diodes: General purpose diode, Fast recovery diode, Schottky diode and its applications.

Power Bipolar Junction Transistors: Physical structure and device operation, Static V-I and switching characteristics, switching limits of Power Transistor.

Power MOSFETS: Physical structure and device operation, Static V-Icharacteristics and switching characteristics, safe operating area.

Insulated Gated Bipolar Transistors: Physical structure and device operation, Static V-I characteristics, Safe operating area.

Thyristor: Physical structure and device operation, static V-I characteristics, two transistor model, methods of turn-on.

GTO (Gate Turn Off) Thyristors: Physical structure and device operation, Static V-I and switching characteristics.

TRIAC: Physical structure and device operation, Static V-I characteristics and applications.

Special Power Devices: Physical structure, Device operation and static V-I characteristics of Reverse Conducting Thyristor (RCT), FET controlled thyristor, Static Induction Thyristors (SITH), MOS Controlled Thyristor (MCT), LASCR. **10**

UNIT-II:

Power Semiconductor Devices (Contd): Protection of devices, Series and parallel operation of thyristors, Commutation techniques of thyristor.

DC-DC Converters: Introduction, Principle of chopper operation, Control strategies, Principles of step-down chopper, step-down chopper with R-L load, Principle of step-up chopper, and operation with R-L load, classification of choppers. **06**

UNIT-III:

Phase Controlled Converters: Single-phase half wave controlled rectifier with resistive and inductive loads, effect of freewheeling diode. Single-phase fully controlled and half controlled bridge converters, Performance Parameters, Three-phase half wave converters, Three-phase fully

controlled and half controlled bridge converters, Effect of source impedance Single-phase and three-phase dual converters. **08**

UNIT-IV:

AC Voltage Controllers: Principle of On-Off and phase controls, Single-phase ac voltage controller with resistive and inductive loads, Three-phase ac voltage controllers (various configurations and comparison only) Single-phase transformer taps changer.

Cyclo-converters: Introduction, The basic principle of operation, single-phase to single-phase, three-phase to single-phase and three-phase to three-phase cyclo-converters, output voltage equation. **08**

UNIT-V:

Inverters: Introduction, Single-phase series resonant inverter, Single-phase bridge inverters, Three-phase bridge inverters, Voltage control of inverters, Harmonics reduction techniques, Single-phase and three-phase current source inverters. **08**

Text Books:

1. M. H. Rashid, "Power Electronics: Circuits, Devices & Applications", Prentice Hall of India Ltd. 3rd Edition, 2004.
2. M. D. Singh and K. B. Khanchandani, "Power Electronics", Tata MC Graw Hill, 2005
3. V. R. Moorthy, "Power Electronics: Devices, Circuits and Industrial Applications", Oxford University Press,2007.
4. B. Jayant Baliga, "Modern Power Devices", John Wiley & Sons, 1987.
5. Dubey G. K. et al, "Thyristorised Power Controllers", Wiley Eastern Limited 1987.
6. John G. K. Kassakian, Martin F. Schlecht and G. C. Verghese, "Principles of Power Electronics", Addison-Wesley Publishing Co., 1991.

Reference Books:

7. M. S. Jamil Asghar, "Power Electronics", Prentice Hall of India Ltd., 2004.
8. Chakrabarti & Rai, "Fundamentals of Power Electronics & Drives", Dhanpat Rai& Sons.
9. Ned Mohan, T. M. Undeland and W. P. Robbins, "Power Electronics: Converters, Applications and Design", Wiley India Ltd, 2008.
10. S. N. Singh, "A Text Book of Power Electronics", Dhanpat Rai& Sons

KEE-604: POWER STATION PRACTICE

L T P
3 1 0

UNIT-I:

Introduction: Electric energy demand and growth in India, electric energy sources.

Thermal Power Plant: Site selection, general layout and operation of plant, detailed description and use of different parts.

Hydro Electric Plants: Classifications, location and site selection, detailed description of various components, general layout and operation of Plants, brief description of impulse, reaction, Kaplan and Francis turbines, advantages & disadvantages, hydro-potential in India. **08**

UNIT-II:

Nuclear Power Plant: Location, site selection, general layout and operation of plant. Brief description of different types of reactors Moderator material, fissile materials, control of nuclear reactors, disposal of nuclear waste material, shielding.

Gas Turbine Plant: Operational principle of gas turbine plant & its efficiency, fuels, open and closed-cycle plants, regeneration, inter-cooling and reheating, role and applications.

Diesel Plants: Diesel plant layout, components & their functions, its performance, role and applications. **08**

UNIT-III:

Sub-stations Layout: Types of substations, bus-bar arrangements, typical layout of substation.

Power Plant Economics and Tariffs: Load curve, load duration curve, different factors related to plants and consumers, Cost of electrical energy, depreciation, generation cost, effect of Load factor on unit cost. Fixed and operating cost of different plants, role of load diversity in power system economy. Objectives and forms of Tariff; Causes and effects of low power factor, advantages of power factor improvement, different methods for power factor improvements. **08**

UNIT-IV:

Economic Operation of Power Systems: Characteristics of steam and hydro-plants, Constraints in operation, Economic load scheduling of thermal plants Neglecting and considering transmission Losses, Penalty factor, loss coefficients, Incremental transmission loss. Hydrothermal Scheduling. **08**

UNIT-V

Non-Conventional Energy Sources: Power Crisis, future energy demand, role of Private sectors in energy management,

MHD generation: Working principle, open and closed cycles, MHD systems, advantages, parameters governing power output.

Solar power plant: Conversion of solar heat to electricity, Solar energy collectors, Photovoltaic cell, power generation, future prospects of solar energy use.

Wind Energy: Windmills, power output with combined operation of wind turbine generation and isolated generating system, technical choices& economic size.

Geothermal Energy: Earth energy, heat extraction, vapor turbine cycle, difficulties & disadvantages,

Tidal energy: Tidal phenomenon, tidal barrage, tidal power Schemes.

Ocean Thermal Energy: Introduction, energy conversion, problems. **08**

Text Books:

1. B. R. Gupta, "Generation of Electrical Energy", S. Chand Publication.
2. Soni, Gupta & Bhatnagar, "A text book on Power System Engg.", Dhanpat Rai& Co.
3. P. S. R. Murthy, "Operation and control of Power System", B S Publications, Hyderabad.

Reference Books:

4. W. D. Stevenson, "Elements of Power System Analysis", McGraw Hill.
5. S. L. Uppal, "Electrical Power", Khanna Publishers.

