DR. M.G.R. EDUCATIONAL & RESEARCH INSTITUTE

(DEEMED UNIVERSITY)

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

B.Tech. – Electrical and Electronics Engineering (Part Time)

Curriculum & Syllabus 2005-06

Code	Course Title	L	T	P	C
Theory	Semester – I				
BMA151	Mathematics – I	3	1	0	4
BME163	Thermodynamics	3	0	0	3
BEE151	Circuit Theory	3	1	0	4
BEE153	Electrical Machines – I	3	1	0	4
Total					15
Theory	Semester – II				
BMA152	Mathematics – II	3	0	0	3
BEC152	Solid State Devices	3	0	0	3
BEE152	Network Analysis & Synthesis	3	1	0	4
BEE154	Electrical machines – II	3	1	0	4
Practical					
BEE160	Electrical Machines Lab	0	0	3	1
Total					15
Theory	Semester - III				
BEC251	Digital Electronics	3	1	0	4
BEC257	Electronic Circuits	3	0	0	3
BEE251	Design of Electrical Machines*	3	1	0	4
BEE253	Electromagnetic Fields	3	1	0	4
Practical					
BCS261	Computer Programming Lab	0	0	3	1
Total					16

* The end semester examination will be conducted as Practical Examination with External and Internal Examiners.

Theory	Semester - IV				
BEC256	Linear Integrated Circuits	3	0	0	3
BEE252	Control Engineering	3	1	0	4
BEE254	Electrical Measurements & Instrumentation	3	0	0	3
BEE256	Transmission & Distribution	3	1	0	4
Practical					
BEE260	Control & Instrumentation Lab	0	0	3	1
Total					15
Theory	Semester - V				
BEC359	Microprocessor & Applications	3	0	0	3
BEC361	Analog & Digital Communication	3	0	0	3
BEE351	Power System Analysis	3	1	0	4
BEE353	Power Electronics	3	1	0	4
Practical					
BEC363	Microprocessor Lab	0	0	3	1
Total					15
Theory	Semester – VI				
BMG352	Management concepts & Organizational Behavior	3	0	0	3
BEE352	Power System Protection & Switchgear	3	0	0	3
BEEE52 BEEE54 BEEE56 BEEE58	Elective – I	3	0	0	3
BEEE60 BEEE62 BEEE64 BEEE66	Elective - II	3	0	0	3
Practical					
BEE360	Power Electronics Lab	0	0	3	1
Total					13
Theory	Semester - VII				
BEE451	High Voltage Engineering	3	0	0	3
BEEE51 BEEE53 BEEE55 BEEE57	Elective – III	3	0	0	3

BEEE59 BEEE61 BEEE63 BEEE65	Elective - IV	3	0	0	3
Practical					
BEE461	Project Work	0	1	15	6
Total					15

Total Credits : 104

LIST OF ELECTIVES

Elective Group I

Code	Course Title	L	T	P	C
BEEE52	Power System Control & Operation	3	0	0	3
BEEE54	Advanced Power Electronic Systems	3	0	0	3
BEEE56	Solid State Relays	3	0	0	3
BEEE58	Neural Networks	3	0	0	3

Elective Group II

Code	Course Title	L	T	P	C
BEEE60	Advanced Control Theory	3	0	0	3
BEEE62	Electrical Drives & Control	3	0	0	3
BEEE64	Special Electrical Machines	3	0	0	3
BEEE66	Fuzzy Logic & Applications	3	0	0	3

Elective Group III

Code	Course Title	L	T	P	C
BEEE51	Utilization of Electrical Energy	3	0	0	3
BEEE53	Micro-controller and its Applications	3	0	0	3
BEEE55	Principles of Robotics	3	0	0	3
BEEE57	Computer Aided Design of Electrical Machines	3	0	0	3

Elective Group IV

Code	Course Title	L	T	P	C
BEEE59	Power Plant Instrumentation	3	0	0	3
BEEE61	Intelligent Controllers	3	0	0	3
BEEE63	Bio-Medical Instrumentation	3	0	0	3
BEEE65	Non-Conventional Energy Sources	3	0	0	3

BMA151	MATHEMATICS I	3	1	0	4

(Part-Time common for EEE and ECE)

UNIT – I

Characteristics Equation – Eigen Values and Eigen Vector of a Real Matrix – Cayley – Hamilton Theorem – Orthogonal reduction of a symmetric to Diagonal form, - Orthogonal matrices – reduction of quadratic form to Canonical form by Orthogonal transformation – Application

UNIT – II

Binomial, Exponential Logarithmic series – Problems of summation, approximation and Co-Efficient

UNIT – III

Expansions of Sin $n\theta$, Cos $n\theta$ in powers of Sinθ & Cosθ - Expansion of tan $n\theta$ - Expansion of Sin Sin $^{n}\theta$, Cos $^{n}\theta$ in terms of Sines and Cosines of multiples of θ functions into real and imajinary parts

UNIT – IV

Functions of two Variables – Partial Derivatives – Total Differential – Differentiation of implict functions – taylors's expansion – maxima and minima by Lagrange's method of undermined multipliers – Jacobians – Differentiations under integral sign

UNIT – V

Transforms of simple functions – Basic Operational properties – Transforms of Derivative and integrals – Initial and Final value theorems – Inverse Transforms – Convolution Theorem – Periodic Function – Application of Laplace Transform for solving linear Ordinary Equations of first order with constant co-efficients

Tutorials: 15 hours

Total No. of Hours: 60

REFERENCE BOOKS :

1.E.Kreyszig, "Advanced Engineering Mathematics", 8th Edition; John Wiley and Sons, Asia Pvt.Ltd, Singapore, 2001

2.T.Veerajan, " Engineering Mathematics", Revised Editiopn, Tata McGraw Hill Publishing Co, New Delhi, 1999

BME163	THERMODYNAMICS	3	0	0	3

1. SYSTEM AND LAWS OF THERMODYNAMICS

Closed and open systems – equilibrium – first law – second law – reversibility – entropy – processes – heat and work transfers- entropy change – Carnot's cycle.

2. POWER CYCLES AND INTERNAL COMBUSTIONS ENGINES

Carnot's cycle – Otto cycle – diesel cycle – Air standard efficiency – Two stroke and four stroke engines – SI and CI engines - Gas turbine operation.

3. STEAM BOILERS AND TURBINES

Steam properties – use of steam tables and charts – boilers and accessories – layout of thermal power stations – steam turbines – impulse and reaction turbine – compounding of turbines – simple velocity diagrams.

4. AIR COMPRESSORS, REFRIGERATION AND AIR CONDITIONING

Reciprocating and rotary compressors – Vapour compression- refrigeration cycle – Applications - air conditioning system layout - selection.

5. HEAT TRANSFER

Conduction – plane wall, cylinder, sphere, composite walls – critical insulation thickness – simple fins – convection – free convection and forced convection – radiation – Black body – grey body radiation exchanges – cooling of machines.

L = 45 T=0 P = 0 Total = 45

REFERENCE BOOKS

1. Nag P. K, 'Engineering Thermodynamics' Tata McGraw Hill, 1995.
2. Kothadaraman and Domkundwar, 'Applied Thermodynamics'.
3. Sachdeva R. C, 'Heat Transfer', Wiley Eastern Ltd.1992
4. T. Roy Choudhury, 'Basic Engineering Thermodynamics', Tata McGraw Hill Publishing Co.Ltd.1997.
5. Ballancy P. L, 'Applied Thermodynamics,' Khanna Publishers.
6. Rai and Sorao, 'Applied Thermodynamics', Satya Prakasm 1985.

BEE151	CIRCUIT THEORY	3	1	0	4

(Common for EEE, ECE and ICE)

1. **BASIC CIRCUIT CONCEPTS**

   V-I relationships of R, L and C – Independent sources – Dependent sources – Kirchhoff's Laws - simple resistive circuits – network reduction – voltage division – current division – source transformation - Formation of matrix equations and analysis by using Mesh-current and Node-voltage methods.

2. **AC FUNDAMENTALS**

   AC quantity, Phasor representation – Sinusoidal steady state analysis of simple series and parallel circuits – power and power factor- analysis by mesh current and node voltage methods - Series resonance and Parallel resonance.

3. **NETWORK THEOREMS**

   Superposition theorem – Thevenin's theorem – Norton's theorem - Maximum power transfer theorem - Reciprocity theorem – Compensation theorem – Substitution theorem - Millman's theorem and Tellegen's theorem with applications.

4. **THREE PHASE CIRCUITS**

   Three-phase systems – phase sequence - Solution of three-phase balanced circuits – Solution of three-phase unbalanced circuits - Power measurement and two-wattmeter method.

5. **COUPLED CIRCUITS**

   Mutual inductance - Coefficient of coupling – Ideal Transformer - Analysis of multi winding coupled circuits – Single and Double Tuned circuits – Critical coupling.

L=45 T=15 P=0 Total = 60

REFERENCES

1. Sudhakar, A. and Shyam Mohan S.P.,"Circuits and Network Analysis and Synthesis", Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1994.
2. Hyatt, W.H. Jr and Kimmerly, J.E., 'Engineering Circuits Analysis', McGraw Hill International Editions, 1993.

3. Edminister, J.A., ‘Theory and Problems of Electric Circuits’, Schaum’s outline series McGraw Hill Book Company, 2nd Edition, 1983.
4. Paranjothi S.R., ‘Electric Circuit Analysis’, New Age International Ltd., Delhi, 2nd Edition, 2000.

BEE153	ELECTRICAL MACHINES – I	3	1	0	4

1. INTRODUCTION

Electrical machine types – Magnetic circuits – Magnetically induced EMF and force – AC operation of magnetic circuits - core losses.

Principles of Electromechanical energy conversion: Energy conversion process – Energy in magnetic system – Field energy and mechanical force – Multiply excited magnetic field systems.

