Dr.M.G.R.
EDUCATIONAL AND RESEARCH INSTITUTE
UNIVERSITY
(Decl. U/S 3 of UGC Act 1956)
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

B.Tech –Electrical and Electronics Engineering (Part Time)
Curriculum and Syllabus
2013 Regulation

I SEMESTER						
S.No	**Sub.Code**	**Title of Subject**	**L**	**T**	**P**	**C**
1	BMA13023	Mathematics I for Electrical and Electronics engineers	3	2	0	4
2	BME13043	Thermodynamics and Heat Transfer Systems	2	2	0	3
3	BEE13006	Electron Devices and Circuits	3	0	0	3
4	BEE13007	Electromagnetic Field Theory and Applications	2	0	2	3
		Total	**10**	**4**	**2**	**13**

II SEMESTER						
S.No	**Sub.Code**	**Title of Subject**	**L**	**T**	**P**	**C**
1	BMA13026	Mathematics II for Electrical and Electronics Engineers	3	2	0	4
2	BEE13011	DC Machines and Transformers	3	2	0	4
3	BCS13035	Object Oriented Programming and Data Structures	3	0	0	3
4	BEE13012	Computer Aided Electrical Circuits and Networks[@]	3	0	2	4
5	BEE13L01	Electrical Machines Laboratory	0	0	2	1
		Total	**12**	**4**	**4**	**16**

III SEMESTER						
S.No	**Sub.Code**	**Title of Subject**	**L**	**T**	**P**	**C**
1	BEE13013	AC and Special Machines	3	2	0	4
2	BEE13014	Introduction to Nano and Digital Electronics	3	2	0	4
3	BEE13015	Electrical and Electronics Measurements	3	0	0	3
4	BEE13020	Microprocessor And Microcontroller	3	2	0	4
5	BEC13L25	Electronics Laboratory	0	0	2	1
		Total	**12**	**6**	**2**	**16**

IV SEMESTER						
S.No	**Sub.Code**	**Title of Subject**	**L**	**T**	**P**	**C**
1	BEC13035	VLSI and Linear Integrated Circuits	3	0	0	3
2	BEE13016	Power Generation and Transmission System	3	0	0	3
3	BEE13017	Control Systems	3	2	0	4
4	BEE13018	Design Of Electrical Machines[@]	2	2	2	4
5	BEE13L03	Measurement and Control Lab	0	0	2	1
		Total	**11**	**4**	**4**	**15**

V SEMESTER						
S.No	**Sub.Code**	**Title of Subject**	**L**	**T**	**P**	**C**
1	BEE13023	Computer Aided Power System Analysis	3	2	0	4
2	BEE13021	Power Electronics	3	2	0	4
3	BEE13019	Power System Protection And Switchgear	3	0	0	3
4	BEE13EXX	Elective-I	3	0	0	3
5	BEE13L05	Power Electronics Laboratory	0	0	2	1
		Total	**12**	**4**	**2**	**15**

VI SEMESTER						
S.No	**Sub.Code**	**Title of Subject**	**L**	**T**	**P**	**C**
1	BEE13028	Electrical Energy Utilization and Conservation	3	0	0	3
2	BEE13026	Power System Operation And Control	3	2	0	4
3	BEE13025	Power Distribution System	3	2	0	4
4	BEE13EXX	Elective-II	2	0	2	3
		Total	**11**	**4**	**2**	**14**

VII SEMESTER						
S.No	**Sub.Code**	**Title of Subject**	**L**	**T**	**P**	**C**
1	BEE13022	Wind Energy Conversion Systems	3	0	0	3
2	BEE13EXX	Elective-III	3	0	0	3
3	BEE13L12	Project Work	0	0	20	10
		Total	**6**	**0**	**20**	**16**

Summary of Credits:

1st Semester Credits	**13**
2nd Semester Credits	**16**
3rd Semester Credits	**16**
4th Semester Credits	**15**
5th Semester Credits	**15**
6th Semester Credits	**14**
7th Semester Credits	**16**
Total	**105**

Elective-I						
S.No	**Sub.Code**	**Title of Subject**	**L**	**T**	**P**	**C**
1	BEE13E01	Introduction on AI Applications to Electrical Engineering	2	0	2	3
2	BEC13E37	Advanced Digital Signal Processing	3	0	0	3
3	BEE13E02	Power plant Instrumentation	3	0	0	3
4	BEE13E03	HVDC Transmission	3	0	0	3

Elective-II						
S.No	**Sub.Code**	**Title of Subject**	**L**	**T**	**P**	**C**
1	BEE13E04	Mechatronics	3	0	0	3
2	BEE13E05	Flexible AC Transmission System	3	0	0	3
3	BCS13E49	Genetic Algorithms and its Applications	2	0	2	3
4	BEE13E06	Industrial Instrumentation.	3	0	0	3

Elective-III						
S.No	**Sub.Code**	**Title of Subject**	**L**	**T**	**P**	**C**
1	BME13E31	Principles of Robotics	3	0	0	3
2	BEE13E07	Fuzzy Logic and its applications	2	0	2	3
3	BEE13E08	Electric Traction	3	0	0	3
4	BEE13E09	Non-Conventional Sources of Energy	3	0	0	3

The @ indicates the Final Examination will be conducted internally by the Department which includes internal examination, execution of Simulation Studies , Proto type model design implementation, Case study report and analysis , etc, respective to the different subject.

Internal Examination Procedure: The end semester examination will be conducted in the department with both theory and practical. The theory exam will be conducted for 50 marks with the question pattern as like as to check the creativity of the brain. The practical exam will be conducted for 50 marks to check the programming or simulation skill of the student

BMA13023 MATHEMATICS I FOR ELECTRICAL AND ELECTRONICS ENGINEERS 3 2 0 4

OBJECTIVE:

- Ability to solve problems in Electrical Machines, Control System etc.
- Capable to apply transformation techniques in Power Sector Industries.

UNIT I: Algebra **12 Hours**

Binomial, Exponential, Logarithmic Series (without proof of theorems) – Problems on Summation, Approximation and Coefficients.

UNIT II: Matrices **12 Hours**

Characteristic equation – Eigen values and Eigen vectors of a real matrix – Properties of Eigen values – Cayley - Hamilton theorem (without proof) – Orthogonal reduction of a symmetric matrix to Diagonal form.

UNIT III: Trigonometry **12 Hours**

Expansions of Sin n θ, Cos n θ, in powers of Sin θ,. and Cos θ,. – Expansion of Tann θ . – Expansions of $\sin^n \theta$ and $\cos^n \theta$. in terms of Sines and Cosines of multiples of θ. – Hyperbolic functions –Separation into real and imaginary parts.

UNIT IV :Laplace Transforms I **12 Hours**

Transforms of simple functions – Properties of Transforms – Inverse Transforms – Transforms of Derivatives and Integrals.

UNIT V: Laplace Transforms II **12 Hours**

Periodic functions – Initial and final value theorems – Convolution theorem – Applications of Laplace transforms for solving linear ordinary differential equations up to second order with constant coefficients.

Total no. of Hours: 60

Text Books :

1. Veerarajan, T.(2007) *Engineering Mathematics (for first year)*, Tata McGraw Hill Publishing Co.

Reference Books :

1. Kreyszig, E.(2011) *Advanced Engineering Mathematics* .9th Ed.John Wiley & Sons.
2. Grewal, B.S.(2012) *Higher Engineering Mathematics*. Khanna Publishers.
3. John Bird,(2006) *Higher Engineering Mathematics*.5th Ed. Elsevier Ltd.

BME13043 THERMODYNAMICS AND HEAT TRANSFER SYSTEMS 2 2 0 3

OBJECTIVES:

- Understand the basic Laws of Thermodynamics and the working principle of IC Engines.
- Understand the design of Turbines and boilers.
- Understand the properties of Fluids and implementation of Hydraulic machinery & Pumps.

UNIT I: Basic Concepts and First Law Of Thermodynamics **9 hours**

Thermodynamics systems, Concepts of continuum, Thermodynamics properties, Equilibrium, Process, Cycle, Work, Heat, Temperature, Zeroth law of thermodynamics. First law of thermodynamics – Applications to closed and open systems – Steady flow Energy Equations – Simple Problems

UNIT II : Second Law Of Thermodynamics **9 hours**

Statements, Reversibility, Causes of irreversibility, Carnot Cycle, Reversed Carnot Cycle, Heat Engines, Refrigerators, Heat Pumps - Clausius Inequality – Entropy - Principles of increase of entropy - Carnot theorem.

UNIT III: Working Fluids **9 hours**

Thermodynamic properties of pure substance, Property diagrams. PVT surface of water and other substances, calculation of properties - First law and second law analysis using tables and charts. Properties of ideal and real gases, Equation of state, Gas laws - Vanderwal's equation of states - Daltons law of partial pressures, Internal Energy, enthalpy, Specific heat and molecular weight of gas mixtures.

UNIT IV: Power Cycles **9 hours**

Air cycles – Assumptions - Otto, Diesel, Dual and Brayton cycle – Air standard efficiency – Mean effective pressure – Working of two stroke and Four Stroke Petrol and Diesel Engines.

UNIT V: Heat Transfer **9 hours**

Introduction to heat transfer, Modes of Heat Transfer - Simple problems involving various modes of Heat Transfer - One dimensional steady state conduction across plane wall-composite wall- composite cylinder with convection boundaries - Hydrodynamic & Thermal Boundary Layer Principles -external flows over a flat plate – Internal flow through pipes – Simple problems only.

Tutorials=15
Total No. of Hours: 45

Text Books

1. Nag, P.K. *Engineering Thermodynamics*. 2nd Ed. New Delhi: Tata McGraw Hill Publishing Company Ltd.
2. Sachdeva, R.C. (1998) *Fundamentals of Heat and Mass Transfer*. New age International (p) Ltd.

References

1. Holman, J.P. (1995) *Thermodynamics*. McGraw Hill.
2. Yunus A. Cengel, *Thermodynamics-An Engineering Approach.* Tata Mc.Graw Hill.
3. Holman, J. P. *Heat transfer*. McGraw Hill Book Company.
4. Ozisik, N.M. *Heat transfer*. McGraw Hill Book Company.

BEE13006 ELECTRON DEVICES AND CIRCUITS 3 0 0 3

OBJECTIVES:

- The student will develop skills in the basics of the Electronic devices.
- Capable of identify the components and design the circuits.
- Incorporate the circuits with the software like PSPICE and interpret the results.