KEE-651: ELECTRICAL SIMULATION LAB

L T P
0 0 2

1. Study of various commands of MATLAB.
2. To determine the frequency responses of transfer functions of different orders.
3. To determine entry value corresponding to any given arguments using Lagrange interpolation.
4. To determine node voltages and branch currents in a resistive network.
5. To obtain transient response of a series R-L-C circuit for step voltage input.
6. To obtain transient response of a parallel R-L-C circuit for step current input.
7. To obtain transient response of a series R-L-C circuit for alternating square voltage waveform.
8. To determine line and load currents in a three phase delta circuit connected to a 3-phase balanced ac supply.
9. To determine Fourier spectra of a periodic signal.
10. To obtain transient response of output voltage in a single phase half wave rectifier circuit using capacitance filter.

Reference Books:

1. Rudra Pratap, "Getting Started with MATLAB 7".
2. The Math Works Inc., "MATLAB: The Language of Technical Computing".
3. The Math Works Inc, "SIMULINK: Dynamic System Simulation".
4. The Math Works Inc., "Sim Power Systems: User's Guide".
5. B.R. Hunt, R. L. Lipsman & J. M. Rosenberg, "A Guide to MATLAB", Cambridge University Press, 2003.
6. O. Beucher and M. Weeks, "Introduction to MATLAB & SIMULINK – A Project Approach", Infinity Science Press LLC, Hingham, MA, Third Edition.

KEE-652: POWER SYSTEM-I LAB

L T P
0 0 2

1. Simulation of transmission lines & measurement of active power flow using model of Short lines.
2. Study of symmetrical fault of a power system with generating sources.

3. Measurement & verification of active & reactive power flow. Compensation of VAR at the Receiving end using long line model.
4. Sequence filters with 3 phase unbalance faults & study of their performance.
5. Experiments on differential relays for protection of bus bars, alternators & Transformers.
6. Protection system for failure of prime mover & excitation of alternators.

Text Books:

1. Hasdi Sadat, "Power System Analysis", Tata McGraw Hill.
2. T. K. Nagsarskar & M.S. Sukhija, "Power System Analysis", Oxford University Press.

KEE-653: POWER ELECTRONICS LAB

L T P
0 0 2

1. To study V-I characteristics of SCR and measure latching and holding currents.
2. To study UJT trigger circuit for half wave and full wave control.
3. To study single-phase half wave controlled rectified with (i) resistive load (ii) inductive load with and without free-wheeling diode.
4. To study single-phase (i) fully controlled (ii) half controlled bridge rectifiers with resistive and inductive loads.
5. To study three-phase fully/half controlled bridge rectifier with resistive and inductive loads.
6. To study single-phase ac voltage regulator with resistive and inductive loads.
7. To study single-phase cyclo-converter
8. To study triggering of (i) IGBT (ii) MOSFET (iii) power transistor
9. To study operation of IGBT/MOSFET chopper circuit
10. To study MOSFET/IGBT based single-phase series-resonant inverter.
11. To study MOSFET/IGBT based single-phase bridge inverter.

Software based experiments (PSPICE/MATLAB)

12. To obtain simulation of SCR and GTO thyristor.
13. To obtain simulation of Power Transistor and IGBT.
14. To obtain simulation of single-phase fully controlled bridge rectifier and draw load voltage and load current waveform for inductive load.
15. To obtain simulation of single-phase full wave ac voltage controller and draw load voltage and load current waveforms for inductive load.
16. To obtain simulation of step down dc chopper with L-C output filter for inductive load and determine steady-state values of output voltage ripples in output voltage and load current.

Text/Reference Books:

1. M. H. Rashid, "Power Electronics: Circuits, Devices and Applications", 3rd Edition, prentice Hall of India.
2. D. W. Hart, "Introduction to power Electronics", Prentice Hall Inc. 1997.
3. Randal Shaffer, "Fundamentals of Power Electronics with MATLAB", Firewall Media, 2007.

KEE-657: SEMINAR

L T P
0 0 2

Students will select and present the topic by their own individually on latest trend in Electrical Engineering. They will also prepare an exhaustive technical report of the concern seminar topic. They will have to present about the seminar before a committee consisting of faculty members constituted by the concerned Head of the Department. Students should be encouraged to present their seminar topic using LCD projector.

SEMESTER VII

KEE-701: ELECTRIC DRIVES & CONTROL

L T P
3 1 0

Unit-I:

Fundamentals of Electric Drive: Electric Drives and its parts, advantages of electric drives, Classification of electric drives. Speed-torque conventions and multi-quadrant operations, Constant torque and constant power operation, Types of load, Load torque: components, nature and classification. **08**

Unit-II:

Dynamics of Electric Drive: Dynamics of motor-load combination; Steady state stability of Electric Drive; Transient stability of electric Drive.

Selection of Motor Power rating: Thermal model of motor for heating and cooling, classes of motor duty, determination of motor power rating for continuous duty, short time duty and intermittent duty, Load equalization. **08**

Unit-III:

Electric Braking: Purpose and types of electric braking, braking of dc, three phase induction and synchronous motors.

Dynamics during Starting and Braking: Calculation of acceleration time and energy loss during starting of dc shunt and three-phase induction motors, methods of reducing energy loss during starting, Energy relations during braking, dynamics during braking. **08**

Unit-IV:

Power Electronic Control of DC Drives: Introduction, Single-phase and three-phase controlled converter fed separately excited dc motor drives(continuous conduction only), dual converter fed separately excited dc motor drive, rectifier control of dc series motor, Supply harmonics, power factor and ripples in motor current, Power factor improvement, Chopper control of separately excited dc motor and dc series motor. **08**

Unit-V:

Power Electronic Control of AC Drives:

Three Phase induction Motor Drive: Introduction, Static Voltage control scheme, static frequency control scheme (VSI, CSI, and cyclo-converter based) static rotor resistance and slip power recovery control schemes.

Three Phase Synchronous motor: Self controlled scheme

Special Drives: Switched Reluctance motor, Brushless dc motor. Selection of motor for particular applications, DC and AC motor drives in transportation system and traction. **08**

Text Books:

1. G. K. Dubey, "Fundamentals of Electric Drives", Narosa Publishing House.
2. S. K. Pillai, "A First Course on Electric Drives", New Age International.

Reference Books:

3. M. Chilkin, "Electric Drives", Mir Publishers, Moscow.
4. Mohammed A. El-Sharkawi, "Fundamentals of Electric Drives", Thomson Asia, Pvt. Ltd. Singapore.
5. N. K. De and Prashant K. Sen, "Electric Drives", Prentice Hall of India Ltd.
6. V. Subrahmanyam, "Electric Drives: Concepts and Applications", Tata McGraw Hill.