2. TRANSFORMERS

Construction – Principle of operation – Equivalent circuit – Losses – Testing – Efficiency and Voltage regulation – All day efficiency.

3. Auto transformer – Three phase transformer connections – Parallel operation of transformers – Three winding transformers - Phase conversion – Tap changing transformers.

4. DC MACHINES

Construction – Armature windings – EMF and Torque – Methods of excitation - Circuit model – Armature reaction – Commutation –– Performance characteristics of generators.

5. Performance characteristics of motors – Starting - Speed control – Testing - Losses and efficiency – Parallel Operation.

L = 45 T = 15 P = 0 Total = 60

TEXT BOOK

Nagrath I.J and Kothari D. P. “Electric Machines”, Tata McGraw Hill Publishing Company Ltd, 1990.

REFERENCES

1. P.C.Sen, “Principles of Electrical Machines & Power Electronics”, John Wiley & Sons, Second Edition, 1997.
2. Fitzgerald.A.E., Charles Kingsely. Jr, Stephen D.Umans, “Electric Machinery”, McGraw Hill Books Company, 1992.
3. Syed.A.Nassar, “Electric Machines and Power system”, Volume – I Electric Machines, McGraw Hill Inc., New York,1995.

BMA152	**MATHEMATICS II**	3	0	0	3

(For Part time EEE & ECE)

UNIT-1 MULTIPLE INTEGRALS (9 hours)

Double integration in Cartesian and Polar Co-ordinates - Change of Order of integration-Double integral – Triple in Cartesian Co-ordinates – Spherical Polar Co-ordinates - Change of variables – Applications.

UNIT-1I VECTOR CALCULUS **(**9 hours)

Scalar and Vector functions – Differentiation – Gradient, Divergence and Curl – Directional Derivatives – Irrotational and Solenoidal fields – Line, Surface and Volume integrals – Green’s, Gauss divergence and stoke’s theorems – Verification and Applications.

UNIT-1I I Fourier Series (9 hours)

Dirichlet’s conditions – General Fourier Series –Half range sine and cosine series - Parseval’s identity-Complex form of Fourier series-Harmonic analysis.

UNIT-1V Partial differential equation (9 hours)

Statement of Fourier integral Theorem-Fourier transforms pairs-Fourier sine & cosine Transforms-Properties-Transforms of Simple Functions-Convolution Theorem – Parseval's Identity.

UNIT-V Partial Differential Equation (9 hours)

Formulation –Solution of Standard type-First order differential equation -Linear partial differential equations of second and higher order with constant coefficients.

Tutorials: 15 hours

Total No. of Hours: 60

Text Books:

1. E. Kreyszig, Advanced Engineering Mathematics (8th ed)- John Wiley and Sons (Asia) Pvt. Ltd., Singapore (2001).
2. Grewal.B.S., "Higher Engineering Mathematics", Khanna Publications, New Delhi
3. Manivachagam, K.,Vittal, P.R., "Engineering Mathematics",2001, Mangayar Publications, Chennai.

Reference Books:

1. Kandasamy, K.Thilagavathy and K.Gunavathy, Engineering Mathematics Vol.II & III (4^{th} Revised ed.) S.Chand & Co., Publishers, New Delhi, 2000.
2. S.Narayanan, T.K. Manikavachagam Pillai, and G . Ramanaiah, "Advanced Mathematics for Engineering Students – Vol. I", 2^{nd} Edition, S.Viswanathan, Printers and Publishers, 1992.
3. M.K Venkataraman , "Engineering Mathematics – Vol.III A & B", National Publishing, Chennai, 13^{rd} Edition, 1998.

BEC152	SOLID STATE DEVICES	3	0	0	3

(Common for ECE, EEE and ICE)

UNIT -I Properties Of Semiconductor Materials: (9 hours)

Drift velocity of electrons in applied electric field-Mobility and conductivity- charge densities in a semi conductor-generation and recombination of charges- Drift and Diffusion current-continuity equation-injected minority carrier concentration-Potential variation within a Graded semiconductor.

UNIT- II PN Junction Diode : (9 hours)

Theory of PN junction diode-VI Characteristics-static and dynamic resistance-effect of temperature on diodes-space charge and diffusion capacitance-Zener diode-avalanche and Zener breakdown mechanisms- Zener diode as a voltage regulator.

UNIT –III (9 hours)

Principles of transistor action-current components-cut off, Active & saturation region-I/P & O/P characteristics CE, CB and CC. Small signal 'β', Break down & Switching characteristics-Transistor biasing-bias stabilization-bias compensation-Thermal runaway-Design with Heat sink.

UNIT IV (9 hours)

Construction feature & Working principles of JFET, MOSFET Depletion and Enhancement mode, Biasing of FET, and MOSFETS.

UNIT V (9 hours)

Small signal mode of transistor - Analysis of amplifiers using small signal model. Common Emitter, Common Base, Common Collector, Common source, Common Drain, Common gate, Multi stage amplifier.

Total No. of Hours:45

Text Books:

1. Boylestad, Robert.L and Nashelsky Louis,"Electronic Devices and Circuit theory", Prentice Hall of India, 6th Edition, 2001.

2. William & Harris, “Electronic Devices and Circuits”, Tata McGraw Hill International Editions, 2000

BEE152	NETWORK ANALYSIS AND SYNTHESIS	3	1	0	4

(Common for EEE, ECE and ICE)

1. TRANSIENT ANALYSIS

   Forced and free response of RL, RC and RLC circuits with D.C. and sinusoidal excitations.

2. TWO PORT NETWORKS

   Characterization of two port networks in terms of Z, Y, H and T parameters – networks equivalents – relations between network parameters – Analysis of T, Ladder, Bridged–T and lattice networks – transfer function of terminated two port networks.

3. NETWORK TOPOLOGY

   Network graphs, tree and cut – sets – tie set and cut – set schedules – primitive impedance and admittance matrices – Application to network solutions.

4. S-DOMAIN ANALYSIS & NETWORK SYNTHESIS

   S - domain network – driving point and transfer impedances and their properties – transform network analysis – poles and zeros of network functions – time domain response of pole-zero plot.

   Realizability of one port network – Hurwitz polynomials and properties – Positive Real functions and properties – synthesis of RL, RC and LC one port networks.

5. FILTERS & ATTENUATORS

   Classification of Filters - filter networks - design of constant K, m–derived and composite filters. Analysis of T, π, lattice, bridged-T, and L type attenuators.

L = 45 T = 15 P=0 Total = 60

REFERENCES

1. Sudhakar. A., and Shyammohan, “Circuits and Networks Analysis and Synthesis” Tata McGraw Hill Publishing Co.Ltd. New Delhi, 1994.
2. Kuo F.F., “Network Analysis and Synthesis”, Wiley International Edition, Second Edition, 1966.
3. Van Valkenburg, M.E., ‘Network Analysis’, Prentice – Hall of India Private Ltd., New Delhi, Third Edition ,1974.
4. Roy Choudhury, “Networks and Systems”, New Age International Ltd.

BEE154	ELECTRICAL MACHINES II	3	1	0	4

1. AC MACHINE FUNDAMENTALS

Introduction – AC windings – EMF Equation – MMF of AC windings – MMF of three-phase windings (Rotating magnetic field) – Torque in AC machines.

SYNCHRONOUS MACHINES

Construction – Equivalent circuit and phasor diagram – Synchronous impedance - Voltage regulation – EMF method, MMF method and POTIER method – Effect of power factor on characteristics – Short circuit ratio.

2. Salient pole synchronous machines - Two Reaction theory – Determination of X_d and X_q (Slip Test) – Power angle characteristics of cylindrical rotor and salient pole machines – Operating limits on alternators - Parallel operation of alternators – Synchronizing power and torque – Two alternators in parallel – Operation of alternator on infinite bus bar.

3. Synchronous motor – Principle of operation – Construction – Equivalent Circuit and phasor diagram – Power and Torque – Speed-Torque characteristics – Effect of change in excitation - V curves and inverted V curves – synchronous condenser – Starting methods - Hunting.

4. THREE PHASE INDUCTION MACHINES

Construction – types – Principle of operation – Equivalent circuit – Torque and Power output – Torque-slip characteristics – Testing - Circle diagram – Starting - Cogging and Crawling - Speed control - Deep bar rotor - Double cage rotor – Induction generator.

5. FRACTIONAL HORSEPOWER MOTORS

Single phase induction motor – Double revolving field theory – equivalent circuit – Speed-torque characteristics – starting methods – Split-phase motor - shaded-pole induction motor – Universal motor – Repulsion motor – Reluctance motor –

Hysteresis motor – Stepper motor – Two-phase servo motor - AC tachometer - Linear induction motor.

L = 45 T = 15 P = 0 Total = 60

REFERENCES

1. B.R.Gupta, Vandana Singhal, “Fundamentals of Electric Machines”, New Age International Publishers, Second Edition, 1996.
2. Nagrath,I.J.and Kothari.D.P., “Electric Machines”, T.M.H publishing Co Ltd., New Delhi, Second Edition, 1990.
3. Fitzgerald, A.E.Charles Kingsley Jr.Stephen D.Umans, “Electric Machinery”, McGraw Hill Book Company,1992.

BEE160	ELECTRICAL MACHINES LAB	0	0	3	1

(For Part Time EEE)

LIST OF EXPERIMENTS

1. Open Circuit and Load test on DC Shunt Generator
2. Load Test on DC Shunt Motor
3. Load Test on DC Series Motor
4. Speed Control of DC Shunt Motor
5. Swinburne’s Test
6. O.C and S.C test on 1-phase Transformer
7. Load Test on Transformer
8. Sumpner’s Test
9. Load Test on Alternator
10. Predetermination of Regulation of Alternator by EMF Method and MMF Method.
11. Load Test on 3-phase Squirrel cage Induction Motor

12. No-load and Blocked Rotor Test on 3-phase Induction Motor
13. V-curve and Inverted V-curves of Synchronous Motor
14. Load Test on 1-phase Induction Motor

BEC251	DIGITAL ELECTRONICS	3	0	0	3

(Common for ECE, EEE and ICE)

UNIT – I Number Systems : Review of Binary, Octal and Hexa decimal number systems – Conversions - Binary Arithmetic form – 1's, 2's complement representation - Codes: BCD, Excess –3, Greycode, ASCII codes, Error detecting codes (Hamming code).