UNIT I: Semiconductor Diode **9 hours**

Theory of p-n junction – p-n junction as diode – p-n diode currents – Volt-ampere characteristics – Diode resistance – Temperature effect of p-n junction – Transition and diffusion capacitance of p-n diode – Diode switching times- Zener Diode- VI Characteristics.

UNIT II: Bipolar Transistor **9 hours**

Junction transistor – Transistor construction – Detailed study of currents in transistor – Input and output characteristics of CE, CB and CC configurations – Transistor hybrid model for CE configuration – Analytical expressions for transistor characteristics – Transistor switching times – Voltage rating.

UNIT III: Field Effect Transistors **9 hours**

Junction field effect transistor – Pinch off voltage – JFET volt-ampere characteristics – JFET small signal model – MOSFETS and their characteristics – FET as a variable resistor – Unijunction transistor.

UNIT IV: Opto Electronic Devices **9 hours**

Photo emissivity and photo Electric theory – Theory, construction and characteristics: light emitting diodes, liquid crystal cell, seven segment display, photo conductive cell, photodiode, solar cell, photo transistor.

UNIT V: Miscellaneous Devices **9 hours**

Theory, characteristics and application: SCR, TRIAC, DIAC, tunnel diode, thermistors, piezo electric devices, charge coupled devices, varactor diode and LDR.

Total No. of Hours: 45

Text Books

1. Jacob Millman, Christos, C. Halkias, (2003) *Electronic Devices and Circuits*. New Delhi: Tata McGraw Hill Publishing Limited.
2. David, A. Bell,(2003) *Electronic Devices and Circuits.* New Delhi: Prentice Hall of India Private Limited.

References

1. Theodre, F. Boghert,(2003) *Electronic Devices & Circuits*.6th Ed. Pearson Education.
2. Ben G. Streetman, Sanjay Banerjee,(2002) *Solid State Electronic Devices.* Pearson Education.PHI.
3. Allen Mottershead, (2003) *Electronic Devices and Circuits – An Introduction*. New Delhi: Prentice Hall of India Private Limited.

BEE13007 ELECTROMAGNETIC FIELD THEORY AND APPLICATIONS 2 0 2 3

OBJECTIVES:

- Graduate is capable of understanding the vector field concepts and the coordinated systems.
- Familiarity to Divergence, Curl and various laws & theorems such as Gauss law, Divergence theorem, Stroke's theorem etc.
- Familiarity to magnetic field and Electromagnetic fields.

UNIT I : Electrostatic Field **9 hours**

Introduction - Concepts of different co-ordinate systems - Gauss law – Coulomb's law – Electric field intensity – Electric flux density -electric fields due to point, line, surface and volume charge distributions – Application of Gauss Law - Electric potential – potential gradient –Poisson's and Laplace equations.

UNIT II :Electrostatic Applications **9 hours**

Field due to dipoles – Dipole moment – Current and Current density Boundary conditions at dielectric and conductor surfaces – Capacitor and capacitance of a system of conductors – Energy stored and energy density – Capacitance due to Spherical shell, Coaxial cable– Electrostatic potential energy–Applications.

UNIT III : Magnetostatics **9 hours**

Introduction to Magnetic materials- Magnetic field intensity- Magnetic flux density (B) – B in free space, conductor, magnetic materials. Magnetization and Permeability – Boundary conditions- Lorentz Law of force,– Biot – Savart Law – Ampere's Law –Magnetic field due to straight conductors, circular loop, infinite sheet of current – Scalar and vector potential – Magnetic force – Torque – Inductance – Energy density – Magnetic circuits – Applications.

UNIT IV: Electrodynamic Fields **9hours**

Faraday's law, induced EMF – transformer and motional EMF, Maxwell's equations (differential and integral forms)- Displacement current – Applications - Relation between field theory and circuit theory.

UNIT V: Electromagnetic Fields and Wave Propagation **9 hours**

Generation – electromagnetic wave equations – Wave parameters- velocity, intrinsic impedance, propagation constant – Wave propagation in free space, lossy and lossless dielectrics, conductors – skin depth, Poynting vector – Plane wave reflection and refraction – Applications

Practicals-15
Total No of hours: 45

Text Books

1. William Hayt, (2005) *Engineering Electromagnetics*.7th Ed. New York: McGraw Hill.
2. Matthew. N.O. Sadiku, (2007) *Elements of Electromagnetics*.4th Ed. First Indian Edition. Oxford University Press.
3. Ashutosh Pramanik, (2006) *Electromagnetism – theory and application*. New Delhi: Prentice Hall of India Private Ltd.

References

1. David K. Cheng, (2004) *Field and Wave Electromagnetics*.2nd Ed. Pearson Education.
2. William H. Hayt Jr, John A. Buck, (2006) *Engineering Electromagnetics*.7th Ed. New Delhi:Tata McGraw Hill Publishing Company Ltd.
3. Edminister, J.A. Schaum's, (2006) *Theory and problems of Electromagnetics*.2nd Ed. Special Indian Edition. Tata McGraw hill.

BMA13026 MATHEMATICS II FOR ELECTRICAL AND ELECTRONICS ENGINEERS 3 2 0 4

OBJECTIVES:

- Ability to solve problems in Electromagnetic fields,Digital signal processing etc.
- Capable to apply transformation techniques in frequency domain using suitable equations and transform pairs..

UNIT I MULTIPLE INTEGRALS **12 Hours**

Double integral in Cartesian and Polar Co-ordinates – Change of order of integration – Triple integral in artesian Co-ordinates – Spherical Polar Co-ordinates – Change of variables (simple problems).

UNIT II VECTOR CALCULUS **12 Hours**

Scalar and Vector functions – Differentiation – Gradient, Divergence and Curl – Directional derivatives – Irrotational and Solenoidal fields– Line, Surface and Volume integrals – Green's, Stroke's and Gauss divergence theorems (statement only) – Verification.

UNIT III PARTIAL DIFFERENTIAL EQUATIONS **12 Hours**

Formation of PDE by eliminating arbitrary constants and eliminating arbitrary functions – Solutions of standard types of first order equations – Lagrange's equation – Linear partial differential equations of second and higher order with constant coefficients.

UNIT IV FOURIER SERIES **12 Hours**

Dirichlet's conditions – General Fourier series – Half range Sine & Cosine series – Parseval's identity – Harmonic Analysis.

UNIT V FOURIER TRANSFORM **12 Hours**

Statement of Fourier integral theorem – Fourier transform pairs – Fourier Sine and Cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's theorem.

Total no. of hrs: 60

Text Books :

1. Veerarajan ,T. (2007) *Engineering Mathematics (for first year)*.Tata McGraw Hill Publishing Co.
2. Veerarajan ,T.(2005) *Engineering Mathematics (for semester III)*, Tata McGraw Hill Publishing Co.
3. Singaravelu,(2009) *Transforms and Partial Differential Equations*. Meenakshi Agency.

Reference Books :

1. Kreyszig, E. (2011) *Advanced Engineering Mathematics*.9th Ed. John Wiley & Sons.
2. Grewal, B.S.(2012) *Higher Engineering Mathematics*, Khanna Publishers.

BEE13011 DC MACHINES AND TRANSFORMERS 3 2 0 4

OBJECTIVES:

- Understand the basic concepts of the rotating circuits.
- Designing the DC machines and understand the working principle of the DC machine.
- Understand the constructional features of the transformers and the Induction Machines.

UNIT I : Electromechanical Energy Conversion **9 hours**

Principles of electromechanical energy conversion – Energy, Co-energy – Elementary concepts of rotating machines — Rotating magnetic field – generated voltage – Torque – Magnetic Leakage

UNIT II : DC Generators **9 hours**

Constructional features of DC machine – Principle of operation of DC generator – EMF equation – Methods of excitation and types of DC generators – Characteristics of Series, Shunt and Compound DC generators – Armature reaction – Commutation – Methods of improving commutation – Parallel operation of DC shunt and compound generators – Applications

UNIT III: DC Motors **9 hours**

Principle of operation of DC motors – Back EMF and its significance – Torque equation – Types of DC motors – Voltage Equation – Characteristics of DC series, shunt and compound motors – Starting of DC motors – Types of starter – Speed control of DC series and shunt motors – Power flow, losses and efficiency –Applications

UNIT IV: Transformers **9 hours**

Principle of operation – Constructional features of single phase and three phase shell type and core type transformers –EMF equation –Transformer on No load and Load – Phasor diagram –Parameters referred to HV / LV windings – Equivalent circuit – Regulation — Auto transformers – Applications

UNIT V: Testing Of DC Machines & Transformers **9 hours**

Losses and efficiency in DC Machines and transformers – Condition for maximum efficiency – Testing of DC machines – Brake test, Swinburne's test, Retardation test and Hopkinson's test – Testing of transformers – Polarity test, load test, open circuit and short circuit tests, Sumpner's test – All day efficiency.

Tutorials=15
Total No. of Hours: 60

Text Books

1. Kothari, D.P. Nagrath, I.J.(2005) *Electrical Machines*. 7th Ed. New Delhi: Tata McGraw Hill Publishing Co. Ltd.
2. Murugesh Kumar, K. (2003) *DC Machines & Transformers*. Vikas Publishing House Pvt Ltd.
3. Bimbhra, P.S. (2003) *Electrical Machinery.* Khanna Publishers.
4. Theraja, B.L. Chand, S. (2008) *Electrical Technology Volume.II AC /DC Machines.*

References

1. Fitgerald, A.E. Charles Kingsel Jr, Stephen, D. Umans, (1992) *Electric Machinery*. McGraw Hill Books Company.
2. Hill Stephen, J. Chapman, (1985) *Electric Machinery Fundamentals.* New Delhi: McGraw Hill Book Co.

BCS13035 OBJECT ORIENTED PROGRAMMING AND DATA STRUCTURES 3 0 0 3

OBJECTIVES:

- Understand the sequence and the array in C- language.
- Understand and designing the binary tree.
- Representing different types of C-graph.
- Capable of programming in C++ and JAVA.
- Familiarity to Polymorphism.