KEE-702: POWER SYSTEM OPERATION AND CONTROL

L T P
3 1 0

UNIT-I:

Introduction : Structure of power systems, Power system control center and real time computer control, SCADA system, Level decomposition in power system, Power system security, Various operational stages of power system, Power system voltage stability, frequency stability, and rotor angle stability. **08**

UNIT-II:

Economic Operation: Concept and problems of unit commitment Input-output characteristics of thermal and hydro-plants System constraints, Optimal operation of thermal units without and with transmission losses, Penalty factor, incremental transmission loss, transmission loss formula (without derivation) Hydrothermal scheduling long and short terms, Concept of optimal power flow. **08**

UNIT-III:

Load Frequency Control: Concept of load frequency control, Load frequency control of single area system: Turbine speed governing system and modeling, block diagram representation of single area system, steady state analysis, dynamic response, control area concept, P-I control, load frequency control and economic dispatch control. Load frequency control of two area system: Tie line power modeling, block diagram representation of two area system, static and dynamic Response. **08**

UNIT-IV:

Automatic Voltage Control: Schematic diagram and block diagram representation, different types of EEE Excitation systems &their controllers and mathematical modeling.

Voltage and Reactive Power control: Concept of voltage control, methods of voltage control-control by tap changing transformer. Shunt Compensation, series compensation, phase angle compensation, concept of bank of capacitors, and bank of inductors. **08**

UNIT-V:

State Estimation: Detection and identification, Linear and non-linear models.

Flexible AC Transmission Systems: Concept, objectives, applications, limitations, and mathematical modeling: FACTs controllers: Structures & Characteristics of following FACTs

Controllers, TCR,FC-TCR, TSC, SVC, STATCOM, TSSC, TCSC, SSSC, TC-PAR, UPFC, HPFC, BESS, SMES, IEEE-FACTS controllers. **08**

Text Books:

1. D. P. Kothari & I. J. Nagrath, "Modern Power System Analysis", Tata McGraw Hill, 3rdEdition.
2. P. S. R. Murty, "Operation and control in Power Systems", B. S. Publications.
3. N. G. Hingorani & L. Gyugyi, "Understanding FACTs", Concepts and Technology of Flexible AC Transmission Systems", Standard Publishers Distributors.
4. J. Wood & B.F. Wollenburg, "Power Generation, Operation and Control", John Wiley & Sons.

Reference Books:

5. O. I. Elgerd, "Electric Energy System Theory" Tata McGraw Hill.
6. P. Kundur, "Power System Stability and Control McGraw Hill.
7. M.H. Rashid, "Power Electronics: Circuits, devices and Applications" Prentice Hall of India, 3rd Edition.
8. T. K. Nagsarkar & M. S. Sukhiza,' Power System Analysis' Oxford University Press.

KEE-703: SWITCHGEAR AND PROTECTION

L T P
3 1 0

UNIT I:

Introduction to Protection System: Introduction to protection system and its elements, functions of protective relaying, protective zones, primary and backup protection, desirable qualities of protective relaying, basic terminology.

Relays: Electromagnetic, attracted and induction type relays, thermal relay, gas actuated relay, design Considerations of electromagnetic relay. **08**

UNIT-II:

Relay Application and Characteristics: Amplitude and phase comparators, over current relays, directional relays, distance relays, differential relay

Static Relays: Comparison with electromagnetic relay, classification and their description, over current relays, Directional relay, distance relays, differential relay. **08**

UNIT-III:

Protection of Transmission Line: Over current protection, distance protection, pilot wire protection, carrier current protection, protection of bus, auto re-closing. **08**

UNIT-IV:

Circuit Breaking: Properties of arc, arc extinction theories, re-striking voltage transient, current chopping, resistance switching, capacitive current interruption, short line interruption, circuit breaker ratings.

Testing of Circuit Breaker: Classification, testing station and equipments, testing procedure, direct and indirect testing. **08**

UNIT-V:

Apparatus Protection: Protection of Transformer, generator and motor.

Circuit Breaker: Operating modes, selection of circuit breakers, constructional features and operation of Bulk Oil, Minimum Oil, Air Blast, SF6, Vacuum and d. c. circuit breakers.

08

Text Books:

1. S. S. Rao, "Switchgear and Protection", Khanna Publishers.
2. B. Ravindranath and M. Chander, Power system Protection and Switchgear, Wiley Eastern Ltd.

Reference Books:

3. B. Ram and D. N. Vishwakarma, "Power System Protection and Switchgear", Tata Mc. Graw Hill.
4. Y. G. Paithankar and S R Bhide, "Fundamentals of Power System Protection", Prentice Hall of India.
5. T. S. M Rao, "Power System Protection: Static Relays with Microprocessor Applications", Tata Mc Graw Hill".
6. A. R. Van C. Warringtaon, "Protective Relays-Their Theory and Practice", Vol. I & II John Willey & Sons.

KEE-751: ELECTRIC DRIVES LAB

L T P
0 0 2

a) Hardware Based Experiments:

1. To study speed control of separately excited dc motor by varying armature voltage using single-phase fully controlled bridge converter.
2. To study speed control of separately excited dc motor by varying armature voltage using single-phase half controlled bridge converter.
3. To study speed control of separately excited dc motor using single-phase dual converter (Static Ward-Leonard Control)
4. To study speed control of separately excited dc motor using MOSFET/IGBT chopper
5. To study closed loop control of separately excited dc motor
6. To study speed control of single-phase induction motor using single phase ac voltage controller.
7. To study speed control of three-phase induction motor using three-phase ac voltage controller
8. To study speed control of three-phase induction motor using three-phase current source inverter
9. To study speed control of three-phase induction motor using three-phase voltage source inverter
10. To study speed control of three-phase slip ring induction motor using static rotor resistance control using rectifier and chopper

11. To study speed control of three-phase slip ring induction motor using static scherbius slip power recovery control scheme.

b) Simulation Based Experiments (using MATLAB or any other software):

12. To study starting transient response of separately excited dc motor
13. To study speed control of separately excited dc motor using single phase fully-half controlled bridge converter in discontinuous and continuous current modes.
14. To study speed control of separately excited dc motor using chopper control in motoring and braking modes.
15. To study starting transient response of three-phase induction motor
16. To study speed control of three phase induction motor using (a) constant V/F control (b) Constant Voltage and frequency control.