UNIT – II Boolean Algebra :Boolean algebra – De-Morgan's law – Simplifications of Boolean expression – Sum of products and product of sums – Karnaugh Map – Quince McClusky method of simplication (Including Don't care conditions).

UNIT – III Combinational Logic : Logic gates – AND, OR, NOT, NOR, NAND and EX-OR – Combinational logic – Arithmetic circuits – Half adder – Full adder, Half Subtractor – Decimal Adder – Excess 3 adder - Code converters – Multiplexer – Demultiplexer – Encoder - Decoder – Design of any combinational logic circuits.

UNIT – IV Sequential Logic Design : Building blocks of Sequential logic – RS, JK, Master–Slave, D and T flip- flop - Asynchronous and synchronous counters – Binary and BCD counters – shift registers – Design and implementation of Sequential synchronous circuits.

UNIT – V Logic Families : Characteristics of RTL, TTL, DTL, families – Schotty, clamped TTL, ECL, IIL – Mos Invertors – Complementary Mos inverters

Tutorials: 15 Total no. of hours: 60

TEXT BOOK:

1. Albert Paul, Malvino and Donald.P.Leach , "Digital Principles and Applications", McGraw Hill Publications.
2. Floyd, "Digital Fundamentals", Universal Book Stall, New Delhi,1993.
3. Moris Mano, "Digital Electronics and Design ", Prentice Hall of India, 2000.

REFERENCE:

1. "Digital Logic & Computer Design", Prentice Hall of India, 2000.
2. " Digital Circuits and Logic Design", Prentice Hall of India.

BEC257	ELECTRONIC CIRCUITS	3	0	0	3

(Common for ECE, EEE and ICE)

UNIT I: RECTIFIER & POWER SUPPLY (9 hours)

Half & Full wave rectifier-filters-shunt, inductor, LC section & Ripple factor,Π Calculation for C, L and LC filters-Voltage regulators-Zener –Series voltage regulator-SMPS.

UNIT II: AMPLIFIERS (9 hours)

Amplifiers-Frequency response of RC coupled amplifiers-Frequency Response of Emitter follower, gain band width product-FET-amplifier at low and high frequency cascaded amplifiers.

UNIT III: FEEDBACK AMPLIFIER & OSCILLATORS (9 hours)

Four basic type of feedback-effect of feedback on amplifier performance-condition for oscillation- Barkhunsen criteria-LC oscillators-Hartely & Colpitts-RC oscillators- Wein bridge, RC phase shift crystal Oscillator.

UNIT IV: MULTIVIBRATORS (9 hours)

Collector coupled & Emitter coupled Astable multivibrator-mono stable, Bistable multivibrator-triggering methods-Storage delay and Calculation of switching time-Schmitt trigger circuits-Speed up Capacitor in switching.

UNIT V: POWER AMPLIFIER (9 hours)

Classification-class A, B, C & AB-Class B push pull –Class B Complimentary -symmetry-Class S, Power sections classifications-Efficiency-Distortion in amplifiers.

Tutorials: 15 hrs. Total No of Hours: 60

REFERENCE BOOKS:

1. David.A.Bell, “Solid State Pulse Circuits”, Prentice Hall of India, 4th Edition, 2001
2. Millman Taub.H, “ Pulse Digital & switching waveform”, Tata McGraw Hill International 2001.
3. Jacob Millman, Cristas C. Halkias, “Integrated Electronics”, Tata Mc Graw Hill, Edition 1991.

BEE251	**DESIGN OF ELECTRICAL MACHINES**	3	1	0	4

1. **INTRODUCTION :** Major considerations – Limitations – Electrical Engineering Materials – Space factor – temperature gradient – Heat flow in two dimensions – thermal resistivity of winding – Temperature gradient in conductors placed in slots – Rating of machines – Eddy current losses in conductors – Standard specifications

2. **DC MACHINES :** Magnetic circuit calculations –Net length of Iron –Real & Apparent flux densities – Design of rotating machines – D.C machines output equations – Selection of number of poles – Design of shunt and series field windings - Armature design – Design of commutator and brushes.

3. **TRANSFORMERS :**KVA output for single and three phase transformers – Window space factor – Overall dimensions – Operating characteristics – Regulation – No load current – Temperature rise of Transformers – Design of Tank with & without cooling tubes – Thermal rating – Methods of cooling of Transformers.

4. **INDUCTION MOTORS :** Magnetic leakage calculations – Leakage reactance of polyphase machines- Magnetizing current – Output equation of Induction motor – Main dimensions –Length of air gap- Rules for selecting rotor slots of squirrel cage machines – Design of rotor bars & slots – Design of end rings – Design of wound rotor-Operating characteristics –Short circuit current – circle diagram – Dispersion co-efficient – relation between D & L for best power factor.

5. **SYNCHRONOUS MACHINES :**Runaway speed – construction – output equations – choice of loadings – Design of salient pole machines – Short circuit ratio – shape of pole face – Armature design – Armature parameters – Estimation of air gap length – Design of rotor –Design of damper winding – Determination of full load field mmf – Design of field winding – Design of turbo alternators – Rotor design - Introduction to computer aided design – Program to design main dimensions of Alternators.

L = 45 T = 15 P = 0 Total = 60

REFERENCE BOOKS:

1. Sawhney, A.K., 'A Course in Electrical Machine Design', Dhanpat Rai & Sons, New Delhi, 1984.
2. Sen, S.K., 'Principles of Electrical Machine Designs with Computer Programmes', Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 1987.

BEE253	**ELECTROMAGNETIC FIELDS**	3	1	0	4

(Common for EEE and ECE)

1. GENERAL PRINCIPLES & ELECTROSTATICS

The field concept – sources of electromagnetic fields, Changes – Columb's Law – Electric field intensity – Electric flux – Gauss's law – Potential – Boundary value problems – Laplace and Poisson's equations – Electrostatic energy – dielectrics – capacitance.

2. MAGNETOSTATICS

Current density – Magnetic field – Magnetic flux – Biot-Savart's law – Ampere's law – Torque – Force – Vector potential – Boundary value problems.

3. ELECROMAGNETIC FIELDS

Faraday's Law – Lenz's law – Maxwell's equations – Displacement current – Eddy current – relation between field theory and circuit theory.

4. LECTROMAGNETIC WAVES

Generation – Propagation of waves in dielectrics – Conductors and transmission lines – Pointing vector – Skin effect.

5.INTRODUCTION TO FIELD MODELLING AND COMPUTATION

Problem formulation – Boundary conditions – solutions – Analytical methods – variables separable methods – Method of images – Numerical methods – Finite difference method – Finite element method.

L = 45 T = 15 Total = 60

REFERENCE BOOKS

1. John D Kraus, "Electromagnetics", McGraw Hill Book Co., New York, Third Edition, 1989.
2. Joseph A Edminister, "Theory and Problems of Electro Magnetics", Schaums outline series McGraw Hill book company New York, 1986.
3. William H.Hayt, Jr., "Engineering Electromagnetics", Tata McGraw Hill Edition, New Delhi, 1998.
4. David J Griffith, "Introduction to Electrodynamics", Prentice Hall of India Pvt. Ltd, New Delhi, Second Edition, 1997.
5. Richard E. Dubroff, S.V.Marshall, G.G.Skitek, "Electromagnetic Concepts and Applications", Fourth Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 1996.
6. Kraus and Fleish, "Electromagnetics with Applications", McGraw Hill International Editions Fifth Edition 1999.

BCS261	COMPUTER PROGRAMMING	0	0	3	1

UNIT I MULTI USER OPERATING SYSTEM

UNIX- Introduction – Basic Commands - Vi Editor-Filters Input/Output Redirection-Piping - transfer of data between devices -Shell Scripts.

UNIT II FUNDAMENTALS OF NETWORKS

Working on a Network environment-Accessing different nodes from one node-Concept of E-mail-Uses of Internet.

UNIT III HIGH LEVEL LANGUAGE

C Language-Introduction –Operators-Expressions-Variables-Input/Output Statement-control statement-Functions-Array-Pointers-Structures Unions-file Handling.

UNIT IV ENGINEERING APPLICATIONS PROGRAMS

File Processing- searching- sorting- string manipulation- matrix manipulation-Finding stress action on the given body- Finding thermal conductivity of materials - Kirchhoff’s voltage and current law- Serial and Parallel resonance - Star to delta and delta to star conversion.

UNIT V C PROJECTS

Database Creation-Student information system-Payroll Processing-Design applications-Animation and games.

L=15 T=0 P=30 Total=45

BEC256	LINEAR INTEGTRATED CIRCUITS	3	0	0	3

(Common for EEE & ECE)

UNIT – I OP-AMP CHARACTERISTICS AND APPLICATIONS

Ideal Op-amp – IC Op-amp – FET OP – amp – DC characteristics. Bias, offset and drift – AC characteristics: BW, slew rate, noise and frequency compensation – Bias Op-amp. Application: Scale changer- inverter and non-inverter - Summer and subtract or – Multiplier and divider – Differentiator and integrator – Instrumentation amplifier – AC amplifier – V to I an d I to V converters - Op- amp circuits using diodes; Precision rectifier – Clipper and clamper – Sample and Hold circuit – log and antilog amplifiers.

UNIT – II COMPARATORS AND SIGNAL GENERATORS

Applications of comparators – Regenerative comparators (Schmitt trigger) – Square wave generator (Astable multivibrator) – Monostable multivibrator –Triangular wave generator – Saw tooth wave generator – Sine wave generators.