UNIT I : Linear Data Structures and Nonlinear Data Structures 9 hours

Stacks, Queues Implementation and Applications, Singly linked list-Doubly linked Lists-circular linked list-Applications - Trees – Binary Trees – Binary Search Tree Implementation – Tree Traversals – AVL Trees

UNIT II : Algorithm Analysis and Graph Algorithms 9 hours

Sorting and Searching –Space complexity-time complexity Linear & Binary Searching analysis-Quick sort-Heap sort-Merge sort-selection sort- RADIX sort-bubble sort-Insertion sort-shell sort-Analysis - Graph operations-DFS-BFS-Minimum cost spanning tree- Krushkal's algorithm- Prim's Algorithm, applications of graphs

UNIT III: Algorithm Design Methods 9 hours

Greedy method – Shortest path – Divide and Conquer –Matrix multiplication- Dynamic programming- Back tracking –Branch and bound- NP Complete Travelling Sales person problem. – N Queens Problem.

UNIT IV: Basics Of OOPS 9 hours

Programming methodologies-Object Oriented concepts-Definition-Data members- Function members- Access specifiers, Constructors- Default constructors- Copy constructors- Destructors- Static members - Control statements, Basics of C++ environment.

UNIT V : Inheritance, Polymorphism and Templates 9 hours

Overloading operators- Functions- Friends- Class derivation- Virtual functions- Abstract base classes- Multiple inheritance- class templates- Function templates- Exception handling- Streams.

Total no. of Hours : 45

Text Books

1. Horowitz, E. Sahani S. Mehta, (2007) *Fundamentals of Data Structures in C++*. Galgotia:
2. Stanley B. Lippman, (2012) *The C++ Primer*. 5th Ed. Addison Wesley.
3. Schildt, H. (2008) *Java 2: The Complete Reference*. 6th Ed. Tata McGraw Hill.

References

1. Weiss Mark Allen, (2007) *Data Structures and Algorithm Analysis in C*. 3rd Ed. Pearson Education.
2. Horowitz E. Sahni, Sanguthevar Rajasekaran, (2007) *Fundamentals of Computer Algorithms*. Galgotia Publications.
3. Jean-Paul Tremblay, Paul G. Sorenson, (2007) *An Introduction to Data Structures with Applications*.2nd Ed. Tata McGraw-Hill.
4. Sara Baase, Allen Van Gelder, (2000) *Computer Algorithms*. Galgotia:
5. Deitel and Deitel, (2011) *C++ How to Program*.8th Ed. Prentice Hall.
6. Balagurusamy, E. (2009) *Programming in Java*.4th Ed. Tata McGraw Hill.

BEE13012 COMPUTER AIDED ELECTRICAL CIRCUITS AND NETWORKS@ **3 0 2 4**

OBJECTIVES:

- Understand the basics of Electric Circuits and components.
- Understand & Designing the AC network & DC network (3 Phase)
- Implementing the theorem concepts in Power system.
- Familiarization of Network graphs, cut sets and Duality of the network .
- Understand and solving the two port networks .
- Understand the S-domain analysis in networks and also about various types of filters and Attenuators.
- Familiarity to the fundamental concepts of Control system.

UNIT I : Basic Circuit Concepts **9 hours**

Basic circuit elements: R,L,C-Ideal sources: dependent and independent-Ohm's law-Kirchoff's laws-Analysis of series and parallel circuits: network reduction, Voltage and Current division-Source transformation-Network Terminologies. DC, AC Circuits-R,L and C connected in series and parallel and the combination of R,L and C – Node Voltage and Mesh or Loop Current Analysis. Resonance in series and parallel RLC circuit- Analyzing si mple circuits through Simulation.

UNIT II: Network Theorems and Coupled Circuits **9 hours**

Network theorems (Analysis of DC and AC Circuits): Thevenin, Norton, Superposition, Maximum power transfer, Tellegan and Reciprocity.
Magnetically Coupled Circuits: Inductance, Mutual Inductance, Coupling Coefficient, Coils connected in series and parallel, DOT rule. Analyzing theorems and coupled circuits through Simulation.

UNIT III: Network Topology and Transient Analysis **9 hours**

Graph theory-Branch Nodal Analysis-Link loop Analysis-Tie set and Cut set matrices- Duality.
Transients: Behaviour of circuit elements under switching conditions and their representation- Forced and free Response of RL, RC, RLC circuits with DC and AC excitations. Analyzing, simple circuits through Simulation.

UNIT IV: Two Port Networks, Filters and Attenuators **9 hours**

Characterization of two port networks in terms of Z, Y, H and T parameters-network equivalents-Relation between Network parameters- Analysis of T, Ladder , Bridged T and Lattice Networks.
Filters and Attenuators: Classification of filters- filter Networks- Design of Constant k, m derived and composite filters. Attenuators: Analysis of T, ∏ Lattice, bridged T, L type. Analyzing simple circuits through Simulation.

UNIT V: S-Domain Analysis and Network Synthesis **9 hours**

S-domain network-driving point and transfer impedances and their properties- transform network analysis-Concept of complex frequency- poles and zeros of network functions- time domain response from pole- zero plot- Reliability of one port network- Hurwitz polynomials - Positive real functions - Synthesis of RL,RC and LC one port networks. Analyzing the pole-zero plot through Simulation.

Practicals:15
Total no. of Hours : 60

Text Books

1. Sudhakar, A. Shyammohan, S. and Palli, *Circuits and Networks-Analysis and Synthesis*. Tata McGraw-Hill.
2. David A. Bell, (2009) Oxford University: Prentice Hall.
3. Steven T. Karris, *Circuit Analysis II with MATLAB Applications*.

References

1. John O. Attia , *Electronics and Circuit Analysis using MATLAB.*
2. Etter, D.M. (1997) *Engineering Problem Solving with MATLAB*. 2nd Ed. Prentice Hall.
3. Gottling, J.G. (1995) *Matrix Analysis of Circuits Using MATLAB*. Prentice Hall.

The @ indicates the Final Examination will be conducted internally by the Department which includes internal examination, execution of Simulation Studies , Proto type model design implementation, Case study report and analysis etc, respective to the different subject

BEE13L01 ELECTRICAL MACHINES LABORATORY 0 0 2 1

OBJECTIVES:

The lab is equipped with all types of DC machines and Transformers which mainly covers experiments with real machines and students gain practical experience in using various DC machines, transformers, starters etc. Various types of experiments related to Electrical machinery like Load characteristics, Load test, Brake test, Parallel Operation ,Loss separation, OC and SC characteristics are done in this Lab.

- To analyze the Internal and External Load Characteristics for DC Generators and Motors
- To determine the speed control using different methods for DC Motor and Generator
- To find the constant loss and copper loss of DC Machines
- To study the effect of frequency and voltage control.
- To find the equivalent circuit of transformer
- To Analyze of the frequency, voltage mismatch with the condition of voltage angle Zero.

Total no. of Hours = 45

BEE13013 AC AND SPECIAL MACHINES 3 2 0 4

OBJECTIVES:

- Understands the construction and operation of Synchronous generator & motors used in the Power system control.
- Capable to draw the circle diagram of Induction machine.
- Understand the concepts of various machines involved in the power system network.

UNIT I:Synchronous Generator **9 hours**

Types & Constructional Features of Synchronous Generators– EMF Equation – Synchronous reactance – Armature reaction – Voltage regulation – EMF, MMF and ZPF methods – Change of excitation and mechanical input.

UNIT II: Synchronous Motor **9 hours**

Principle of operation – Construction – Equivalent Circuit and phasor diagram – Power and Torque – Power flow – Power developed by synchronous motors – Speed-Torque characteristics – Effect of change in excitation – V curves and inverted V curves – Hunting & suppression .

UNIT III: Three Phase Induction Motor **9 hours**

Construction – Types of rotors – Cage and wound rotor machines – Principle of operation – Production of rotating magnetic field – Equivalent circuit – Torque and Power output – Torque-slip characteristics – Condition for maximum efficiency – Testing – Load Test – No load and Blocked rotor test – Circle diagram.

UNIT IV: Starting & Speed Control Of Induction Motors **9 hours**

Necessity for Starters – Starting methods of three phase induction motor – Types of Starters – Stator resistance and reactance – Rotor resistance starter- **s**tar-delta starter – Cogging & Crawling – Speed control – Voltage control –Rotor resistance control.

UNIT V: Special Machines **9 hours**

Single phase induction motor – Constructional details – Double revolving field theory – Equivalent circuit – Speed-torque characteristics – Starting methods – Split-phase motor - shaded-pole induction motor – Universal motor – Variable Reluctance motor, Switched Reluctance Motor, Stepper Motor, Permanent Magnet Motors.

Tutorials=15
Total No. of Hours: 60

Text Books

1. Nagrath, I.J. Kothari, D.P. (2005) *Electric Machines*.7th Ed. New Delhi: T.M.H publishing Co Ltd.
2. Bhimbhra, P.S. (2003) *Electrical Machinery*. Khanna Publishers.

References

1. Fitzgerald,Kingsley, Umans, (1990) *Electric Machinery*. 5th Ed. New Delhi: McGraw Hill Books co.
2. Stephen J. Chapman, (1985) *Electric Machinery Fundamentals*. New Delhi : McGraw Hill Book Co.
3. Say, M.G. (1980) *Alternating current Machines*.4th Ed. ELBS & Pitman. London:
4. Sen, S.K. (1984) *Electrical Machinery*. New Delhi: Khanna Publishers.

BEE13014 INTRODUCTION TO NANO AND DIGITAL ELECTRONICS 3 2 0 4

OBJECTIVES:

- Understand the concepts of number system, conversions of numbers.
- Capable to verify the different types of gates using truth table with logic circuits.
- Familiarity to use logic gates in sequential & combinational circuits.
- Incorporates the Hardware Description Language (HDL) programming with the sequential circuits.

UNIT I: Fundamentals & Overview Of Nano science **9 hours**

Nano revolution of the xx Century, Properties at Nano scale (Optical, Electronic). Theory, definitions and scaling.

UNIT II: Different Classes Of Nano materials **9 hours**

Metal & Semiconductor Nanomaterials, Quantum Dots, Wells & wires, Molecule to bulk transitions Bucky balls and Carbon Nanotubes.

UNIT III : Number System & Boolean Algebra **9 hours**

Review of binary, octal, hexadecimal number- conversions- signed binary arithmetic (2's complement method)- BCD Arithmetic-Deriving a Boolean equation from truth table-simplification of Boolean functions using K-map & Quine Mc Cluskey method.