KEE-752: POWER SYSTEM-II LAB

L T P
0 0 2

(A) Hardware Based:

1. To determine direct axis reactance (xd) and quadrature axis reactance (xq) of a salient pole alternator.
2. To determine negative and zero sequence reactances of an alternator.
3. To determine sub transient direct axis reactance (xd) and sub transient quadrature axis reactance (xq) of an alternator
4. 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
5. To study the IDMT over current relay and determine the time current characteristics
6. To study percentage differential relay
7. To study Impedance, MHO and Reactance type distance relays
8. To determine location of fault in a cable using cable fault locator
9. To study ferranty effect and voltage distribution in H.V. long transmission line using transmission line model.
10. To study operation of oil testing set.

Simulation Based Experiments (using MATLAB or any other software)

11. To determine transmission line performance.
12. To obtain steady state, transient and sub-transient short circuit currents in an alternator
13. To obtain formation of Y-bus and perform load flow analysis
14. To perform symmetrical fault analysis in a power system
15. To perform unsymmetrical fault analysis in a power system

Text Books:

3. Hadi Sadat, “Power System Analysis”, Tata Mc Graw Hill.
4. T. K. Nagsarskar & M. S. Sukhija, “Power System Analysis”, Oxford University Press.

KEE-754: PROJECT (PHASE-I)#

L T P
0 0 4

Project shall be assigned to students at the start of VIIth semester. There should not usually be more than 3 students in batch. The project should be based on latest technology as far as possible and it may be hardware or/and software based. The assessment of performance of students should be made at least twice in the semester. Students should be encouraged to present their progress of project using LCD projector.

KEE-758: INDUSTRIAL TRAINING-II**

L T P
0 0 2

Students will go Industrial training of four weeks in any industry or reputed organization after the VIth semester examination in summer. They will also prepare an exhaustive technical report of the training which will be duly signed by the officer under whom training was taken in the industry/organization. They will have to present about the training before a committee consisting of faculty members constituted by the concerned Head of the Department.

SEMESTER VIII

KEE-801: INSTRUMENTATION AND PROCESS CONTROL

L T P
3 1 0

UNIT-I:

Transducer-I: Definition, advantages of electrical transducers, classification, characteristics, factors affecting the choice of transducers, Potentiometers, Strain guages, Resistance thermometer, Thermistors, Thermocouples, LVDT, RVDT. **08**

UNIT-II:

Transducer-II: Capacitive, Piezoelectric Hall effect and opto electronic transducers. Measurement of Motion, Force pressure, temperature, flow and liquid level. **08**

UNIT-III:

Telemetry: General telemetry system, land line & radio frequency telemetering system, transmission channels and media, receiver & transmitter. Data

Acquisition System: Analog data acquisition system, Digital data acquisition system, Modern digital data acquisition system. **08**

UNIT-IV:

Display Devices and Recorders: Display devices, storage oscilloscope, spectrum analyzer, strip chart & x-y recorders, magnetic tape &digital tape recorders.

Recent Developments: Computer aided measurements, fibre optic transducers, microsessors, smart sensors, smart transmitters. **08**

UNIT-V:

Process Control: Principle, elements of process control system, process characteristics, proportional (P), integral (I), Derivative (D), PI, PD and PID control modes. Electronic, Pneumatic & digital controllers. **08**

Text Books:

1. A. K. Sawhney, "Advanced Measurements & Instrumentation", Dhanpat Rai & Sons
2. B. C. Nakra & K. Chaudhry, "Instrumentation, Measurement and Analysis", Tata McGraw Hill 2nd Edition.
3. Curtis Johns, "Process Control Instrumentation Technology", Prentice Hall

Reference Books:

4. E.O. Decblin, "Measurement System – Application & design", McGraw Hill.
5. W. D. Cooper and A.P. Beltried, "Electronics Instrumentation and Measurement Techniques", Prentice Hall International.

6. Rajendra Prasad, “Electronic Measurement and Instrumentation”, Khanna Publisher.
7. M. M. S. Anand, “Electronic Instruments and Instrumentation Technology”, PHI Learning.

KEE-802: ADVANCED CONTROL SYSTEM

L T P
3 1 0

UNIT-I:

State Space Analysis of Continuous System: Review of state variable representation of continuous system, conversion of state variable models to transfer function and vice-versa, solution of state equations and state transition matrix, controllability and obsrvability, design of state observer and controller. **08**

UNIT-II:

Analysis of Discrete System: Discrete system and discrete time signals, state variable model and transfer function model of discrete system, conversion of state variable model to transfer function model and vice-versa, modeling of sample hold circuit, solution of state difference equations, steady state accuracy, stability on the z-plane and Jury stability criterion, bilinear transformation, Routh-Hurwitz criterion on rth planes. **08**

UNIT-III:

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

Non-linear System: Types of non linearities, phenomena related to non - linear systems. Analysis of non- linear systems-Linearization method, second order non-linear system on the phase plane, types of phase portraits, singular points, system analysis by phase-plane method, describing function and its application to system analysis. **08**

UNIT-IV:

Optimal Control: Introduction, formation of optimal control problem, calculus of variations minimization of functions, constrained optimization.Pontryagin’s Minimum Maximum Principle, Linear Quadratic Problem-Hamilton Jacobi equation, Riccati equation and its solution. **08**

UNIT-V:

Adaptive Control: Introduction, modal reference adaptive control systems, controller structure, self tuning regulators. Introduction to neural network, fuzzy logic and genetic algorithms. **08**

Text Books:

1. M. Gopal, “Digital Control and State variable Methods”, Tata Mc Graw Hill
2. Ajit K. Madal, “Introduction to Control Engineering: Modeling, Analysis and Design”, New Age International.
3. D. Landau, “Adaptive Control”, Marcel Dekker Inc.
4. S. Rajasekaran & G. A. Vjayalakshmi Pai, “Neural Networks, Fuzzy Logic and Genetic Alogorithms: Synthesis and Applications”, Prentice Hall of India.

Reference Book:

5. Donald E. Kiv, "Optimal Control Theory: An Introduction", Prentice Hall
6. B. C. Kuo, "Digital Control Systems", Sounders College Publishing
7. C. H. Houpis and G. B. Lamont, "Digital Control Systems: Theory, Hardware, Software", Mc Graw Hill.