UNIT – III VOLTAGE REGULATORS AND MULTIPLIERS

Series Op-amp regulator - IC voltage regulators – general purpose regulator – Switching regulator – Multiplying DC voltages - Frequency doubling – phase – angle detection – AM Modulation / Demodulation.

UNIT – IV ACTIVE FILTERS AND TIMERS

RC active filters: low pass – high pass – band pass band reject – notch – first order – Second order – transformation – State variable filter – Switched capacitor filters – Timer functional diagram – Monostable operation – Astable operation – Their application – Schmitt trigger – Counter timers.

UNIT – V PLL, ADC and DAC

Basic Principles – phase detector and comparator: analog and digital voltage controlled oscillator – Low pass filter - PLL – Applications of PLL – DAC/ADC techniques – Integrating DAC /ADC Specifications.

Total Hours: 45

TEXT BOOKS:

Roy Choudhury and Shail Jain, “Linear Integrated Circuits”, Wiley Eastern Ltd., 1991.

REFERENCE BOOKS:

1.Coughlin and Dirscol, “Operational amplifiers and Linear Integrated circuits”, Prentice Hall of India Pvt., Ltd., 1992

2.Millman and Halkias, “Integrated Electronics”, McGraw Hill, 1992.

BEE252	CONTROL ENGINEERING	3	1	0	4

(Common for EEE and ECE)

1. Introduction: 9

   Open-loop and closed –loop systems, servomechanisms and regulator systems; Transfer function; Block diagram reduction, Signal flow graphs.

2. Mathematical models of Physical Systems: 9

   Mechanical systems - Translational and rotational systems, Gear trains, Electrical systems, Thermal systems and Fluid systems.

   Components of feedback control systems - Potentiometers as error sensing devices, Synchros, Servomotors, Stepper motors, Tachogenerators.

3. Stability: 9

   Concept of Stability, necessary and sufficient conditions of Stability, Closed-loop systems, merits and demerits, Routh-Hurwitz Criterion.

   Transient Response: Typical inputs, convolution integral, Time domain specifications, steady state errors.

4. Frequency Response: 9

   Definition, equivalence between transient response and frequency response, Bode plots.

   Nyquist Stability Criterion: Development of criterion, gain and phase margins, m-circles and Nichol's chart.

5. Root Locus method: 9

   Rules for sketching of root loci, Root contours.

   Synthesis: Lag and Lead networks, proportional, derivative and integral controllers.

L= 45 T=15 P = 0 Total = 60.

TEXT BOOK

I.J.Nagrath and M.Gopal, 'Control System Engineering', Wiley Eastern Ltd., Reprint 1995.

REFERENCES

1. M.Gopal, 'Control System Principles and Design', Tata McGraw Hill, 1998.
2. Ogatta, 'Modern Control Engineering', Tata McGraw Hill 1997.
3. C.J.Chesmond, 'Basic Control System Technology', viva low priced student edition, 1998.
4. R.C.Dorf and R.H.Bishop, 'Modern Control Systems,' Addison Wesley, 1995.

BEE254	ELECTRICAL MEASUREMENTS AND INSTRUMENTATION	3	0	0	3

1. INTRODUCTION (6 hours)

Functional elements of an instrument - static and dynamic characteristics – errors in measurement - statistical evaluation of measurement data - standard and calibration.

2. ELECTRICAL AND ELECTRONICS INSTRUMENTS (12 hours)

Principle and types analog and digital ammeters and voltmeters – single and three phase Wattmeters and Energy meter - magnetic measurements – instrument transformers – instruments for measurement of frequency and phase.

3. SIGNAL CONDITIONING CIRCUITS (9 hours)

Bridge circuits – differential and Instrumentation amplifiers - filter circuits - V/f and f/V converters – P/I and I/P converters – S/H Circuit, A/D and D/A converters - multiplexing and Demultiplexing - data acquisition systems – grounding techniques.

4. STORAGE AND DISPLAY DEVICES (8 hours)

Magnetic disc and tape recorders – digital plotters and printers – CRT displays – digital CRO – LED, LCD and Dot matrix displays.

5. TRANSDUCERS (10 hours)

Classification of transducers – selection of transducers – resistive, capacitive and inductive transducers – piezo electric transducers – optical and digital transducers. pH electrodes - transducers for measurement of displacement, temperature, level, flows, pressure, velocity, acceleration, torque, speed, viscosity and moisture.

L = 45 Total = 45

TEXT BOOKS

1. Doebeling, E.O., 'Measurement Systems – Application and Design', McGraw Hill Publishing Company, 1990.
2. H.S. Kalsi, ‘Electornic Instrumentation’, TMH Co., 1995.

REFERENCES

1. Stout M.B., 'Basic Electrical Measurement', Prentice Hall of India, 1986.
2. Dalley, J.W., Riley, W.F. and Meconnel, K.G., 'Instrumentation for Engineering Measurement', John Wiley & Sons, 1993
3. Moorthy, D.V.S., 'Transducers and Instrumentation', Prentice Hall of India Pvt. Ltd., 1995.

BEE256	TRANSMISSION AND DISTRIBUTION	3	1	0	4

1. INTRODUCTION 9

Structure of Electric Power system –Transmission and Distribution systems - Typical power station and substation layouts - Single line diagram - Recent trends in Power transmission - EHV AC and HVDC transmission.

Mechanical Design of Transmission Lines – Sag, Calculation of Sag and Tension, Effect of ice and wind loading, Sag Template, Vibrations of conductors and Dampers.

2. TRANSMISSION LINE PARAMETERS 9

Resistance, Inductance and Capacitance of single and three phase transmission lines - Stranded and Bundled conductors -Symmetrical and unsymmetrical spacing - Transposition -Application of self and mutual GMD -Skin and Proximity effect - Inductive interference with neighbouring circuits.

3. CHARACTERISTICS AND PERFORMANCE OF TRANSMISSION LINES 9

Equivalent circuits for short, medium and long lines –Attenuation constant, phase constant, Surge impedance -Transmission efficiency and voltage regulation -Real and Reactive Power flow in lines –Power angle diagram -Receiving end power circle diagram -Limiting factors of transmission line load ability –Shunt and Series compensation –Ferranti effect and Corona loss.

4. INSULATORS AND CABLES 9

Insulators: Types of insulators for overhead lines, Voltage distribution in insulator string and grading - String efficiency.

Underground cables: Constructional features of LT and HT cables – Capacitance – Dielectric stress and Grading –Thermal characteristics.

5. ECONOMICS OF POWER SUPPLY SYSTEMS 9

Economic choice of conductor size and voltage level, maximum demand and diversity factor, Tariffs, Power factor correction, Energy conservation.

L = 45 T = 15 P = 0 Total = 60

REFERENCE BOOKS

1. Wadhwa, C.L., “Electrical Power Systems”, Wiley Eastern Limited India, 1985.
2. Nagarath I.J and Kothari D.P., “Modern Power System Analysis”, Tata McGraw Hill Publishing Company, 1990.
3. Despande, M.V., “Electrical Power Systems Design”, Tata McGraw Hill Publishing Company New Delhi, 1990.

BEE260	CONTROL & INSTRUMENTATION LAB	0	0	3	1

1. Transfer function of self excited DC Generator
2. Transfer function of Armature controlled DC Motor.
3. Transfer function of Field controlled DC Motor.
4. Transfer function of AC Servomotor.
5. Frequency response of Lag, Lead & Lag – Lead networks.
6. Study of DC Position Control system.
7. Study of P, PI and PID Controllers (First Order).
8. Study of temperature measuring transducers (Thermocouples).
9. Study of displacement and pressure transducers (LVDT).
10. AC Bridges.
11. DC Bridges.
12. Calibration of Single phase Energy meter.
13. Calibration of Three-phase Energy meter.
14. Measurement of Three-phase power and power factor.

P = 45 Total = 45

BEC359	MICROPROCESSOR AND ITS APPLICATION	3	0	0	3

UNIT – I: Internal Architecture of 8085 microprocessor –Instruction set –Addressing Modes –8085 interrupts – Timing diagram – Debugging Techniques – Assembly level programming

UNIT – II : USART (8251) – Programmable Interval Timer (8253/8254) programmable Peripheral interface (8255) – CRT controller (8275 / 6845) – Floppy disk Controller (8272)

UNIT – III : Programmable DMA controller (8257)- Programmable Interrupt controller (8259)-Keyboard display Interface (8279) – ADC / DAC Interfacing.

UNIT – IV :8086 Architecture and pin configuration – Minimum mode and maximum mode configuration - Addressing modes – Basic Instructions – 8086 Interrupts – Assembly level Programming – Introduction to 80186, 80286, 80386 and Pentium processor

UNIT – V : Typical Application of 8085 – Stepper Motor controls – Traffic light controls – waveform generation – Analog interfacing and industrial control – Microcomputer based system with seven segment displays and key switches

L= 45 T=0 P = 0 Total = 45

TEXT:

1. Ramesh S.Gaonkar, Microprocessor Architecture Programming and Applications with 8085. Fourth edition, Penram International publishing 2000.
2. Douglas V. Hall, Microprocessor and Interfacing, programming and Hardware, Tata McGraw Hill, Second Edition 1999.

REFERENCES:

1. Yu_Cheng Liu Glenn A. Gibson, Microcomputer systems the 8086 / 8088 family, Prentice Hall 2001.
2. Kenneth J.Ayala The 8086 Microprocessor, Programming and Interfacing the PC, Penram International Publishing, 1995.

BEC361	**ANALOG AND DIGITAL COMMUNICATION**	3	0	0	3

UNIT- I

Basic communication Systems – Need for modulation in communication Systems – Amplitude modulation – Double side band amplitude modulation, single side band modulation and vestigial side band modulation – Frequency and Phase modulation - Narrow band and wide band FM.