UNIT IV : Combinational Circuits **9 hours**

Truth table and Boolean equation for fundamental and derived gates-AND, OR,NOT,NOR,NAND,EX-OR gates-Implementation of a Boolean function using Logic gates and universal gates-Design of adder, subtractor, comparators, code converters, encoders, decoders, multiplexers and de-multiplexers- Function realization multiplexers.

UNIT V: Synchronous and Asynchronous Sequential Circuits **9 hours**

Latches-Flip flops - Analysis of synchronous sequential circuits- state diagram; state reduction; state assignment-Mealy and Moore Models- Design of Shift Registers and counters (Binary and BCD). Analysis and Design Procedure for Asynchronous Sequential Circuits.

Tutorials=15
Total No. of Hours: 60

Text Books

1. Morris Mano, M. (2002) *Digital Logic and Computer Design.* Prentice Hall of India:
2. John M. Yarbrough, (2002) *Digital Logic, Application & Design*. Thomson.

References

1. Charles H. Roth, (2002) *Fundamentals Logic Design*. 4th Ed. Jaico Publishing.
2. Floyd, (2003) *Digital Fundamentals*. 8th Ed. Pearson Education.
3. John F. Wakerly, (2002) *Digital Design Principles and Practice*.3rd Ed. Pearson Education.

BEE13015 ELECTRICAL & ELECTRONICS MEASUREMENTS 3 0 0 3

OBJECTIVES:

- Familiarity to the Instruments and its calibration.
- Understand the various types of Analog & Digital meters, bridges & converters.
- Understand the signal conditioning circuits & various types of display devices.

UNIT-I :Introduction **9hours**

Functional elements of Instrument -Static and Dynamic characteristics -Errors in measurement Statistical evaluation of measurement data -Standard and Calibration.

UNIT-II : Transducers and Data Acquisition systems **9hours**

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.

UNIT-III : Storage and Display Devices **9hours**

Magnetic disc and Tape Recorders –Digital plotters and printers -CRT displays -Digital CRO – LED, LCD and Dot matrix displays- Data Loggers.

UNIT-IV :Comparison Methods Of Measurements **9hours**

D.C & A.C potentiometers, D.C & A.C bridges, transformer ratio bridges, self-balancing bridges –PMMC, moving iron -- Electrostatic and Electromagnetic interference –Grounding techniques- Elements of data acquisition systems.

UNIT-V : Electrical and Electronics Instruments **9hours**

Principle and types analog and digital ammeters and voltmeters -Single and three phase Wattmeter and Energy meter - magnetic measurements -Instrument Transformers -Instruments for measurement of frequency and phase.

Total no. of Hours - 45

Text Books

1. Doebeling, E.O.(1990) *Measurement Systems – Application and Design*.McGraw Hill Publishing Company.
2. Kalsi, H.S. (1995) *Electronic Instrumentation*.TMH Co.

References

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

BEE13020 MICROPROCESSOR & MICROCONTROLLERS 3 2 0 4

OBJECTIVES:

- Capable of programming in different processors and controllers.
- Capable of interfacing using processors.
- Well known to applications of Processors.

UNIT – I 8085 Processor **9 hours**

Functional block diagram - Signals – Memory interfacing – I/O ports and data transfer concepts – Timing Diagram – Interrupt structure Instruction format and addressing modes – Assembly language format – Data transfer, data manipulation & control instructions, subroutine and stack.

UNIT – II Peripheral Interfacing **9 hours**

Study of Architecture and programming of ICs: 8255 PPI, 8259 PIC, 8251 USART, 8279 Key board display controller and 8253 Timer/ Counter – Interfacing with 8085 - A/D and D/A converter interfacing.

UNIT – III Micro controller 8051 **9 hours**

Functional block diagram - Instruction format and addressing modes – Interrupt structure – Timer –I/O ports – Serial communication. Data Transfer, Manipulation, Control & I/O instructions.

UNIT – IV Micro controller Programming & Applications **9 hours**

Simple programming exercises key board and display interface- interfacing an LCD- interfacing to ADC- interfacing a DAC, Sensors – Closed loop control of servo motor- interfacing a stepper motor.

UNIT - V Introduction to ARM Processors **9 hours**

Basic ARM architecture – ARM assembly language program – ARM organization and implementation– The ARM instruction set - The thumb instruction set – ARM CPU cores.

Tutorials=15
Total No. of Hours: 60

Text books

1. Gaonkar, R.S (2006) *Microprocessor Architecture Programming and Application*. New Delhi: Wiley Eastern Ltd.
2. Muhammad Ali Mazidi, & Janice Gilli Mazidi, (2003) *The 8051 Micro Controller and Embedded Systems*. 5th Indian reprint, Pearson Education.
3. Steve Furber,(2000) *ARM System –On –Chip architecture*. Addison Wesley.

Reference books

1. William Kleitz, (2006) *Microprocessor and Micro Controller Fundamental of 8085 and 8051 Hardware and Software*. Pearson Education.
2. Daniel Tabak, *Advanced Daniel Microprocessors*. McGraw Hill Inc.

BEC13L25	**ELECTRONICS LABORATORY**	**0**	**0**	**2**	**1**

OBJECTIVES:

The lab is equipped with Analog Devices, Circuits, Nano and Digital Electronics mainly covers hands-on experiments and students gain practical experience in using various Solid-State Devices, Digital Logic application & Design etc. Various types of experiments related to Electronics can be analyzed with Static characteristics, Frequency response, logic design etc. are done in this Lab.

- The students will learn about designing of analog circuits with passive and active components.
- The students will learn about the designing of digital circuits using gates
- The students will learn about the Nano technology and related to that they will do some basic experiments.

In this laboratory student should complete minimum 10 Experiments, minimum five from above mentioned OBJECTIVESs, minimum two from student their own idea and three experiment from given component by faculty

Total no. of Hours = 45

BEC13035 VLSI & LINEAR INTEGRATED CIRCUITS 3 0 0 3

OBJECTIVES:

- Familiarity to Electronic devices in Integrated form.
- Understands the concepts of Regulators, Filters using OpAmp and Multivibrators using Timer.
- Capable to design the logic circuits.
- Fabrication of Integrated Circuits
- Programming using VHDL
- Design of combinational elements & regular array logic

UNIT I: IC Fabrication **9 hours**

IC classification, fundamental of monolithic IC technology, epitaxial growth, masking and etching, diffusion of impurities-CMOS technology-n-well, p-well, twin-tub, SOI process- Design Rules and layout – stick diagrams.

UNIT II: Characteristics Of OP-AMP **9 hours**

Ideal OP-AMP characteristics, DC characteristics, AC characteristics, offset voltage and current: voltage series feedback and shunt feedback amplifiers, differential amplifier; frequency response of OP-AMP; Basic applications of op-amp – summer, differentiator and integrator.

UNIT III: Applications Of OP-AMP **9 hours**

Instrumentation amplifier, first and second order active filters, V/I & I/V converters, comparators, multivibrators, Monostable, Astable, Bistable, S/H circuit, D/A converter (R-2R ladder and weighted resistor types), A/D converter - Dual slope, successive approximation and flash types.

UNIT IV: Special ICS **9 hours**

555 Timer circuit – Functional block, characteristics & applications; 566-voltage controlled oscillator circuit; 565-phase locked loop circuit functioning and applications, Analog multiplier ICs.

UNIT V: Application ICS **9 hours**

IC voltage regulators - LM317, 723 regulators, switching regulator, power amplifier, ICL 8038 function generator IC, isolation amplifiers, optocoupler, optoelectronic ICs.

Total No of hours: 45

Text Books

1. Ramakant, A. Gayakward, (2003) *Op-amps and Linear Integrated Circuits.*6th Ed. Pearson Education PHI.
2. Roy Choudhary, D. Sheil B. Jani, (2003) *Linear Integrated Circuits*. 2nd Ed. New Age.

References

1. Jacob Milman, Christos C. Halkias, (2003) *Integrated Electronics - Analog and Digital circuits system.* Tata McGraw Hill.
2. Robert F. Coughlin, Fredrick F. Driscoll, (2002) *Op-amp and Linear ICs*. 4th Ed. Pearson Education/ PHI.

BEE13016 POWER GENERATION AND TRANSMISSION SYSTEM 3 0 0 3

OBJECTIVES:

- Capable of designing a power system network with various line parameters and the basic concepts of HVDC & FACTS.
- Understand the transmission line parameters and capable of modeling transmission line.
- Understand the properties of Insulators & Cables and the distributor system.

UNIT-I: Steam Power Station **9hours**

Steam Power Station: Main parts and working of a Steam Power Station, characteristics of steam Turbines, Characteristics of turbo alternators, steam station auxillaries , steam station layout, super pressure steam stations.

UNIT-II: Hydro and Nuclear Power Plant **9hours**

Hydro power station: Hydrology, Hydrographs, flow duration curve, mass curve, Types of Dam, Principles of working of a Hydro Electric power plant. Nuclear power plant: Principle of Nuclear Energy, types of power reactor, location of nuclear power plant, layout of power station, reactor control, nuclear waste disposal, Gas turbine plant and Diesel power plant schemes.

UNIT-III: Electrical Power Transmission **9hours**

Introduction to transmission system planning-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, Vibration of conductors and Dampers.

UNIT-IV: Transmission Line Parameters **9hours**

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.

UNIT-V: Characteristics and Performance Of Transmission Lines **9hours**

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.

Total No of Hours :45

Text books

1. Gupta, B.R. *Generation of Electrical Energy*. Chand.S Publications.
2. Wadhwa, C.L.(1985) *Electrical Power systems*. Wiley Eastern Limited India.

References

1. Car, T.H. *Electric Power Station*. Chappman & Hall:
2. Deshpande, M.V. (1990) *Elements of Electric power station Design*. New Delhi: Tata McGraw Hill Publishing Company.
3. Mehta, V.K. & Rohit,(2005) *Principles of Power system*. Chand.S & Publication Co.
4. Nagrath, I.J and Kothari, D.P.(1990) *Modern Power System Analysis*. New Delhi: Tata McGraw Hill Publishing Company.

BEE13017 CONTROL SYSTEMS 3 2 0 4

OBJECTIVES:

- Capable to solve problems in time domain & frequency domain.
- Understand the frequency response for the stability of the system.
- Understand the State space Analysis of different variables.