KEE-851: VIRTUAL INSTRUMENTATION LAB

L T P
0 0 2

1. VI program to add, subtract, multiply and divide two numeric inputs using numerical control.
2. VI program to find the speed when distance and time are given.
3. VI program to Perform various Boolean operations (AND, OR, NAND, NOR, XOR).
4. Create a VI to find the roots of a quadratic equation using subVIs. Find both the values of the roots and the nature of roots.
5. VI program which consists of a knob and waveform chart.
6. VI program where a sinusoidal signal can be simulated and shown through a waveform chart.
7. VI program which consist of dial and a thermometer.
8. VI program to compare a thermometer with a set point and if it exceeds the limit, an indicator is on.
9. VI program to build a function generator.
10. Create a VI to find the factorial of the given numbers using For Loop and Shift Registers.
11. Build a VI to solve a linear equation using matrix functions.
12. VI program using a while loop, generate random numbers and display it on a waveform chart.
13. VI program to create an array.
14. VI program to unbundle the elements of a cluster into a small cluster and separate elements. Also modify the input cluster to modified cluster.
15. Build a VI that displays two random plots on a waveform chart in sweep update mode. The plots should be a random plot and a running average of the last four points.
16. To study the performance of electromagnetic transducer as a speed measurement device
17. Study of P, PI and PID controllers
18. Measurement of displacement using LVDT and RVDT
19. Measurement of load using strain gauge based load cell.
20. Measurement of temperature by RTD.
21. Measurement of temperature by thermocouple

DEPARTMENTAL ELECTIVES

KEE-011: SPECIAL ELECTRICAL MACHINES

L T P
3 1 0

UNIT-I:

Poly-phase AC Machines: Construction and performance of double cage and deep bar three phase induction motors; e.m.f. injection in rotor circuit of slip ring induction motor, concept of constant torque and constant power controls, static slip power recovery control schemes (constant torque and constant power) **08**

UNIT-II:

Single phase Induction Motors: Construction, starting characteristics and applications of split phase, capacitor start, capacitor run, capacitor start capacitor-run and shaded pole motors.

Two Phase AC Servomotors: Construction, torque-speed characteristics, performance and applications. **08**

UNIT-III:

Stepper Motors: Principle of operation, variable reluctance, permanent magnet and hybrid stepper motors, characteristics, drive circuits and applications.

Switched Reluctance Motors: Construction; principle of operation; torque production, modes of operation, drive circuits. **08**

UNIT-IV:

Permanent Magnet Machines: Types of permanent magnets and their magnetization characteristics, demagnetizing effect, permanent magnet Dc motors, sinusoidal PM ac motors, brushless dc motors and their important features and applications, PCB Motors.

Single phase synchronous motor; construction, operating principle and characteristics of reluctance and hysteresis motors; introduction to permanent magnet generators. **08**

UNIT-V:

Single Phase Commutator Motors: Construction, principle of operation, characteristics of universal and repulsion motors; Linear Induction. Motors. Construction, principle of operation, Linear force, and applications. **08**

Text Books:

1. P. S. Bimbhra, "Generalized Theory of Electrical Machines", Khanna Publishers.
2. P. C. Sen "Principles of Electrical Machines and Power Electronics", John willey & Sons, 2001

Reference Books:

3. G. K. Dubey "Fundamentals of Electric Drives", Narosa Publishing House, 2001

4. Cyril G. Veinott "Fractional and Sub-fractional horse power electric motors", McGraw Hill International, 1987
5. M. G. Say, "Alternating current Machines", Pitman & Sons.

KEE-012: HIGH VOLTAGE ENGINEERING

L T P
3 1 0

UNIT-I:

Break Down in Gases: Ionization processes, Townsend's criterion, breakdown in electronegative gases, time lags for breakdown, streamer theory, Paschen's law, break down in non-uniform field, breakdown in vacuum.

Break Down in Liquid Dielectrics: Classification of liquid dielectric, characteristic of liquid dielectric, breakdown in pure liquid and commercial liquid.

Break Down in Solid Dielectrics: Intrinsic breakdown, electromechanical breakdown, breakdown of solid, dielectric in practice, breakdown in composite dielectrics. **10**

UNIT-II:

Generation of High Voltages and Currents: Generation of high direct current voltages, generation of high alternating voltages, generation of impulse voltages, generation of impulse currents, tripping and control of impulse generators. **08**

UNIT-III:

Measurement of High Voltages and Currents: Measurement of high direct current voltages, measurement of high alternating and impulse voltages, measurement of high direct, alternating and impulse currents, Cathode Ray Oscillographs for impulse voltage and current measurements. **08**

UNIT-IV:

Non-Destructive Testing: Measurement of direct current resistively, measurement of dielectric constant and loss factor, partial discharge measurements. **06**

UNIT-V:

High Voltage Testing & Insulation Coordination: High voltage testing of electrical power apparatus-Power frequency, impulse voltage and DC testing-International and Indian standards-Insulation Coordination. **08**

Text Book:

1. M. S. Naidu and V. Kamaraju, "High Voltage Engineering", Tata Mc-Graw Hill.

Reference Books:

2. E. Kuffel and W. S. Zacngal, "High Voltage Engineering", Pergamon Press.
3. M. P. Chaurasia , "High Voltage Engineering", Khanna Publishers
4. R. S. Jha, "High Voltage Engineering", Dhanpat Rai & sons
5. C. L. Wadhwa, "High Voltage Engineering", Wiley Eastern Ltd.
6. M. Khalifa, "High Voltage Engineering Theory and Practice", Marcel Dekker.
7. Subir Ray, "An Introduction to High Voltage Engineering", Prentice Hall of India

KEE-013: ARTIFICIAL NEURAL NETWORKS AND FUZZY SYSTEM

L T P
3 1 0

UNIT-I:

Neural Networks-1(Introduction & Architecture): Neuron, Nerve structure and synapse, Artificial Neuron and its model, activation functions, Neural network architecture: single layer and multilayer feed forward networks, recurrent networks. Various learning techniques; perception and convergence rule, Auto-associative and hetro-associative memory. **08**

UNIT-II:

Neural Networks-II (Back propogation networks): Architecture: perceptron model, solution, single layer artificial neural network, multilayer perception model; back propogation learning methods, effect of learning rule co-efficient ;back propagation algorithm, factors affecting backpropagation training, applications. **08**

UNIT-III

Fuzzy Logic-I (Introduction): Basic concepts of fuzzy logic, Fuzzy sets and Crisp sets, Fuzzy set theory and operations, Properties of fuzzy sets, Fuzzy and Crisp relations, Fuzzy to Crisp conversion. **08**

UNIT-IV

Fuzzy Logic –II (Fuzzy Membership, Rules): Membership functions, interference in fuzzy logic, fuzzy if-then rules, Fuzzy implications and Fuzzy algorithms, Fuzzyfications & Defuzzificataions, Fuzzy Controller, Industrial applications. **08**

UNIT-V

Fuzzy Neural Networks: L-R Type fuzzy numbers, fuzzy neutron, fuzzy back propogation (BP), architecture, learning in fuzzy BP, inference by fuzzy BP, applications. **08**

Text Books:

1. Kumar Satish, “Neural Networks”, Tata Mc Graw Hill
2. S. Rajsekaran & G. A. Vijayalakshmi Pai, “Neural Networks, Fuzzy Logic and Genetic Algorithm:Synthesis and Applications”, Prentice Hall of India.