UNIT – II

AM, FM detectors, AM, FM Transmitters, Receivers – Performance measurement.

UNIT-III

Digital communication advantages – Basic block diagram – Sampling theorem – Quantization – PCM –DPCM –Delta modulation –ADM – Application.

UNIT – IV

Power spectra of PAM signals, Inter symbol interface ideal Nyquist channel, raised cosine channel. Correlative and Precoding – Eye pattern and Equalizations Techniques.

UNIT – V

History and Evaluation of Mobile Radio Systems, types of Mobile wireless Services/Systems – Cellular, WLL, Paging, Satellite Systems, Standard, Future trends in Personal Wireless systems. Cellular concepts and Frequency reuse, Multiple Access Schemes, Channel Assignment and handoff, interface and System Capacity, Trunkig and Erlang Capacity calculations.

L=45 T=0 P=0 Total=45

Reference Books:

1. Taub and Scilling, ‘Principles of Communications Systems’, TMH, New Delhi,1995.
2. P.B.Lathi, ‘Modern digital and Analog Communications Systems’, 3rd Edition, Oxford University Press, 1998.
3. Simon Hawkins, ‘Digital Communications’, John Wiley and Sons, 1988.
4. K.Feher, ‘Wireless Digital Communication’, Prentice Hall of India, New Delhi,1995.

BEE351	**POWER SYSTEM ANALYSIS**	3	1	0	4

1. **INTRODUCTION** : Need for Power system analysis in planning and operation of power system - Per Unit representation – Single line diagram – Symmetrical components – Sequence impedance and sequence networks of transmission line, synchronous machine and transformers.
2. **NETWORK MODELLING** : Primitive network and its matrices – Bus incidence matrix – Bus admittance matrix by Singular transformation and inspection methods - Bus impedance matrix – Z-Bus building algorithm - Modeling of transformer with off-nominal tap ratio, synchronous generator, transmission line and loads for Short circuit, Power flow and Stability studies.
3. **POWER FLOW ANALYSIS :** Problem definition – Bus classification –Derivation of power flow equation –Solution by Gauss–Seidel, Newton-Raphson methods and FDLF – Modifications when P-V buses are present - Computation of slack bus power, transmission loss and line flows.
4. **SHORT CIRCUIT ANALYSIS** : Need for Short circuit study - Symmetrical short circuit analysis – Short circuit of synchronous machine (both no-load and load condition) – Selection of circuit breakers.

   Unsymmetrical fault analysis – LG, LL, LLG and open conductor faults.
5. **STABILITY ANALYSIS :** Dynamics of a Synchronous machine – Swing equation and Power angle equation – Steady state Stability and Transient state Stability - Equal area criterion – Cearing angle and time- Numerical solution of Swing equation for single machine.

L = 45 T=15 P = 0 Total = 60

TEXT BOOKS

Nagarath .I.J, Kothari .D.P, ‘Power system Engineering’, TMH Pub. Co. Ltd., 1994.

REFERENCES

1. John J. Grainger and Stevenson Jr. W.D., ‘Power System Analysis’, McGraw Hill International Edition, 1994.

2. Stagg, G.W. and El-Abaid, A. H., ‘Computer Methods in Power System Analysis’, McGraw-Hill International Book Company.

BEE353	POWER ELECTRONICS	3	1	0	4

1. POWER SEMI-CONDUCTOR DEVICES

Principle of operation - characteristics and modeling of power diodes, SCR, TRIAC, GTO, power BJT, power MOSFET and IGBT.

2. PHASE CONTROLLED CONVERTERS

Single-phase semi-converter and full converter with RL load – Three-phase semi-converter and full converters with RL load – Effect of source and load inductance – Single-phase and three-phase Dual converters- firing circuits.

3. DC CHOPPERS

Thyristor commutation techniques - natural and forced commutation – Principle of chopper operation – Step up and Step down choppers – Switching mode regulators – Thyristor chopper circuits.

4. INVERTERS

Single-phase voltage source inverters – Three-phase bridge inverters – Voltage control of single-phase inverters – Voltage control of three-phase inverters – Forced commutated Thyristor inverters - Series inverter- PWM inverters – Current source inverters.

5. AC VOLTAGE CONTROLLERS

Single-phase and three-phase AC voltage controllers - Sequence control of AC voltage regulators. Cycloconverters – single-phase and three-phase cycloconverters

L = 45 T=15 P = 0 Total = 60

TEXT BOOKS

Rashid, M.H., 'Power Electronics - Circuits Devices and Applications', Prentice Hall of India, 2nd Edition, 1995.

REFERENCES

1. Singh.M.D and Kanchandani-'Power Electronics'-Tata McGraw Hill & Hill publication Company Ltd, New Delhi, 2002.
2. Dubey, G.K., Doradia, S.R., Joshi, A. and Sinha, R.M., 'Thyristorised Power Controllers', Wiley Eastern Limited, 1986.
3. Lander,W., 'Power Electronics', McGraw Hill and Company, Third Edition, 1993.
4. P.S. Bimbhra, "Power Electronics", Khanna Publishers, 3rd Edition, 1999.

BEC363	**MICROPROCESSOR LAB**	0	0	3	1

(Common for EEE and ECE)

8085 Microprocessor:

1. Assembly language Programming for single byte, multibyte, addition and subtraction
2. Assembly language Programming for Multiplication and division
3. Searching and sorting
4. Square and square root

Interfacing:

5. Wave form generation using 8255 PPI
6. Traffic light controller
7. Stepper Motor Controller
8. Keyboard Interfacing
9. Matrix display

8086 Microprocessor:

10. Average of N numbers
11. Block Movement of Data
12. Multibyte Addition
13. Maximum of given series
14. Square of a given number

L = 0 T=0 P = 45 Total = 45

BMG352	**MANAGEMENT CONCEPTS AND ORGANIZATIONAL BEHAVIOR**	3	0	0	3

Objective: This course is aimed at addressing the contemporary issues, which fall under the broad title of management, and its function. In addition, there will also be an attempt to analyze the behavior of individuals within an organization and the issues of working with other groups or teams.

Contents:

1. Management-Definition, evolution, MBO
2. Management functions – Planning, Organizing, Leading, Motivating, Control and Operations / Marketing / Finance /HR
3. Organizing and Managing HR and communicating
4. Motivating and Leading
5. Behaviour of an individual in an organization – attitude, Value, job satisfaction, personality, Perception, concepts of learning, motivation – Theories and application.
6. Group behavior – structure process, decision-making, work team - different from group –leadership, communication – theories.
7. Power and politics, Organizational culture
8. Oraganization work culture, and work design.
9. HR policies and practices.
10. Managing the future – new worker/new manager/new organization etc.

Text Books:

1. Stephen P.Robbins, Organisational Bahavior, PHI, 9th Edition, 2001.
2. Koontz O'Dannel, Principles of Management – McGraw Hill Publishing Co. Ltd.
3. Peter Drucker, The Practice of Management – Allied Publications.
4. L.M.Prasad, Management Principles, Sultan chand & Sons.

Reference Books:

1. Stephen P.Robbins and David A. Decenzo, Fundamentals of management, Pearson Education, 3rd edition, 2001
2. Koontz, Essentials of Management, Tata McGraw Hill, 5th Edition,2001.
3. Gupta, C.B., Management theory and Practice, Sultan Chand & Sons.
4. Steward Black & Lyman W.Porter, Management – Meeting new challenges, Prentice Hall, 2001.

BEE352	POWER SYSTEM PROTECTION & SWITCHGEAR	3	0	0	3

1. RELAYS 12

Need for protection – essential qualities of protective relays – Electromagnetic relays, Induction relays – Over current relays - Directional, Distance, Differential and negative sequence relays.

Static relays – components of static relays – over current relays, differential protection and distance protection - microprocessor-based relays.

2. APPARATUS PROTECTION 8

Transformer, Generator, Motor, Bus bar and Transmission line protection – Feeder protection.

3. THEORY ARC QUENCHING 7

Arc phenomena – arc interruption – Current zero interruption theories – recovery voltage and restriking voltage - RRRV – current chopping – Resistance switching.

4. CIRCUIT BREAKERS 9

Various types of circuit breakers - selection of circuit breakers – Testing of circuit breakers – Auto reclosing.

5. PROTECTION AGAINST OVERVOLTAGES 9

Mechanism of lightning – Over voltage due to lightning – Protection against lightning –Protection of electrical apparatus against traveling waves – types of lightning arresters – Surge absorbers.

L = 45 T=0 P = 0 Total = 45

TEXT BOOKS

1. Ravindranath, B and Chander, N, ‘Power System Protection and Switchgear’, Wiley Eastern Ltd., 1977
2. 2.Chakrabarti.A, Soni.M.L, Gupta .P.V, Bhatnagar.U.S, “A Text Book on Power System Engineering’, Dhanpat Rai & Co. pvt. Ltd., 2002.

REFERENCES

1. Patra, S.P., Basu, S.K. and Chowduri, S., ‘Power systems Protection’, Oxford and IBH Publishing Co, 1983.
2. Sunil.S.Rao, ‘Switchgear and Protection’, Khanna Publishers, New Delhi, 1986.

BEE360	POWER ELECTRONICS LABORATORY	0	0	3	1

LIST OF EXPERIMENTS

1. SCR, MOSFET & IGBT Characteristics
2. UJT, R, RC Firing circuits for SCR.
3. SCR DC Voltage Commutated chopper.
4. SCR DC Current Commutated chopper.
5. SCR phase control circuit.
6. TRIAC phase control circuit
7. SCR half controlled & fully controlled converters.
8. SCR three phases AC regulator.
9. Speed control of DC shunt motor using three- phase fully controlled converter.
10. SCR single-phase cyclo-converter.
11. SCR series inverter.
12. SCR Parallel inverter.
13. IGBT chopper.
14. IGBT Based PWM inverter (Single Phase).