UNIT I : Introduction and Control Systems Components **9 hours**

Open loop-closed loop control-mathematical models of physical systems-differential equations-transfer function-armature control-field control-block diagram reduction-signal flow graphs.
Control system components-DC servomotors-AC servomotor--synchronous-stepper motor.

UNIT II: Time Response Analysis, Design Specifications & Performance Indices **9 hours**

Standard test signals-time response of first order , second order systems-steady state errors and error constants.

UNIT III: Frequency Response and Concept Of Stability **9 hours**

Bode plot, polar plot, Nyquist stability. Concept of stability-necessary conditions- Hurwitz stability criterion-Routh stability criterion-relative stability analysis.

UNIT IV: Introduction to Design Of Compensators **9 hours**

Realization of basic compensators-lag, lead, lag-lead. Introduction to P, PI, PD, PID controllers, tuning of PID controllers,

UNIT V: Case Studies **9 hours**

Electrical power control systems, Industrial applications of motor control system, Synergies in control system between aerospace and industry/automotive applications, feedback controllers.

Tutorials=15
Total No. of Hours: 60

Text Books

1. Nagrath, L.J. Gopal, M. *Control System Engineering*.4th Ed. New age International (P) Ltd Publishers.
2. Ogata, K. *Modern Control Engineering-analysis of system dynamics, system design using Root Locus.* 4th Ed. Prentice Hall for practice and solutions.

References

1. www.GaliLMc.com - *GALIL we move the world-featured tutorials – motion controllers, tuning servo systems, adjustment of PID filter.*

BEE13018 DESIGN OF ELECTRICAL MACHINES @ 2 2 2 4

OBJECTIVES:

- The graduate will be capable of designing the transformers etc.
- Capable of designing the rotor bars & slots.
- The graduate will be capable of designing machine parameters related to the Industrial needs.

UNIT I: Introduction **9hours**

Major considerations – Limitations– Space factor temperature gradient – Heat flow in two dimensions – Thermal resistivity of winding – Temperature gradient in conductors placed in slots

UNIT II: DC Machines **9hours**

Magnetic circuit calculations –Net length of Iron –Real & Apparent flux densities– D.C machines output equations –Design of shunt and series field windings– Design of Commutator and brushes.

UNIT III:Transformers **9hours**

KVA output for single and three phase transformers – Window space factor – Temperature rise of Transformers – Design of Tank with & without cooling tubes.

UNIT IV: Induction Motors **9hours**

Magnetic leakage calculations – Leakage reactance of poly-phase machines- Output equation of Induction motor — circle diagram – Dispersion co-efficient – relation between D & L for best power factor.

UNIT V: Synchronous Machines **9hours**

Runaway speed – construction – output equations – choice of loadings – Design of salient pole machines – Short circuit ratio – Introduction to computer aided design – Program to design main dimensions of Alternators.

Tutorials = 15
Total no. of Hours = 60

Text Book

1. Sawhney, A.K. Dhanpat Rai & Sons, (1984) *A Course in Electrical Machine Design*. New Delhi:

References

1. Sen, S.K. (1987) *Principles of Electrical Machine Designs with Computer Programmes*. New Delhi: Oxford and IBH Publishing Co. Pvt. Ltd.

The @ indicates the Final Examination will be conducted internally by the Department which includes internal examination, execution of Simulation Studies , Proto type model design implementation, Case study report and analysis etc, respective to the different subject

BEE13L03	MEASUREMENT AND CONTROL LAB	0	0	2	1

OBJECTIVES:

The lab is equipped with components required for calibrating Measurement and to conduct control experiments.

- In this laboratory, students will obtain knowledge about different types of Transducers, bridges and its characteristics.
- The students will understand the concept of calibration of energy meters in single phase, three phase and measure the power , iron loss and power factor .
- To familiarize the students with the measurement of low resistance, inductance and capacitance-factor using simulation package such as LABVIEW /MATLAB etc.
- To familiarize the students with the concept of DC motor, AC servomotor, AC tachometer and its characteristics practically.
- Students will gain knowledge about effect of controllers (P, PI, PID)
- The students will be familiar with digital simulation of first order and second order systems, root locus, Routh-Hurwitz stability.
- In Simulation, the students will design systems with different transfer functions and find gain margin, phase margin using Bode plot or root locus.
- Students can choose any innovative ideas of their own interests based on the above OBJECTIVES.

Total No of hours: 45

BEE13023 COMPUTER AIDED POWER SYSTEM ANALYSIS 3 2 0 4

OBJECTIVES:

- Familiarity to Single line diagram, Z-bus & Y-Bus Algorithm.
- Familiarity to various load flow problems.
- Capable of analyzing the fault balanced & unbalanced circuits and steady state analysis of the power system network

UNIT-I: Introduction 12 hours

Modern power system (or) electric energy system - Analysis for system planning and operational studies – basic components of a power system. Generator models - transformer model – transmission system model - load representation. Single line diagram – per phase and per unit representation – change of base.

UNIT-II: Power Flow Analysis 12hours

Importance -Simple building algorithms for the formation of Y-Bus matrix and Z-Bus matrix-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. Programming and Simulation of Load flow Studies.

UNIT- III:Fault Analysis – Balanced faults 12hours

Importance short circuit (or) for fault analysis - basic assumptions in fault analysis of power systems. Symmetrical (or) balanced three phase faults – problem formulation – fault analysis using Z-bus matrix – algorithm and flow chart. Computations of short circuit capacity, post fault voltage and currents. Programming and Simulation of Various Faults

UNIT- IV: Fault Analysis – Unbalanced Faults 12hours

Introduction to symmetrical components – sequence impedances – sequence networks – representation of single line to ground, line to line and double line to ground fault conditions. Unbalanced fault analysis - problem formulation – analysis using Z-bus impedance matrix – (algorithm and flow chart) Programming and Simulation of Various Faults

UNIT- V: Stability Analysis 12hours

Importance of stability analysis in power system planning and operation - classification of power system stability - angle and voltage stability – simple treatment of angle stability into small-signal and large-signal (transient) stability-Single Machine Infinite Bus (SMIB) system: Development of swing equation-solution by modified Euler method and fourth order RK method - equal area criterion - determination of critical clearing angle-Methods of improving transient stability. Programming and Simulation of Stability Studies.

Tutorials=15
Total No. of Hours: 60

Text Books

1. HadiSaadat, (2002) *Power System Analysis*. New Delhi: Tata McGraw Hill Publishing Company.
2. Olle I. Elgerd, (2003) *Electric Energy Systems Theory – An Introduction.* 2nd Ed. New Delhi: Tata McGraw Hill Publishing Company Limited.

References

1. Kundur, P. (1994) *Power System Stability and Control*. Tata McGraw Hill, Publications.
2. John J. Grainger, W.D. Stevenson Jr, (1994) *Power System Analysis*. McGraw Hill International Book Company.
3. Nagrath, I.J. Kothari, D.P. (1990) *Modern Power System Analysis*. New Delhi:Tata McGraw-Hill Publishing Company.

BEE13021 POWER ELECTRONICS 3 2 0 4

OBJECTIVES:

- Familiarity to Power Electronic Devices and its characteristics.
- Capable of designing the triggering of firing circuits.
- Familiarization to inverters, choppers and Industrial drives.

UNIT-I : Power Semiconductor Devices **9 hours**

Power semiconductor devices Overview: Characteristics of power Structure, operation, Static characteristics and switching characteristics (Turn on and Turn off) of SCR, TRIAC, BJT, MOSFET and IGBT – Two transistor model of SCR – Series and Parallel operation of SCR – Turn on circuits for SCR – Different techniques of commutation – Protection of Thyristors against over voltage, over current, dv/dt and di/dt

UNIT-II : Phase Controlled Converters **9 hours**

Single phase and three phase half controlled and fully controlled rectifiers with R, RL and RLE loads – Waveforms of load voltage and line current – Inverter operation of fully controlled converter – harmonic factor, power factor, ripple factor, distortion factor – operation with freewheeling diode – effect of source inductance – dual converter.

UNIT-III: Inverters **9 hours**

Voltage and current source inverters – Single phase and three phase inverters (both 120^{o} mode and 180^{o} mode) inverters – PWM techniques: Sinusoidal PWM, modified sinusoidal PWM - multiple PWM – Resonant series inverter – current Source Inverter – UPS

UNIT-IV: DC to DC Converters **9 hours**

DC choppers – Step-down and step-up chopper – Time ratio control and current limit control –Various classes of Operation – Buck, boost and buck – boost type choppers – merits and applications – Concept of Resonant switching – SMPS.

UNIT-V : AC Voltage Controllers & Industrial Applications **9 hours**

Single phase AC voltage controllers – Sequence control of AC voltage regulators – Multistage sequence control – Three-phase AC voltage controllers – Cycloconverters – single-phase and three-phase cycloconverters – Static Compensators – HVDC Transmission system.

Tutorials=15
Total No. of Hours: 60

Text Books

1. Rashid, M.H. (2004) *Power Electronics - Circuits Devices and Applications*.3rd Ed. Prentice Hall of India.
2. Bimbhra, P.S. (1999) *Power Electronics*.3rd Ed. Khanna Publishers.

References

1. Singh, M.D. Kanchandani, (2002) *Power Electronics*. New Delhi: Tata McGraw Hill & Hill publication Company Ltd.
2. Dubey, G.K. Doradia, S.R. Joshi, A. Sinha, R.M. (1986) *Thyristorised Power Controllers*. Wiley Eastern Limited.
3. Lander, W. (1993) *Power Electronics*.3rd Ed. McGraw Hill and Company.

BEE13019 POWER SYSTEM PROTECTION & SWITCHGEAR 3 0 0 3

OBJECTIVES:

- Understands the protection schemes for various power system equipments.
- Understands the schemes incorporated for Over voltage protection
- Understands the principle of Static Relay.

UNIT-I Protective Relays **9hours**

Need for protection – essential qualities of protective relays –some common relay terms– Electromagnetic relays, Induction relays – Over current relays - Directional, Distance, Differential and negative sequence relays – Universal Torque Equation.

UNIT-II Apparatus Protection **9hours**

Protection of Generator-. Motor protection, Bus bar protection and Transmission line protection-Differential protection, distance protection. Carrier current protection. Feeder protection, CT and PT and their application in protective schemes.