Reference Books:

3. Siman Haykin, ”Neural Netowrks”, Prentice Hall of India

4. Timothy J. Ross, "Fuzzy Logic with Engineering Applications", Wiley Indi
5. S N Shivanandan, S Sumathi and S N Deepa, "Introduction to Neural Networks Using Matlab 6.0", Tata McGraw-Hill Education, 2006

KEE-021: COMPUTER AIDED POWER SYSTEM ANALYSIS

L T P
3 1 0

UNIT-I:
Network Matrices: Evaluation of bus admittance matrix (YBUS), Bus impedance matrix (ZBUS), Branch impedance matrix (ZBT) and loop Impedance matrix (ZLOOP) by singular and non singular transformations. **08**

UNIT-II:
Short Circuit Studies: Formulation of ZBUS for single phase and three phase networks, Transformation of network matrices using symmetrical components; Short circuit studies using ZBUS, YBUS and ZLOOP. **06**

UNIT-III:
Load Flow Studies: Representation of off-load, on-load tap changing and phase shifting transformers, DC link, Decoupled and fast decoupled methods, Sparsity technique; Introduction to load flow of integrated AC/DC system. **08**

UNIT-IV:
Stability Studies: Network formulation for stability studies for different types of loads (constant impedance, constant current and constant power loads), Digital computer solution of swing equation for single and multi-machine cases using Runge-Kutta and predictor corrector methods, Effects of exciter and governor on transient stability. **08**

UNIT-V:
Voltage Stability and Small –Signal Stability: Voltage Stability Transmission system characteristics, Generator characteristics, Load characteristics. Introduction of reactive compensating devices. Classification of voltage Stability, voltage stability Analysis, voltage collapse and its Prevention. Small-Signal Stability –Concept of stability of Dynamic System, Eigen-properties of the State Matrix, Single-machine Infinite Bus System, Power System Stabilizer. **10**

Reference Books:

1. Prabha Kundur, "Power System Stability and Control", Tata McGraw Hill, New Delhi, 2006.
2. G. W. Stagg and A.H.EI-Abiad, "Computer Methods in Power System Analysis", McGraw Hill, 1971.
3. G. I. Kusic, "Computer Sided Power System Analysis", Prentice Hall International, 1986.

4. L. P. Singh, “Advanced Power System Analysis and Dynamics”, Wiley Eastern.

KEE-022: ADVANCED POWER SEMICONDUCTOR DEVICES

L T P
3 1 0

Unit-I:

Introduction: General overview of power semiconductor devices and their desirable characteristics, Comparison of power semiconductor devices.

Power Diodes: General purpose diode, Fast recovery diode, Schottky diode, Diode snubbers. **08**

Unit-II:

Power Bipolar Junction Transistors: Physical structure and device operation, Static V-I and switching characteristics, Secondary breakdown and safe operating area, Snubber circuits, Base drive control.

Power MOSFETS: Physical structure and device operation, Static V-I and switching characteristics, Operating limitations and safe operating area, Gate drive and snubber circuits. **08**

Unit-III:

Thyristors: Physical structure and device operation, Two-transistor analogy, Static V-I and switching characteristics, Gate characteristics, Firing circuits, Snubber circuits, Series and parallel operation.

TRIAC: Physical structure and device operation, Static V-I characteristics and applications. **08**

Unit-IV:

GTO (Gate Turn Off) Thyristors: Physical structure and device operation, Static V-I and switching characteristics, Drive and snubber circuits.

Insulated Gated Bipolar Transistors: Physical structure and device operation, Static V-I and switching characteristics, Safe operating area, Drive and snubber circuits. **08**

Unit-V:

Special Power Devices: Physical structure, Device operation and static V-I characteristics of reverse conducting thyristor, Field controlled thyristor, MOS controlled thyristor. **08**

Text Books:

1. B. Jayant Baliga, “Modern Power Devices”, John Wiley & Sons, 1987.
2. N. Mohan, T. M. Undeland and W. P. Robbins, “Power Electronics Converters, Applications and Design”, Johan Wiley & Sons, 1995.
3. M. H. Rashid, “Power Electronics: Circuit, Devices and Applications”, Prentice Hall of India, 1996.
4. G. K. Dubey et al, “Thyristorised Power Controllers”, Wiley Eastern Limited 1987.
5. M. D. Singh and K.B. Khanchandani, “Power Electroncs”, Tata McGraw Hill, 2001.
6. John G. K. Kassakian, Martin F. Schlecht and G. C. Verghese, “Principles of Power Electronics”, Addison-Wesley Publishing Co., 1991.

KEE-023: ELECTRICAL MACHINE DESIGN

L T P
3 1 0

UNIT-I:
Basic design principles and approaches, specification, Magnetic and electric loading, out put equations and output coefficients, Main dimensions. Ratings, Heating cooling and temperature rise. **08**

UNIT-II:
Transformer: Magnetic circuit, core construction and design, winding types, insulation, Loss allocation and estimation, Reactance, Temperature rise. **08**

UNIT-III:
D C Machine: No. of poles and main dimensions, armature, windings, Magnetic circuit and Magnetisation curve, Commutator and brushes. **08**

UNIT-IV:
Induction Machine-3 phase: Rating specifications, standard frame sizes, Main dimensions specific loadings, Design of stator windings, Rotor design-slots and windings, calculations of equivalent circuit parameters. **10**

UNIT-V:
Computer assisted design of above machines. **06**

Text Book:

1. A K Sawhney; A Course in Electrical Machine Design; Dhanpat Rai & Co.
2. Clayton A E & Hancock N N : The Performance and Design of Direct Current Machines ; CBS Publishers and Distributors
3. M G Say: The Performance and Design of Alternating Current Machines; CBS Publishers and Distributors.
4. S K Sen: Principles of Electrical Machine Design with Computer Programs; Oxford & IBH Pub. Co. Norton, Machine design, Pearson Education.