L =0 T =0 P = 45 Total = 45

BEE451	**HIGH VOLTAGE ENGINEERING**	3	0	0	3

1. OVERVOLATGES AND INSULATION COORDINATION : Natural causes of over voltages - lightning phenomena - over voltages due to switching surges - system faults and other abnormal conditions - principles of insulation co-ordination.

2. ELECTRICAL BREAKDOWN IN GASES, SOLIDS AND LIQUIDS : Classical gas laws - Ionization and decay processes – Townsend's current growth equation - secondary processes – Townsend's criterion for breakdown – Breakdown in electro negative gases - Streamer theory - Paschen's law - breakdown in non-uniform fields and corona discharges – Practical considerations in using gases for insulation purposes - Vacuum insulation. Conduction and breakdown in pure and commercial liquids. Intrinsic breakdown in solids - electromechanical breakdown - thermal breakdown - breakdown in solid and composite dielectrics.

3. GENERATION OF HIGH VOLTAGES AND HIGH CURRENTS : Generation of high DC voltage, alternating voltage, impulse voltages and impulse currents

4. MEASUREMENT OF HIGH VOLTAGE AND HIGH CURRENTS :Measurement of high voltage ac, dc and impulse voltage – CRO for impulse voltage and current measurements – Measurement of high dc, ac and impulse currents.

5. HIGH VOLTAGE TESTING : Testing of insulators and bushings – Testing of isolators and circuit breakers – Testing cables – Testing of transformers – Testing Surge Diverters.

Non-destructive testing of materials – measurement of dc resistivity, measurement of dielectric constant and loss factor – Partial discharge measurement.

L = 45 T = 0 P = 0 Total = 45

TEXT BOOKS

M.S. Naidu and V.Kamaraju, 'High Voltage Engineering', Tata McGraw Hill, 2nd Edition, 1995.

REFERENCES

1. Kuffel, E and Zaengl, W.S, 'High Voltage Engineering Fundamentals', Pargamon Press, Oxford, London, 1986.

2. Kuffel, E and Abdullah, M., 'High Voltage Engineering', Pergamon Press, Oxford, 1970.

3. Pearmain, A.J., 'High Voltage Measurement', Testing and Design, John Wiley and Sons, New York, 1982.

BEEE52	POWER SYSTEM CONTROL AND OPERATION	3	0	0	3

1. INTRODUCTION

   Need for Voltage regulation and frequency regulation in power system-system load characteristics- Basic P-f and Q-v control loops - cross coupling between control loops - Plant level and System level controls.

2. REAL POWER AND FREQUENCY CONTROL

   Fundamentals of Speed Governing mechanisms and modeling - Speed-Load characteristics-regulation of two Synchronous Machines in parallel - Control areas - LFC of single & Multi areas - Static & Dynamic Analysis of uncontrolled and controlled cases –Tie line with frequency bias control – Steady state instabilities.

3. REACTIVE POWER AND VOLAGE CONTROL

   Excitation system Modeling - Static & Dynamic Analysis - stability compensation - Effect of Generator loading – static shunt capacitor, Reactive VAR compensator, Synchronous condenser, tap changing Transformer - static VAR System Modeling - System Level Voltage control.

4. ECONOMIC DISPATCH CONTROL

   Need for Economic Dispatch-Characteristics curve for Steam and hydroelectric Units - Co-ordination Equation with Loss and without losses - Solution by Iteration method & Gradient method (no derivation of loss co-efficient) - Base point and Participation Factor.

5. UNIT COMMITMENT

   Constraints in Unit Commitment -Unit Commitment Solution methods-Priority List methods- Dynamic Programming solution – Lagrange Relaxation solution.

L=45 T=0 P=0 Total=45

TEXT BOOKS:

1. Olle I.Elgerd, ‘Electric energy and System Theory-An Introduction’, Tata McGraw hill publishing company.
2. Allen J.Wood, Bruce F.Wollenberg, ‘Power Generation system and control’ ,John wiley and sons.

REFERENCE BOOKS:

1. Kundur, ‘Power system stability and control’, McGraw hill publishing company, 1994
2. Kirchmayer L.K., ‘Economic operation of power system’, John Wiley & sons.
3. Mahalanbis, A.K.Kothari,D.P and Ahson,S.I.,’Computer Aided power system analysis and control’, Tata McGraw hill publishing company.

BEEE54	ADVANCED POWER ELECTRONIC SYSTEMS	3	0	0	3

1. REACTIVE POWER COMPENSATION 9

TSC And TCR Systems – Systems – Theory Of Load Compensation – Power Factor Improvement Using Forced Commutation Methods – Suitable Core Reactors – Control Strategies

2. CONTROL USING STATIC TAP CHANGERS 9

Conventional And Static Tap Changing Methods, Control Schemes And Comparison

3. EXCITATION CONTROL 9

Solid-State Excitation Of Synchronous Generators – Static Brushless Systems And Governor Excitation System And Control Strategies

4. UPS SYSTEMS 9

Quasi – Resonant Converters, Resonant Inverters, Parallel Redundant And Non - redundant Ups Using Resonant Power Converters, Switched Mode Power Supply.

5. OTHER APPLICATIONS 9

HVDC System, Facts, Induction Heater Control Using Phase Control And Resonant Inverters.

L=45 T=0 P=0 Total=45

Text Book:

Mohan, N., et al., “Power Electronics: Converter, Applications and Design”, John Wiley and sons, 1989.

Reference Books:

Miller, T.J.E., “Reactive Power Control in Electric systems”, Wiley Inter Science Publication 1982.

BEEE56	SOLID STATE RELAYS	3	0	0	3

UNIT 1: 9

Advantages of Static Relays – Generalized Characteristics and Operational Equations of Relays – Steady State and Transient Performance of Signal Driving Elements – Signal Mixing Techniques and Measuring Techniques – CT's and PT's in Relaying Schemes – Saturation Effects.

UNIT 2: 9

Static Relay Circuits (Using Analog and Digital IC's) for Over Current, Inverse Time Characteristics, Differential Relay and Directional Relay.

UNIT 3: 9

Static Relay Circuits for Generator Loss of Field, Under Frequency Distance Relays, Impedance, Reactance, MHO, Reverse Power Relays.

UNIT 4: 9

Static Relay Circuits for Carrier Current Protection – Steady State and Transient Behavior of Static Relays – Testing and Maintenance – Tripping Circuits using Thyristor.

UNIT 5: 9

Microprocessor Based Relays – Hardware and Software for the Measurement of Voltage, Current, Frequency, Phase Angle – Microprocessor Implementation f Over Current Relays – Inverse Time Characteristics – Impedance Relay – Directional Relay – MHO Relay.

L=45 T=0 P=0 Total=45

Text Books:

1. Badriram and Vishwakarma D.N., Power System Protection and Switchgear, Tata McGraw Hill, New Delhi, 1995.
2. Rao T.S.M., Power System Protection – Static Relays, McGraw Hill, 1979.

Reference Books:

1. Van C.Warrington, “Protection Relays – Their Theory and Practice”, Chapman and Hall.
2. Ravindranath B. and Chander M., “Power System Protection and Switchgear”, Wiley Eastern, 1992.
3. Russel C.Mason, “The Art and Science of Protective relays”.

BEEE58	NEURAL NETWORKS	3	0	0	3

1. INTRODUCTION TO ARTIFICIAL NEURAL NETWORKS 9

Neuro – physiology – General Processing Element – ADALINE – LMS learning rule – MADALINE – Perceptron.

2. BPN AND BAM 9

Back Propagation Network – Updating of output and hidden layer weights – Application of BPN – Associative memory – Bi-directional Associative Memory - Hop field memory – Traveling sales man problem.

3. SIMULATED ANNEALING AND CPN 9

Annealing, Boltzmann machine – Learning – Application – Counter Propagation network – Architecture – Training – Application.

4. SOM AND ART 9

Self-organizing map – Learning algorithm – Feature map classifier – Applications – Architecture of Adaptive Resonance theory – ART1 and ART2.

5. CASE STUDY: 9

1. Implementation of BPN algorithm in a computer language
2. Application of Neural Networks for Pattern recognition, data compression
3. Hop field networks for an n bit A/D converter

L = 45 T=0 P = 0 Total = 45

Reference Books:

1. J.A. Freeman and B.M. Skapura, “Neural Networks, Algorithms Applications and Programming Techniques”, Addison-Wesley, 1990.
2. Laurence Fausett, “Fundamentals of Neural Networks: Architecture, Algorithms and Applications”, Prentice Hall, 1994.

BEEE60	ADVANCED CONTROL THEORY	3	1	0	4

Unit 1: 9

Linear system design- Introduction of Compensating networks - Lag, lead Compensation –Feedback compensation – P, PI, PID controllers – Design using Bode plot and root locus techniques.

Unit 2: 9

State space analysis - State space formulation -State variables - Phase variables and Canonical variables - State space models from differential equations - State transition matrix- - Eigen values and Eigen vectors-Diagonalisation -Canonical and Jordan forms

Unit 3: 9

Controllability and Observability - Pole placement - Design of feedback controllers - Full and reduced order observers.

Unit 4: 9

Sampled data system – sampling process – Analysis of sampling process – frequency domain – reconstruction of sampled signals – hold circuits – Z and inverse Z transform – mapping between s and z planes – pulse transfer function – step response – stability analysis.

Unit 5: 9

Non-linear systems –Properties of Non Linear system – Jump Resonance - Phase Plane method - Singular points – Construction of Phase Trajectories - System analysis by Phase Plane method - Describing function method - Describing function of Non-linear systems - Stability analysis by Describing function method - Liapunov's stability criteria.

L=45 T=15 P=0 Total=45

TEXT BOOK:

Nagrath.I.J and Gopal.M, “Control system Engineering”, 2nd Edition, Wiley Eastern,1995.