UNIT-III Circuit Breakers **9hours**

Arc phenomena – arc interruption – Current zero interruption theories – recovery voltage and restriking voltage - RRRV – current chopping – Resistance switching- Various types of circuit breakers – selection and Testing of circuit breakers – Fuses – HRC fuses.

UNIT-IV Protection Against Overvoltages **9hours**

Mechanism of lightning – Over voltage due to lightning – Protection against lightning –Protection of Electrical apparatus against travelling waves – types of lightning arresters-ratings and location – Surge absorbers-arcing grounds -Peterson Coil.

UNIT-V Static Relays **9hours**

Static relays **– c**omponents of static relays – over current relays, differential protection and distance protection – Microprocessor based relays.

Total no. of Hours = 45

Text books

1. Ravindranath, B. and Chander, N.(1997) *Power System Protection and Switchgear*. Wiley Eastern Ltd.
2. Chakrabarti, A. Soni, M.L.Gupta, P.V. Bhatnagar, U.S.(2002) *A Text Book on Power System Engineering*. Dhanpat Rai & Co. Pvt. Ltd.

References

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

BEE13L05	POWER ELECTRONICS LABORATORY	0	0	2	1

OBJECTIVESs:

The lab is equipped with devices required to conduct Power Electronics and Switch Gear Experiments. It mainly covers hands-on experiments with Real time Simulator kit and students gain practical experience.

- Obtaining the anode (VAK – 1A) forward conduction characteristics including the measurement of holding and latching currents.
- Application of single SCR as half-wave rectifier.
- Obtaining steady state output characteristics of both MOSFET and IGBT.
- Obtaining Switching characteristics, turn-on and turn-off time of both MOSFET and IGBT.
- To study the triggering circuit of a single phase DC chopper circuit, class A commutation chopper circuit, class B commutation chopper circuit, class D commutation chopper circuit.
- To study the triggering circuit of an A.C. phase angle controller using TRIAC, performance with resistive and inductive load.
- To observe various waveforms with R and R-L loads for both fully controlled, half controlled converter and to study the variation of power factor against delay angle.
- Obtaining AC waveform of a lower frequency by synthesizing the output waveform from constant voltage, constant frequency AC waveform to segment the AC supply without an intermediate DC line, DC voltage from a constant DC voltage, the controlled output voltage without any additional components

Total No of hours: 45

BEE13028 ELECTRICAL ENERGY UTILIZATION & CONSERVATION 3 0 0 3

OBJECTIVES:

- Understand the conventional and nonconventional methods of power generation.
- Understand the utilization of energy.
- Understand the small scale and large scale conservation of energy.
- Understand the requirements of electric traction.

UNIT-I : Heating and Welding **9 hours**

Advantages and methods of electric heating, resistance ovens, induction heating, dielectric heating, the arc furnace, heating of building. Electric welding, resistance and arc welding, control devices.

UNIT- II: Illumination **9 hours**

Importance of lighting – properties of good lighting scheme – laws of illumination –photometry - types of lamps – lighting calculations – basic design of illumination schemes for residential, commercial, street lighting and sports ground – energy efficiency lamps.

UNIT- III: Electric Drives **9 hours**

Type of electric drives, choice of motor, starting and running characteristics, speed control, temperature rise, particular applications of electric drives, types of industrial loads, continuous, intermittent and variable loads, load equalization

UNIT IV: Introduction to Electric and Hybrid Vehicles **9 hours**

Configuration and performance of electrical vehicles, traction motor characteristics, tractive effort, transmission requirement and energy consumption

UNIT-V: Energy Conservation **9 hours**

Principle of energy conservation - waste heat recovery - Heat pump – Economics of energy conservation, cogeneration, combined cycle plants, electrical energy conservation opportunities

Total No of hours: 45

Text books

1. Epenshaw Taylor, (2009) *Utilization Of Electric Energy.* 12th Impression. Universities Press.
2. Mehrdad, Ehsani, Yim in Gao, Sabastien E. Gay, Ali Emadi, *Modern Electric, Hybrid Electric and Fuel Cell Vehicles*.CRC Press.
3. Wadhwa, C.L. (2003) *Generation, Distribution and Utilization of Electrical Energy*. NewAge International Pvt. Ltd.
4. Gupta, B.R. (2003) *Generation of Electrical Energy*. New Delhi: Eurasia Publishing House (P) Ltd.

Reference books

1. Soni Gupta, Bhatnager-DhanapatRai& sons *A Course in Electrical Power.*
2. Uppal, S.L. *Electrical Power.* Khanna Publications.

BEE13026 POWER SYSTEM OPERATION AND CONTROL 3 2 0 4

OBJECTIVES:

- Familiarity to system load characteristics and the regulation system.
- Capable to solve different control such as real power frequency and reactive power voltage control.
- Capable to interpret Unit commitment & Economic dispatch.

UNIT- I Introduction 12hours

System load Characteristics–load curves and load-duration curve - load factor - diversity factor.(Qualitative treatment with block diagram). Need for Voltage regulation and frequency regulation in power system - Basic P-F and Q-V control loops - cross coupling between control loops.

UNIT- II Real Power - Frequency Control 12hours

Fundamentals of AGC-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.

UNIT- III Reactive Power–Voltage Control 12hours

Excitation system Modeling - Static & Dynamic Analysis - stability compensation-Principles of transmission line compensation - Effect of Generator loading – static VAR System Modeling - System Level Voltage control.

UNIT- IV Commitment and Economic Dispatch 12hours

Need for Economic Dispatch-Characteristics curve for Steam and hydroelectric Units - Co-ordination Equation with Loss and without losses - Solution by Iteration method (no derivation of loss co-efficient) - Base point and Participation Factor- Constraints in Unit Commitment -Unit Commitment Solution methods-Priority List methods.

UNIT-V Computer Control Of Power Systems 12hours

Need of computer control of power systems. Concept of energy control centre (or) load dispatch centre and the functions - system monitoring - data acquisition and control. System hardware configuration – SCADA and EMS functions. Various operating states (Normal, alert, emergency, in-extremis and restorative). State transition diagram showing various state transitions and control strategies.

Tutorials=15
Total No. of Hours: 60

Text Books

1. Allen. J. Wood and Bruce F. Wollenberg,(2003) *Power Generation, Operation and Control*. John Wiley & Sons. Inc.
2. Chakrabarti & Halder,(2004) *Power System Analysis: Operation and Control*. Ed. Prentice Hall of India:
3. Kundur, P,(1994) *Power System Stability and Control.* USA: MCGraw Hill Publisher.

References

1. Kothari, D.P. and Nagrath, I.J. (2003) (For Chapters 1, 2 & 3) *Modern Power System Analysis*.3rd Ed.Tata McGraw Hill Publishing Company Limited.
2. Grigsby, L.L. (2001) *The Electric Power Engineering, Hand Book*. CRC Press & IEEE Press.
3. Hadi Saadat, (2007) (For the chapters 1, 2, 3 and 4) *Power System Analysis*.11th Reprint.

BEE13025 POWER DISTRIBUTION SYSTEM 3 2 0 4

OBJECTIVES:

- Capable to design LT network.
- Familiarity to various load flow problems.
- Capable of designing a power system network.
- Understand the concept of communication techniques.

UNIT-I Introduction to Distribution System 9 hours

Standard values of voltage, current & frequency-standard parameters-AC & DC Distribution - Importance of AC Distribution- Requirement of AC Distribution-load-Types-definitions - Load forecasting-factors affecting PS loads

UNIT-II Distribution Substation & Maintenance 9 hours

Substation-classification-Feeder-Types-Distribution automation-Communication-Battery-Charger-Capacitor bank-power transformer-circuit breakers - isolator-CT & PT – grounding

UNIT-III Load Flow Analysis & Loss Calculations 9 hours

Load flow analysis – Fast decoupled load flow (FDLP) – comparison with other method- Voltage drop and loss calculation- analysis of distribution losses-Economic analysis of equipment losses.

UNIT-IV LT Distribution and Billing 9 hours

Distribution transformer- Types-erection- maintenance-LT Network-Tariff – types consumer billing –metering-prepaid meter- testing of meters- High voltage metering

UNIT-V Reliability and Consumer Service 9 hours

Definition of reliability-limitations of distribution system-power quality- Regulation-consumer care Standard-Load management-Theft of energy and prevention

Tutorials=15
Total No. of Hours: 60

Text Books

1. Ramamurthy, G. *Hand Book of Electrical power Distribution* .Universities press.
2. Pabla, A.S. *Electrical power distribution.*Tata Mc graw Hill.

References

1. Mehta, V.K. Rohit. *Principle of power system*. CHAND, S. & CO.
2. Tarun Gonan, *Electrical power distribution system Engineering.* CRC Press.

BEE13022 WIND ENERGY CONVERSION SYSTEMS 3 0 0 3

OBJECTIVES:

- The Graduate will be able to design wind Energy conversion system such as subsystems and its components.
- Capable to solve the Energy crisis.
- Familiarity to Power Electronic Devices and its characteristics.
- Designing various Electrical Machines for WECS.

UNIT- I: Introduction to Wind Systems **9 hours**

Historical uses of wind – History of wind turbines – Horizontal axis wind turbines – Darreius Wind Turbines – Innovative wind turbines – Components of the wind energy conversion system – Power output from an ideal wind turbine – Power output from practical wind turbines.

UNIT-II: Wind Characteristics & Measurements **9 hours**

Meteorology of wind – Wind speed statistics – Weibull Statistics – Rayleigh and normal distribution – Wind measurements – Eolian features – Biological Indicators – Types of anemometers and their operation – Wind direction – Wind measurements with balloons.

UNIT-III : Wind Turbine Subsystems & Components **9 hours**

Rotor – Blades – Aerodynamic design – Structural Design – Fabrication – Aerodynamic Control Surfaces – Hub – Types- Drive Train – Coupling – Gearbox – Brake – Types – Main frame & Nacelle – Tower

UNIT- IV: Electrical Machines For WECS **9 hours**

Induction Machine – Theory of IM operation - Dynamic dq Modeling - Doubly fed Induction Generator – Synchronous Machines – Theory of operation – Starting wind turbines with IG - Variable Reluctance Machine – Effect of Harmonics.