KEE-031: NON-CONVENTIONAL ENERGY RESOURCES

L T P
3 1 0

UNIT-I:

Introduction: Various non-conventional energy resources-Introduction, availability, classification, relative merits and demerits.

Solar Cells: Theory of solar cells. solar cell materials, solar cell array, solar cell power plant, limitations. **08**

UNIT-II:

Solar Thermal Energy: Solar radiation, flat plate collectors and their materials, applications and performance, focussing of collectors and their materials, applications and performance; solar thermal power plants, thermal energy storage for solar heating and cooling, limitations. **08**

UNIT-III:

Geothermal Energy: Resources of geothermal energy, thermodynamics of geo-thermal energy conversion-electrical conversion, non-electrical conversion, environmental consideration **Magneto-hydrodynamics (MHD):** Principle of working of MHD Power plant, performance and limitations.

Fuel Cells: Principle of working of various types of fuel cells and their working, performance and limitations. **08**

UNIT-IV:

Thermo-electrical and thermionic Conversions: Principle of working, performance and limitations.

Wind Energy: Wind power and its sources, site selection, criterion, momentum theory, classification of rotors, concentrations and augments, wind characteristics. performance and limitations of energy conversion systems. **08**

UNIT-V:

Bio-mass: Availability of bio-mass and its conversion theory.

Ocean Thermal Energy Conversion (OTEC): Availability, theory and working principle, performance and limitations.

Wave and Tidal Wave: Principle of working, performance and limitations. Waste Recycling Plants. **08**

Text Books:

1. D. S. Chauhan and S. K. Srivastava, "Non-conventional Energy Resources", New Age International.
2. M. V. R. Koteswara Rao, "Energy Resources: Conventional & Non-Conventional", BSP Publications, 2006.

Reference Books:

3. Raja et. al., "Introduction to Non-Conventional Energy Resources", Scitech Publications.
4. John Twideu and Tony Weir, "Renewal Energy Resources", BSP Publications, 2006.
5. Peter Auer, "Advances in Energy System and Technology", Vol. 1 & II Edited by Academic Press.

KEE-032: UTILIZATION OF ELECTRICAL ENERGY AND TRACTION

L T P
3 1 0

Unit-I:

Electric Heating: Advantages and methods of electric heating, Resistance heating, Electric arc heating, Induction heating, Dielectric heating **08**

Unit-II:

Electric Welding: Electric Arc Welding, Electric Resistance welding, Electronic welding control

Electrolyte Process: Principles of electro deposition, Laws of electrolysis, applications of electrolysis **08**

Unit-III

Illumination: Various definitions, Laws of illumination, requirements of good lighting, Design of in door lighting and outdoor lighting systems

Refrigeration and Air Conditioning: Refrigeration systems, domestic refrigerator, water cooler Types of air conditioning, Window air conditioner **08**

Unit-IV:

Electric Traction-I: Types of electric traction, systems of track electrification Traction mechanics- types of services, speed time curve and its simplification, average and schedule speeds Tractive effort, specific energy consumption, mechanics of train movement, coefficient of adhesion and its influence **08**

Unit-V:

Electric Traction-II: Salient features of traction drives, Series – parallel control of dc traction drives (bridge transition) and energy saving, Power Electronic control of dc and ac traction drives Diesel electric traction. **08**

Text Books:

1. H. Partab, "Art and Science of Electrical Energy", Dhanpat Rai & Sons.
2. H. Partab, "Modern Electric Traction", Dhanpat Rai & Sons.

Reference Books:

3. G. K. Dubey, "Fundamentals of Electric Drives", Narosa Publishing House

4. C. L. Wadhwa, "Generation, Distribution and Utilization of Electrical Energy", New Age International Publications.

KEE-033: EHV AC & DC TRANSMISSION

L T P
3 1 0

UNIT-I:
Introduction: Need of EHV transmission, standard transmission voltage, comparison of EHV ac & dc transmission systems and their applications & limitations, surface voltage gradients in conductor, distribution of voltage gradients on sub-conductors, mechanical considerations of transmission lines, modern trends in EHV AC and DC transmission **08**

UNIT-II:
EHV AC Transmission: Corona loss formulas, corona current, audible noise – generation and characteristics corona pulses their generation and properties, radio interference (RI) effects, over voltage due to switching, ferroresonance, reduction of switching surges on EHV system, principle of half wave transmission.

08

UNIT-III:
Extra High Voltage Testing: Characteristics and generation of impulse voltage, generation of high Ac and Dc voltages, measurement of high voltage by spheregaps and potential dividers.
Consideration for Design of EHV Lines: Design factors under steady state limits, EHV line insulation design based upon transient over voltages. Effects of pollution on performance of EHV lines. **08**

UNIT-IV:
EHV DC Transmission-I: Types of dc links, converter station, choice of converter configuration and pulse number, effect of source inductance on operation of converters. Principle of dc link control, converter controls characteristics, firing angle control, current and Excitation angle control, power control, starting and stopping of dc link. **08**

UNIT-V:
EHV DC Transmission-II: Converter faults, protection against over currents and over voltages, smoothing reactors, Generation of harmonics, ac and dc filters, Multi Terminal DC systems (MTDC): Types, control, protection and applications. **08**

Text Books:

1. R. D. Begamudre, "Extra High Voltage AC Transmission Engineering", Wiley Eastern.
2. K. R. Padiyar, "HVDC Power Transmission Systems: Technology and System Reactions", New Age International.
3. J. Arrillaga, "High Voltage Direct current Transmission", IEEE Power Engineering Series 6, Peter Peregrinus Ltd, London.

Reference Books:

4. M. S. Naidu & V. Kamaraju, "High Voltage Engineering", Tata McGraw Hill.
5. M. H. Rashid , "Power Electronics: Circuits, Devices and Applications", Prentice Hall of India.
6. S. Rao, "EHV AC and HVDC Transmission Engineering and Practice", Khanna Publisher.
7. "EPRI, Transmission Line Reference Book, 345 KV and above" Electric Power Research Institute. Palo Alto, California, 1982.

KEE-041: POWER QUALITY

L T P
3 1 0

Unit-I:

Power Quality Terms and Definitions: Introduction, transients, Short Duration Voltage Variations: interruption, Sag, Swell; Long Duration Voltage Variations: under Voltage, over Voltage and Sustained Interruptions**;** Voltage and Phase Imbalance; waveform distortion; voltage fluctuation; power frequency variations**,** Harmonics, Frequency deviation monitoring.