REFERENCE BOOKS:

1. M.Gopal, “Digital Control & State Variable methods”, TMH, 1997
2. Ogata, “Modern Control Engineering”, TMH, 1997.

BEEE62	ELECTRICAL DRIVES & CONTROL	3	1	0	4

1. DRIVE CHARACTERISTICS 9

Mechanical characteristics - constant torque and constant HP operations – Multi-quadrant operation – Drive specifications - Rating of motors – selection of drives.

2. DC DRIVES 9

Single phase and three-phase converter fed drives – continuous and discontinuous conduction modes – chopper fed drives - four-quadrant operation – closed loop drive system.

3. STATOR CONTROLLED INDUCTION MOTOR DRIVES 9

Variable terminal voltage control – Variable frequency control – V/f control - AC voltage controllers – Four-quadrant control and closed loop operation - Frequency controlled drives- VSI and CSI fed drives – closed loop control.

4. ROTOR CONTROLLED INDUCTION MOTOR DRIVES 9

Rotor resistance control – slip power recovery schemes - sub synchronous and super synchronous operations – closed loop control – Braking in induction motors.

5. SYNCHRONOUS MOTOR DRIVES 9

Wound field cylindrical rotor motor – operation from constant voltage and frequency source – operation from current source – operation from constant frequency – Brushless excitation – Permanent magnet synchronous motor.

Self-controlled Synchronous motor drives – Brushless dc and ac motor drives – CSI with load commutation – Cycloconverter with load commutation.

L = 45 T=15 P = 0 Total = 60

TEXT BOOK:

Dubey. G.K., “Power Semiconductor Controlled Drives”, Prentice Hall International, 1989.

REFERENCES:

1. Vedam Subrahmanyam, “Electric drives concepts and applications”, TMH Pub. Co.Ltd., 1994.
2. Murphy, J.M.D and Turnbull.F.G. , “Thyristor control of AC Motors”, Pergamon Press, 1988.
3. Sen. P.C., “Thyristor D.C. Drives”, John Wiley and Sons, 1981.
4. B. K.Bose, “ Modern Power Electronics and AC Drives”, Prentice Hall Onglewood cliffs, New Jersey, 2002.

BEEE64	SPECIAL ELECTRICAL MACHINES	3	0	0	3

1. SYNCHRONOUS RELUCTANCE MOTORS 9

Constructional Features – Types – Axial and Radial Air Gap Motors – Operating Principle – Reluctance – Phasor Diagram – Characteristics – Vernier Motor

2. STEPPING MOTORS 9

Constructional Features – Principle of Operation – Variable Reluctance Motor – Hybrid Motor – Single and Multi Stack Configurations – Theory of Torque Predictions – Linear and Non-linear Analysis – Characteristics – Drive Circuits.

3. SWITCHED RELUCANCE MOTORS 9

Constructional Features – Principle of Operation – Torque Prediction – Power Controllers – Nonlinear Analysis – Microprocessor Based Control – Characteristics – Computer Control.

4. PERMANENT MAGNET BRUSHLESS D.C MOTORS 9

Principle of Operation – Types – Magnetic Circuit Analysis – EMF and Torque Equations – Power Controllers – Motor Characteristics and Control.

5. PERMANENT MAGNET SYNCHRONOUS MOTORS 9

Principle of Operation – EMF and Torque Equations – Reactance – Phasor Diagram – Motor Controllers – Converters – Volt-amp Requirements – Torque Speed Characteristics – Microprocessor Based Control.

L=45 T=0 P=0 Total=45

Text Books:

1. Miller,T.J.E., ‘Brushless Permanent Magnet and Reluctance Motor and Drives’, Clarendon Press, Oxford, 1989.
2. Aearnley, P.P., ‘Stepping Motors – A Guide to Motor Theory and Practice’, Peter Perengrinus, London, 1982.

Reference Books:

1. Kenjo, T., ‘Stepping Motors and their Microprocessor controls,’ Clarendon Press, London, 1984.2.
2. Kenjo, T., and Nagamori, S., ‘Brushless Permanent Magnet and DC Motors’, Clarendon Press, London, 1988.

BEEE66	FUZZY LOGIC	3	0	0	3

1. INTRODUCTION TO FUZZY SETS 5

Crispness – Vagueness - Fuzziness - Uncertainty -Fuzzy Set Theory.

2. FUZZY MATHEMATICS 10

Fuzzy Set - Basic definition-Extension Fuzzy Measures - Measures of Fuzziness-The extension principles and applications.

3. FUZZY THEORY 10

Fuzzy Relations - Fuzzy graphs-Fuzzy analysis- Probability Theory-Possibility Theory-Fuzzy Set Theory.

4. FUZZY APPLICATIONS 10

Fuzzy Logic and Approximate Reasoning Expert System and Fuzzy Control-Pattern Recognition.

5. FUZZY APPLICATIONS IN POWER SYSTEMS 10

Decision making in power system control through Fuzzy set theory-Use of Fuzzy set Nodels of LP in power systems Scheduling Problems.

L=45 T=0 P=0 Total=45

Text Book:

Zimmermann, H.J., “Fuzzy Set Theory and its Applications”, 2nd Edition, Kluwer Academic Publishers.

Reference book:

George Klir &Tina. A. Folger, “Fuzzy Sets, Uncertainity and Information”, Prentice Hall of India Private Ltd.

BEEE51	**UTILIZATION OF ELECTRICAL ENERGY**	3	0	0	3

1. ELECTRIC LIGHTING

Production of light – Definition of terms – Lighting calculations – Types of lamps – Interior and Exterior illumination systems – Lighting schemes – Design of Lighting schemes – Factory lighting – Flood lighting – Energy saving measures.

2. ELECTRIC HEATING

Resistance heating – Induction heating – Dielectric heating – Arc furnace – Control equipment, efficiency, and losses – Energy conservation in Arc Furnace Industry.

3. ELECTRIC WELDING

Welding equipment – Characteristics of carbon and metallic arc welding – Butt welding – Spot welding – Energy conservation in welding.

4. ELECTRIC VEHICLE

Railway electrification – Definition and analysis of Traction effort – Speed ~ Time curve – Traction motors – Battery driven vehicles – Energy efficiency drives – Advanced speed control measures.

5. ELECTRO CHEMICAL PROCESS

Electrolysis – Electroplating – Electro deposition – Extraction of metals – Current, efficiency – Batteries – Types – Charging methods.

L = 45 T=0 P = 0 Total = 45

Text Books:

1. Tripathy,S.C., “Electric Energy Utilization & Conservation” – Tata McGraw Hill Publishing Company.
2. Uppal,S.L., “Electric Power”, Khanna Publishers.
3. Soni,M.L., P.V.Gupta & Bhatnagar , “A course in Electric Power”, Dhanpat Rai & Sons.

Reference Books:

1. Partab,H., “Art & Science Utilization of Electrical Energy” – Dhanpat Rai & Sons.
2. Wadhwa,C.L., “Generation, Utilization & Distribution” - Wilsey Eastern Ltd.
3. Suryanarayana,N.V., “Utilization of Electric Power” - Wilsey Eastern Ltd.

BEEE53	MICROCONTROLLER AND ITS APPLICATIONS	3	0	0	3

UNIT – I 9

Intel 8051 Architecture – Hardware – I/O ports – External Memory – Counters and Timer – Serial data I/O – Interrupts, Assembly language, Addressing modes, Instruction Set - Simple programs, 8051 interfacing to LCD, ADC, DAC and Stepper Motors.

UNIT- II 9

Motorola 68HC11 Architecture – Input / Output ports – Resets and self-protection – Interrupt Timing – A/D and D/A converters.

UNIT – III 9

Intel 8096 CPU Structure – Register file – Assembly Language – Addressing modes – Instruction set – simple programs.

UNIT – IV 9

Interrupt structure – Programmable timers – Real time clock latency – Interrupt density and Interval consideration, shared resources and critical regions.

UNIT – V 9

SOFTWARE AND EXPANSION METHODS

Queues – Table and Strings – Program organization – State machines – Key switch parsing – Timing consideration – UART ports – I/P O/P Serial ports programmable controllers.

L = 45 T=0 P = 0 Total = 45

Reference Books:

1. Kenneth J.Ayala, “The 8051 Microcontroller Architecture, Programming & Applications”, Penram International publishing (India), Second Edition, 1996.
2. Muhammed Ali Mazidi, Janice Gillies Pie Mazidi, “The 8051 Microcontroller and Embedded Systems”, Pearson Education Asia.

3. Peatman J.B, “Design with Microcontrollers”, McGraw Hill Book International Ltd, Singapore, 1989.
4. Intel Manual on 16 – bit “Embedded controllers”, Santa Clara, 1991.

BEEE55	PRINCIPLES OF ROBOTICS	3	0	0	3

1. Introduction to Robotics 9

Automation and Robotics – Robot Anatomy – Classification of Robots by Configuration and Control – Basic Components of robots System - Manipulators, Wrists, End Effectors, Power, Control Units – Robot Sensors, Force Sensors - Introduction to AI – Legged Locomotion.

2. Robot Motion Analysis and Control 9

Introduction to Manipulator Kinematics – Homogeneous Transformation and Robot Kinematics – Robot Dynamics – Manipulator Path Controller – Configuration of a Robot Controller – Control of a Robot Joint.

3. Robot Drive Systems 9

Introduction to Robot drives – Electric, Hydraulic and Pneumatic – Electrical Actuators – Stepper Motors, Stepper Motor Drives, Linear Stepper Motors, Brushless DC Motors, Direct Drive Actuators – Hydraulic Actuators – Pneumatic drives – Servo Amplifiers.

4. Machine Vision for Robotics 9

Introduction to machine vision – image Acquisition – Illumination Techniques – Imaging Geometry – Some Basic Relationship between Pixels – Analog to Digital Signal conversion –Image Storage – Image Processing and Analysis, Preprocessing, Segmentation, Feature Extractions, Recognition, Interpretation.