UNIT-V : Overview Of Converters **9 hours**

Six Pulse Converter – 12 Pulse Converter – Sequential control of converters – Converter Control – EMI and Power Quality Problems – Control of Cycloconverter – Matrix Converters – High Frequency Cycloconverter, VFC and CFC.

Total No of Hours: 45

Text books

1. Manwell, J.F. Mcgowan, J.G. Rogers, A.L.(2002) *Wind Energy Explained – Theory, Design & Application*. John Wiley & Sons.
2. Gray L. Johnson,(1985) *Wind Energy Systems*. Prentice Hall Inc.
3. Bose, B.K. (2001) *Modern Power Electronics & AC Drives*. Prentice Hall.

References

1. Vaughn Nelson, (2009) *Wind Energy – Renewable Energy & the Environment*. CRC Press.

BEE13E01 INTRODUCTION ON AI APPLICATIONS TO ELECTRICAL ENGINEERING 2 0 2 3

OBJECTIVES:

- Familiarity to Artificial Intelligence, Fuzzy System.
- Capable to do programming using optimization techniques.

UNIT I: Introduction to Artificial Intelligence **9hours**

Computational Intelligence Paradigms - Heuristic Search – Techniques for heuristic search and classification, State Space Search – Strategies for implementation of Graph search based on Recursion patent – directed search production system and learning.

UNIT II: Fuzzy Systems **9hours**

Fuzzy Sets: Definitions - Membership Functions-Operators - Fuzzy Set Characteristics - Fuzziness and Probability. Fuzzy Logic and Reasoning: Fuzzy Logic - Linguistics Variables - Fuzzy Rules Fuzzy Inferencing - Fuzzification - Inferencing - Defuzzification - Fuzzy Controllers : Components of Fuzzy Controllers- Types - Mamdani Fuzzy Controller.

UNIT III: Artificial Neural Networks **9hours**

Calculating the Net Input Signal - Activation Functions - Artificial Neuron Learning .Supervised Learning Neural Networks: Neural Network Types Feed forward Neural networks Supervised Learning Rules-Gradient Descent Optimization. Unsupervised Learning Neural Networks: Hebbian Learning Rule - Learning Rule - Stochastic Training Rule.

UNIT IV: EVOLUTIONARY ALGORITHM **9hours**

Particle Swarm Optimization: Basic Particle Swarm Optimization -Global Best PSO-Local Best PSO. Genetic Algorithms: Canonical Genetic Algorithm -Crossover -Mutation - Control Parameters. Ant colony Algorithms: Ant Colony Optimization -Foraging Behaviour of Ants-Simple Ant Colony Optimization.

UNIT V: APPLICATION OF COMPUTATIONAL INTELLIGENCE **9hours**

Study the Algorithm and Code for travel salesman problems, Traffic monitoring problems, transportations problems, fault diagnosis problems with computational intelligence.

Total no of hours :45

References

1. Andries P.Engelbrecht, (2000) *Computational intelligence*. University of Pretoria-South Africa:
2. Singiresus. Rao, *Engineering optimization*. West Lafayette. Indiana.

BEC13E37 ADVANCED DIGITAL SIGNAL PROCESSING 3 0 0 3

OBJECTIVES:

- Understands the concepts of filters, algorithm and its applications.
- Capable to design multirate signal processing using I and D factor.
- Capable to solve time domain analysis using transforms.

UNIT I: Parametric Methods for Power Spectrum Estimation **9 hours**

Relationship between the auto correlation and the model parameters – The Yule – Walker method for the AR Model Parameters – The Burg Method for the AR Model parameters – unconstrained least-squares method for the AR Model parameters – sequential estimation methods for the AR Model parameters – selection of AR Model order.

UNIT II : Adaptive Signal Processing **9 hours**

FIR adaptive filters – steepest descent adaptive filter – LMS algorithm – convergence of LMS algorithms – Application: noise cancellation – channel equalization – adaptive recursive filters – recursive least squares.

UNIT III: Multi rate Signal Processing **9 hours**

Decimation by a factor D – Interpolation by a factor I – Filter Design and implementation for sampling rate conversion: Direct form FIR filter structures – Poly phase filter structure.

UNIT IV: Speech Signal Processing **9 hours**

Digital models for speech signal : Mechanism of speech production – model for vocal tract, radiation and excitation – complete model – time domain processing of speech signal:- Pitch period estimation – using autocorrelation function – Linear predictive Coding: Basic Principles – autocorrelation method – Durbin recursive solution.

UNIT V: Wavelet Transforms **9 hours**

Fourier Transform : Its power and Limitations – Short Time Fourier Transform – The Gabor Transform - Discrete Time Fourier Transform and filter banks – Continuous Wavelet Transform – Wavelet Transform Ideal Case – Perfect Reconstruction Filter Banks and wavelets – Recursive multi-resolution decomposition – Haar Wavelet – Daubechies Wavelet-Familiarization of related simulation package.

Total No of Hours : 45

Text Books

1. John G. Proakis, Dimitris G. Manobakis (2000) *Digital Signal Processing, Principles, Algorithms and Applications*.3rd Ed. PHI.
2. Monson H. Hayes, (2002) – *Statistical Digital Signal Processing and Modeling*. Wiley.

References

1. Rabiner, L.R. Schaber, R.W. (1979) *Digital Processing of Speech Signals*. Pearson Education .
2. Roberto Crist, (2004) *Modern Digital Signal Processing*. Thomson Brooks/Cole .
3. Raghuveer M. Rao, Ajit S. Bopardikar, (2000) *Wavelet Transforms, Introduction to Theory and applications*. Asia : Pearson Education.

BEE13E02 POWER PLANT INSTRUMENTATION 3 0 0 3

OBJECTIVES:

- Familiarity to Power Generation.
- Capable to measure Electrical parameters.
- Capable to monitor and control the renewable energy systems.

UNIT I: Overview Of Power Generation **9 hours**

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 UP&I diagram of boiler – cogeneration.

UNIT II: Measurements in Power Plants **9 hours**

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.

UNIT III: Analyzers in Power Plants **9 hours**

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

UNIT IV: Control Loops in Boiler **9 hours**

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

UNIT V: Turbine – Monitoring and Control **9 hours**

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

Total No of Hours: 45

Text Books

1. Sam G. Dukelow, (1991) *The control of Boilers, instrument* .Society of America:
2. (1971) *Modern Power Station Practice*.Vol.6.Instrumentation, Controls and Testing. Pergamon Press. Oxford:

References

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

BEE13E03 HVDC TRANSMISSION 3 0 0 3

OBJECTIVES:

- Compare the present transmission system with the DC system
- Analyze the HVDC Converters.
- Model the HVDC system.

UNIT – I Introduction **9hours**

Introduction of DC Power transmission technology – Classification of HVDC links- Components of HVDC transmission system- Comparison of AC and DC- Planning and Modern trends in DC transmission.

UNIT– II Analysis Of HVDC Converters **9hours**

Pulse number – Choice of converter configuration – Simplified analysis of Graetz circuit – Converter bridge characteristics – Characteristics of a twelve pulse converter – Detailed analysis of converters.

UNIT – III Converter and HVDC System Control **9hours**

General – Principles of DC Link Control- Converter control characteristics – System control Hierarchy – Firing Angle control – Current and Extinction angle control – Starting and stopping of DC Link – Power Control.

UNIT – IV Harmonics and Filters **9hours**

Introduction – Generation of harmonics – Design of AC filters and DC filters – Interference with neighbouring communication lines.

UNIT – V HVDC Cables and Modeling Of HVDC Systems **9hours**

Introduction of DC cables – Basic physical phenomenon arising in DC insulation – Practical dielectrics – Dielectric stress consideration – Economics of DC cables compared with AC cables- Introduction to converter model of HVDC.

Total no. of Hours = 45

Text Books

1. Padiyar, K. R.(1990) *HVDC power transmission system*.1st Ed. New Delhi: Wiley Eastern Limited.
2. Edward Wilson Kimbark, (1971) *Direct Current Transmission*. Vol. I. Wiley inter science. New York: London: Sydney:

References

1. Colin Adamson and Hingorani N.G. (1960) *High Voltage Direct Current Power Transmission*. London: Garraway Limited.
2. Arrillaga, J. Peter Pregrinus, (1983) *High Voltage Direct Current Transmission*. London:
3. Rakosh Das Begamudre, (1990) *Extra High Voltage AC Transmission Engineering*. New Delhi: NewAge International (P) Ltd.
4. Kundur, P. (1994) *Power System Stability & Control*.USA: McGraw Hill Publications.

BEE13E04 **MECHATRONICS** **3 0 0 3**

OBJECTIVES:

- Understand the concepts sensors and transducers.
- Capable to do interfacing programming.
- Capable to solve control system problems.

UNIT-I: Introduction **9 hours**

Mechatronics – definition and key issues – evolution – elements – mechatronics approach to modern Engineering design.

UNIT-II: Sensors and Transducers **9 hours**

Types – displacement, position, proximity and velocity sensors – signal processing – data display.

UNIT-III: Actuation Systems **9 hours**

Mechanical types – applications – electrical types – applications – pneumatic and hydraulic systems – applications – selection of actuators

UNIT-IV: Control Systems **9 hours**

Types of controllers – programmable logic controllers – applications – ladder diagrams – microprocessor applications in mechatronics – programming interfacing – computer applications

UNIT-V: Recent Advances **9 hours**

Manufacturing mechatronics – automobile mechatronics — medical mechatronics – office automation – case studies.

Total No of Hours: 45

Text Books

1. Bulton, N. (1995) *Mechatronics : Electronic Control system for Mechanical and Electrical Engineering*, Longman.
2. Dradly, D.A. Dawson, D. Burd, N.C. and Loader, A.J. (1993) *Mechatronics: Electronics in products and processes*, Chapman & Hall.

References

1. (1968) *HMT Mechatronics*. New Delhi: Tata McGraw-Hill.
2. Galip Ulsoy, A. and Devices, W.R.(1989) *Microcomputer Applications in Manufacturing* .USA: John wiley.
3. James Harter,(1995) *Electromechanics : Principles, concepts and devices*. New Jersey: Prentice Hall.

BEE13E05 FLEXIBLE AC TRANSMISSION SYSTEM 3 0 0 3

OBJECTIVES:

- Comparison of DC & AC systems.
- Modeling the power flow system.
- Comparison of Shunt & Series FACTS Controllers.
- Study about the Combined FACTS Controllers.