Power Quality Problems: Poor load power factor, load containing harmonics, notching in load voltage, DC offset in loads, Unbalanced loads, disturbance in supply voltage. **08**

Unit-II:

Voltage Sag: Sources of voltage sag: motor starting, arc furnace, fault clearing etc; estimating voltage sag performance and principle of its protection; solutions at end user level- Isolation Transformer, Voltage Regulator, Static UPS, Rotary UPS, Active Series Compensator. **08**

Unit-III:

Electrical Transients: Sources of Transient Over voltages-Atmospheric and switching transients-motor starting transients, power factor correction capacitor switching transients, ups switching transients, neutral voltage swing etc; devices for over voltage protection. **06**

Unit-IV:

Harmonics: Causes of harmonics; current and voltage harmonics: measurement of harmonics; effects of harmonics on-Transformers, AC Motors, Capacitor Banks, Cables, and Protection Devices, Energy Metering, Communication Lines etc. harmonic mitigation techniques. **08**

Unit-V:

Wiring and Grounding: Reasons for grounding, typical wiring and grounding problems, solutions to wiring and grounding problems.

Monitoring Power Quality: Power quality related standards, standard test waveforms, and detailed power quality monitoring, Power quality measurement devices: Harmonic Analyzer, Transient Disturbance Analyzer, wiring and grounding tester, Flicker Meter, Oscilloscope, multimeter etc.

Custom Power Devices: Utility customer interface, Network Reconfiguration devices; Load compensation and voltage regulation using D-STATCOM; protecting sensitive loads using Dynamic Voltage Restorer (DVR); Unified power Quality Conditioner (UPQC). **10**

Text Books:

1. Roger C. Dugan, McGrahan, Santoso & Beaty, "Electrical Power System Quality", McGraw Hill
2. Arindum Ghosh & Gerard Ledwich, "Power Quality Enhancement Using Custom Power Devices", Kluwer Academic Publishers
3. C. Sankaran, "Power Quality", CRC Press.

Reference Books:

4. G. W. Heydt, "Electric Power Quality", Stars in a Circle Publications, 1991.
5. G. J. Parter and J. A. V. Sciver, "Power Quality Salutations: Case Study for Troubleshooters", Fairmont Press.

KEE-042: BIO-INSTRUMENTATION

L T P
3 1 0

UNIT-I:

Basic physiological system of the body: Problems encountered in measuring living systems, bioelectric potentials, biomaterials

Basic Transducer Principles: Active and passive transducers, Transducers for biomedical applications. Generation, propagation and distribution of bioelectric potentials (ECG, EEG and EMG). **08**

UNIT-II:

Bio-potential electrodes: Basic types (micro, skin surface and needle electrodes) biochemical transducers. (PH, blood, gas and specific ions electrodes).

The cardiovascular system and measurements: Heart and cardiovascular system and circulation block diagram, blood pressure and measurement, characteristics of blood flow and heart sounds. Electrocardiography, ECG lead configurations, ECG recording and their types. **08**

UNIT-III:

The Nervous System: The anatomy of nervous system, Neuronal communication, EPSP & IPSP Organization of the brain, Measurements from the nervous system

Systemic Body & Skin Temperature Measurement: Temperature measurements, Brief idea about ultrasonic measurements. **08**

UNIT-IV:

Patient care monitoring: Elements of intensive care, Organization of the Hospital for patient-care monitoring, Pace-makers-types, systems, modes and generators, Defibrillators-types. Bio telemetry & applications of telemetry in patient care. **08**

UNIT-V:

Automation of chemical tests, Instrumentation for diagnostic X-Rays, Interfacing computer with medical instrumentation and other equipments, biomedical computer applications. Shock hazards from electrical equipments, methods of accident prevention. **08**

Text Book:

1. T. Cromwell, F. J. Weibell & F. A. Pfieffer, "Biomedical Instrumentation & Measurements", Prentice Hall International

Reference Books:

2. R. S. Khanpur, "Handbook of Biomedical Instrumentation", Tata Mc Graw Hill
3. H. E. Thomas, "Handbook of Biomedical Instrumentation and Measurement", Restone Publishing Company
4. J. G. Webester, "Medical Instrumentation", Houghton Mifflin.

KEE-043: POWER CONVERTER APPLICATIONS

L T P
3 1 0

UNIT-I:

Industrial Applications: Electric heating, Advantages & disadvantages, Concept of resistance and induction heating, AC voltage controllers for resistance heating, High frequency inverters for induction heating, Illumination control, High frequency fluorescent lighting system. **08**

UNIT-II:

Application in High Voltage DC Transmission: Introduction to HVDC transmission, Basic layout for HVDC transmission system, Types of HVDC links, Twelve pulse converters, Control of HVDC converters, Control characteristics, Converter faults and protection, Harmonic filters and power factor correction capacitors. **08**

UNIT-III:

Applications in Static VAR Control: Concept of static VAR control, Thyristor controlled VAR compensation techniques, Series compensation, Synchronous link converter based VAR compensation, Unified power flow controller (UPFC). **08**

UNIT-IV:

Applications in Power Supplies: Classification and sources of power line disturbances, Need of uninterruptible power supply (UPS) system, Static UPS systems – short break & no break UPS systems, Components of UPS systems, Introduction to SMPS, Configurations-flyback converter, two transistor / MOSFET flyback converter, paralleling flyback converter, forward converter, push-pull converter, half-bridge converter, full-bridge SMPS, Advantages & disadvantages. **08**

UNIT-V:

Applications in Grid Interconnected Renewable Energy Systems: Single-phase and three-phase photovoltaic array interconnection, Maximum power point tracking (MPPT), Wind / fuel cell and small hydro interconnections with utility grid.

Other Applications: DC circuit breaker, single-phase and three-phase AC switches Static excitation control of synchronous generators. **08**

Text Books:

1. N. Mohan, T. M. Undeland and W. P. Robbins, "Power Electronics Converters, Applications and Design", John Wiley & Sons, 1995.
2. H. Rashid, "Power Electronics: Circuits, Devices and Applications", Prentice Hall of India, 1996.

Reference Books:

3. E. W. Kimbark, "Direct Current Transmission", Vol-I, Wiley Interscience, 1971.
4. T. J. Miller, "Reactive Power Control in Electric System", Wiley Interscience, 1982.
5. K. R. Padiyar, "HVDC Power Transmission: Technology and System Reactions", New Age International.

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Institute Vision

To be supplier of globally competitive professionally well qualified technical man power of world class standard for contributing need of the nation by evolving sustainable flexible and dynamic system responsive to as aspirants of the industry and to be resource centre for generation and dissemination of technology for the socio-economic development of the society.