5. Robot programming and Applications 9

Methods of Robot programming – Lead through Programming Methods – A robot Program as a Path in space – Motion Interpolation – Weight, Signal and Delay Commands – Branching Capabilities – Robot Programming Examples for Pick and Place Application using VAL – Application of Robots in Material Handing, Processing operations, Assembly and Inspections – Future Applications of Robots.

L = 45 T=0 P = 0 Total = 45

Textbooks:

1. Richard D.Klaffer, Thomas A. Chimelewski,Michael Negain, ‘Robotic Engineering –An Integrated Approach’, PHI Pvt Ltd, 1989.
2. Mikell P.Groover, Michel Wein Roger Nagel and Nicholas G.Ordy, ‘Industrial Robotics, Technology, Programming and Applications’, McGraw Hill, 1987.

Reference Books:

1. B.Siciliano, ‘Modeling and Control of Robot Manipulators, Tata McGraw-Hill, 1996.
2. M.W.Spong and W.Vidyasagar, ‘Robot Dynamics and Control’, John Wiley and Sons, 1989.
3. J.J.Graig, ‘Introduction to Robotics, Mechanics and Control’, Addison Wesley Publishers, 1989.

BEEE57	COMPUTER AIDED DESIGN OF ELECTRICAL MACHINES	3	0	0	3

1. Introduction: 6

   Conventional design procedures –Limitations - Need for analysis based design.

2. Mathematical formulation of Field problems: 12

   Development of torques / forces- Electromagnetic Field Equations – Magnetic Vector/Scalar potential –Electrical Vector /Scalar potential – Stored energy in field problems- Inductances- Lap lace and Poisson's Equations –Energy functional – Principle of energy conversion.

3. Philosophy of FEM: 9

   Mathematical Models – Differential / Integral equations – Finite Difference method – Finite Element Method – Energy minimization – Variation method – 2D Field problems – Discretisation – Shape functions – Stiffness matrix – Solution techniques.

4. CAD Packages: 9

   Elements of a CAD System – Preprocessing – Modeling – Meshing – Material Properties – Boundary Conditions – Setting up solution – Post-processing.

5. Design Applications: 9

   Design of Solenoid Actuator – Induction motor – Switched Reluctance Motor – Synchronous Machines.

L=45 T=0 P=0 Total=45

Reference Books:

1. Silvester and Ferrani, "Finite Elements of Electrical Engineers", Cambridge University press, 1983.
2. S.R.H.Hoole , "Computer – Aided, Analysis and Design of Electromagnetic Devices", Elsevier, New York, Amsterdam, London , 1989.

3. D.A Lowther and P.P Silvester, “Computer Aided Design in Magnetics”, Springer Verlag, New York, 1956.
4. S.J Salon, “ Finite Element Analysis of Electrical Machines”, Kulwer Academic Publishers, London, 1995.
5. C.W.Trowbridge, “An Introduction to Computer aided Electromagnetic Analysis”, Vector Field Ltd.
6. User Manuals of MAGNET, MAXWELL& ANAYS, Software Packages.

BEEE59	POWER PLANT INSTRUMENTATION	3	0	0	3

1. OVERVIEW OF POWER GENERATION 9

Brief survey of methods of power generation-hydro, thermal, nuclear, solar and wind power – importance of instrumentation in power generation – thermal power plants – building blocks – details of boiler processes ÛP & I diagram of boiler –cogeneration.

2. MEASUREMENTS IN POWER PLANTS 9

Electrical measurements – current, voltage, power, frequency, power-factor etc., non-electrical parameters – flow of feed water, fuel, air and steam with correction factor for temperature – steam pressure and steam temperature-drum level measurement – radiation detector – smoke density measurement – dust monitor.

3. ANALYZERS IN POWER PLANTS 9

Flue gas oxygen analyzer – analysis of impurities in feed water and steam – dissolved oxygen analyzer – chromatography – PH meter-fuel analyzer – pollution monitoring instruments.

4. CONTROL LOOPS IN BOILER 9

Combustion control – air/fuel ratio control – furnace draft control – drum level control – main steam and reheat steam temperature control – super heater control – attemperator – deaerator control – distributed control system in power plants-interlocks in boiler operation.

5. TURBINE-MONITORING AND CONTROL 9

Speed, Vibration, shell temperature monitoring and control-steam pressure control – lubricant oil temperature control – cooling system.

L=45 T=0 P=0 Total=45

TEXT BOOKS

1. Sam G. Dukelow, “The control of Boilers”, Instrument Society of America, 1991.
2. “Modern Power Station Practice”, Vol.6, Instrumentation, Controls and Testing, Pergamon Press, Oxford, 1971.

REFERENCES

1. Elonka, S.M.and Kohal A.L. “Standard Boiler Operations”, McGraw Hill, New Delhi, 1994.
2. R.K.Jain, “Mechanical and industrial Measurements”, Khanna Publishers, New Delhi, 1995.

BEEE61	INTELLIGENT CONTROLLERS	3	0	0	3

1. Introduction 9

Fuzzy Logic and neural networks in the control of AC drives – Artificial intelligence and expert systems theory in the control of drives and Power electronic converters like UPS.

2. Vector control of AC drives 9

A Review –Traditional Phasors – AC motor equation – space phasors and analysis of AC motors – A short review of inverters for the control of AC motors.

3. Robust control techniques 9

Introduction to Robust control – Robust servo control – Linear and nonlinear – Adaptive control – MRAC – Self tuning control.

4. Robust AC drive control 9

Introduction – Control methods – Observe for robust control – Speed observer – Speed sensor less operation – Neuro-observer – Fuzzy robust control self tuning Fuzzy controllers - Stability considerations.

5. Soft computing applied to intelligent control of AC drives 9

Introduction – Soft computing – Neuro, fuzzy algorithms and their combination in the control and diagnosis of AC drives – PE systems intelligent control – Sensor failure detection using Neuro and fuzzy – Hardware for soft computing.

L=45 T=0 P=0 Total=45

Text Books:

Bimal.K.Sen, ‘ Modern Power Electronics and AC Drives’, Pearson publications,2002.

Reference Books:

1. Yashiko Dote and RG Hoft, “Intelligent control power Electronic Systems”, Oxford University press, 1998.
2. Vedam Subrahmanyam, “Thyristor control of electric drives”, TMH, 1988.
3. Vedam Subrahmanyam, “Electric Drives – Concepts and Applications”,

BEEE63	BIOMEDICAL INSTRUMENTATION	3	0	0	3

1. BASIC PHYSIOLOGY: 9

   Cells and their structures – Transport of ions through cell membrane – Resting and excited state – Tran membrane potential – Action potential – Bio-electric potential – Nervous system – Physiology of muscles – Heart and blood circulation – Respiratory system – Urinary system.

2. BASIC TRANSDUCER PRINCIPLES AND ELECTRODES: 9

   Transducer principles - Active transducers - Passive transducers -Transducer for Bio-medical application - Electrode theory- Bio-potential electrode - Bio - chemical transducer.

3. CARDIOVASCULAR SYSTEM 9

   The heart and cardiovascular system – Blood pressure – Characteristics of blood flow – Heart sounds - Electro cardiography – Measurements of blood pressure – Measurement of blood flow and cardiac O/P Plethysmography – Measurements of heart sounds.

4. X-RAY AND RADIOISOTOPE INSTRUMENTATION: 9

   X-ray imaging radiography – Fluoroscopy – Image intensifiers – Angiography - Medical use of radioisotopes – Beta radiations – Detectors – Radiation therapy.

5. BIO-TELEMETRY: 9

   Introduction to biotelemetry – Physiological parameters adaptable to biotelemetry – the components of biotelemetry systems – Implantable units – Applications of telemetry in patient care – Application of computer in Bio-medical instrumentation, Anatomy of Nervous system – Measurement from the nervous system – EEG – EMG.

L = 45 T=0 P = 0 Total = 45

Reference Books:

1. Lesis Cromwell Fred, J.Werbell and Erich A.Pfraffer, Biomedical instrumentation and Measurements – Prentice Hall of India, 1990.
2. M.Arumugam, Bio-medical Instrumentation – Anuradha Agencies Publishers, 1992.
3. Khandpur, Handbook on Biomedical Instrumentation – Tata McGraw Hill Co Ltd., 1989.

BEEE65	**NON-CONVENTIONAL ENERGY SOURCES**	3	0	0	3

UNIT I

General: primary and commercial energy sources – study of availability, energy consumption pattern and growth rate in India .Non commercial energy sources – Availability, Economics, and efficiency.

UNIT II

Solar energy and applications: Solar radiation – principles of solar energy collection – types of collector – characteristics and principles of different types of collector and their efficiencies - Solar energy applications – Water heaters, air heaters, solar cooling, solar drying and power generation – Solar tower concept (solar plant) – solar pump.

UNIT III

Wind energy: Energy from the wind – General theory of wind mills – types of wind mills – performance of wind machines – wind power - efficiency.

UNIT IV

Tidal energy: Energy from tides and waves – working principles of tidal plants – tidal power generations – geothermal energy – principle of working of geothermal power plants.

UNIT V

Bio – energy: Energy from Bio – mass – Biogas plants – various types – Industrial wastes – municipal waste – Burning plants – Energy from the Agricultural wastes – Applications.

L = 45 T=0 P = 0 Total = 45

REFERENCE BOOKS:

1. S.P.Sukhatme, Solar Energy; (Principles of thermal collection and storage), Tats McGraw Hill Publishers, Fourth Print – February 1989.

2. G D Rai, Solar Energy Utilisation, Khanna Publishers, Second revised edition, 1984.
3. Ronald Shaw, Wave Energy; (A Design Challenge), Ellis Horwood Limited publishers, First edition, 1982.
4. Putnam, Energy from the wind, Prentice Hall of India.