UNIT I Introduction **9hours**

The concept of flexible AC transmission - reactive power control in Electrical power transmission lines - uncompensated transmission line – series and shunt compensation. Overview of FACTS devices - Static Var Compensator (SVC) – Thyristors Switched Series capacitor (TCSC) – Unified Power Flow controller (UPFC) - Integrated Power Flow Controller (IPFC).

UNIT II Static VAR Compensator (SVC) and Applications **9hours**

Voltage control by SVC – advantages of slope in dynamic characteristics – influence of SVC on system voltage. Applications - enhancement of transient stability – enhancement of power system damping – prevention of voltage instability.

UNIT III Thyristors Controlled Series Capacitor(TCSC) and Applications **9hours**

Operation of the TCSC – different modes of operation – modeling of TCSC – variable reactance model – modeling for stability studies. Applications - improvement of the system stability limit – enhancement of system damping – voltage collapse prevention.

UNIT IV Emerging FACTS Controllers **9hours**

Static Synchronous Compensator (STATCOM) – operating principle – V-I characteristics – Unified Power Flow Controller (UPFC) – Principle of operation - modes of operation – applications

UNIT V Power Flow Modeling **9hours**

Power flow modeling of SVC, TCSC, STATCOM and UPFC.

Total no. of Hours = 45

Text books

1. Mohan Mathur, R. Rajiv K. Varma, *Thyristor – Based Facts Controllers for Electrical Transmission Systems*. IEEE press and John Wiley & Sons, Inc.
2. ACHA etal, E. *Power Electronic Control in Electrical Systems*. Newness Power Engineering Series.

References

1. John, A.T.(1999) *Flexible AC Transmission System*. Institution of Electrical and Electronic Engineers (IEEE).
2. Narain G. Hingorani, Laszio, Gyugyl, (2001)*Understanding FACTS Concepts and Technology of Flexible AC Transmission System*. Delhi: Standard Publishers.

BCS13E49 GENETIC ALGORITHMS AND ITS APPLICATIONS 2 0 2 3

OBJECTIVES:

- Capable to find the feasible solution using optimization methods.
- Capable to develop different algorithms.
- Capable to do simulation using advanced applications.

UNIT I : Introduction to Optimization **9hours**

Finding the Best Solution- Analytical Optimization- Natural Optimization Methods - Genetic Algorithm.

UNIT II: Binary Genetic Algorithm **9hours**

Introduction- Components of a Binary Genetic Algorithm - Population - Mating - Mutations - Next Generation – Convergence.

UNIT III: Continuous Genetic Algorithm **9hours**

Components -Variables and Cost Function -Variable Encoding, Precision, and Bounds - Initial Population Pairing - Mating - Mutations -The Next Generation – Convergence.

UNIT IV : Basic Applications **9hours**

Mary Had a Little Lamb- Algorithmic Creativity-Genetic Art - Word Guess - Locating an Emergency-Response Unit - Antenna Array Design- Evolution of Horses.

UNIT V: Advanced Applications **9hours**

Travelling Salesperson Problem - Decoding a Secret Message - Robot Trajectory Planning - Combining GAs with Simulations- Optimizing Artificial Neural Nets with GAs – Solving High-Order Nonlinear Partial Differential.

Total No of hours :45

References

1. Randy L. Haupt, Sue Ellen Haupt, (2005) *Practical genetic algorithms.*A Wiley-Interscience Publication.
2. Mitchell, M. (1996) *Introduction to Genetic Algorithms*. Indian reprint.Cambridge: USA: MIT press.
3. Andries P. Engel brecht, (2000) *Computational intelligence*. university of Pretoria: South Africa:

BEE13E06 INDUSTRIAL INSTRUMENTATION 3 0 0 3

OBJECTIVES:

- Implementing Sensors & Actuators.
- Knowledge to measure the instruments used in Industries.
- Design of special techniques in various meters.

UNIT I: Measurement Of Force, Torque and Velocity **9hours**

Electric balance – Different types of load cells – Magnets – Elastic load cells - Strain gauge load cell – Different methods of torque measurement – Strain gauge, relative regular twist – Speed measurement – Revolution counter – Capacitive Tacho-drag cup type Tacho – D.C and A.C Tacho generators – Stroboscope.

UNIT II: Measurement Of Acceleration, Vibration, Density and Viscosity **9hours**

Accelerometers – LVDT, piezoelectric, strain gauge and variable reluctance type accelerometers – Mechanical type vibration instruments – Seismic instrument as an accelerometer and vibrometer – Calibration of vibration pick-ups – Units of density, specific gravity and viscosity used in industries – Baume scale, API scale – Pressure head type densitometer – Float type densitometer – Ultrasonic densitometer – Bridge type gas densitometer – Viscosity terms – Saybolt viscometer – Rotameter type.

UNIT III: Pressure Measurement **9hours**

Units of pressure - Manometers – Different types – Elastic type pressure gauges – Bourdon type bellows – Diaphragms – Electrical methods – Elastic elements with LVDT and strain gauges – Capacitive type pressure gauge – Piezo resistive pressure sensor – Resonator pressure sensor – Measurement of vacuum – McLeod gauge – Thermal conductivity gauges – Ionization gauge, cold cathode and hot cathode types – Testing and calibration of pressure gauges – Dead weight tester.

UNIT IV: Temperature Measurement **9hours**

Definitions and standards – Primary and secondary fixed points – Calibration of thermometer, different types of filled in system thermometer – Sources of errors in filled in systems and their compensation – Bimetallic thermometers – Electrical methods of temperature measurement – Signal conditioning of industrial RTDs and their characteristics – Three lead and four lead RTDs.

UNIT V: Thermocouples and Pyrometers **9hours**

Thermocouples – Laws of thermocouple – Fabrication of industrial thermocouples – Signal conditioning of thermocouples output – Thermal block reference functions – Commercial circuits for cold junction compensation – Response of thermocouple – Special techniques for measuring high temperature using thermocouples – Radiation methods of temperature measurement – Radiation fundamentals – Total radiation & selective radiation pyrometers – Optical pyrometer – Two colour radiation pyrometers.

Total No. of Credits -45

Text Books

1. Doebelin, E.O.(2003) *Measurement Systems – Application and Design*. Tata McGraw Hill publishing company.
2. Jain, R.K. (1999) *Mechanical and Industrial Measurements*. New Delhi: Khanna Publishers.

References

1. Patranabis, D.(1996) *Principles of Industrial Instrumentation*. Tata McGraw Hill Publishing Company Ltd.
2. Sawhney, A.K. and Sawhney, P.(2004) *A Course on Mechanical Measurements, Instrumentation and Control* Dhanpath Rai and Co.
3. Nakra, B.C. & Chaudary, B.C.*Instrumentation Measurement & Analysis*.Tata McGraw Hill Publishing Ltd.
4. Singh, S.K.(2003) *Industrial Instrumentation and Control*.Tata McGraw Hill.
5. Eckman, D.P. *Industrial Instrumentation*. Wiley Eastern Ltd.

BME13E31 PRINCIPLES OF ROBOTICS 3 0 0 3

OBJECTIVES:

- Understands the concept of robotic system and its auxillary parts.
- Understands about motion analysis, drive systems and machine vision for robotics.
- The graduate will be capable to work in programming of robots.

UNIT I Basic Concepts **9 hours**

Definition and origin of robotics different types of robotics – various generations of robots – degrees of freedom Asimov's laws of robotics – dynamic stabilization of robots.

UNIT II Power Sources and Sensors **9 hours**

Hydraulic, pneumatic and electric drives – determination of HP of motor and gearing ratio – variable speed arrangements – path determination – micro machines in robotics – machine vision – ranging – laser – acoustic – magnetic, fibre optic and tactile sensors.

UNIT III Manipulators, Actuators and Grippers **9 hours**

Construction of manipulators – manipulator dynamics and force control – electronic and pneumatic manipulator control circuits – end effectors – U various types of grippers – design considerations.

UNIT IV Kinematics and Path Planning **9 hours**

Solution of inverse kinematics problem – multiple solution Jacobian work envelope – hill climbing techniques – robot programming languages

UNIT V Case Studies **9 hours**

Multiple robots – machine interface – robots in manufacturing and non-manufacturing applications – robot cell design – selection of robot.

Total No of Hours: 45

Text Books

1. Mikell, P. Weiss, G.M. Nagel, R.N. Odraj, N.G.(1996) *Industrial Robotics*. Singapore: McGraw-Hill.
2. Ghosh, (1998) *Control in Robotics and Automation: Sensor Based Integration*. Chennai : Allied Publishers.

References

1. Deb, S.R. (1992) *Robotics technology and flexible Automation*. USA : John Wiley.
2. Asfahl, C.R. (1992) *Robots and manufacturing Automation*. USA : John Wiley.
3. Klafter, R.D. Chimielewski, T.A. Negin, M. (1994) *Robotic Engineering – An Integrated Approach*. New Delhi: Prentice Hall of India.
4. McKerrow, P.J. (1991) *Introduction to Robotics*.USA: Issac Asimov I Robot, (1986) "Ballantine Books". New York: Addison Wesley.

BEE13E07 FUZZY LOGIC AND ITS APPLICATION 2 0 2 3

OBJECTIVES:

- Understand the terminology and learning methods related to neural networks.
- Understands the applications of neural networks in image processing, signal processing, modeling and control.
- Understands about the mathematical adaptation of neuro-fuzzy systems.

UNIT I : Introduction to Fuzzy Sets **9hours**

Basic definitions and relations- classical sets- classical set operations- properties of classical sets- fuzzy sets- fuzzy membership functions- fuzzy set operations-properties of fuzzy sets.

UNIT II: **Introduction to Fuzzy Logic** **9hours**

Introduction-predicate logic- tautologies- contradictions- deductive inferences- fuzzy logic-approximate reasoning.

UNIT III : **Fuzzy Control and Stability** **9hours**

Introduction- Basic Definitions- Inference Engine- Defuzzification -Fuzzy Control Design- Analysis of Fuzzy Control Systems- Stability of Fuzzy Control Systems- Lyapunov Stability

UNIT IV: Application Of Fuzzy Logic **9hours**

Introduction- Building Energy Management System (BEMS)-Air Conditioning System- Process Control- Digital PID Controller-Management of Chilling System- Application of Fuzzy Control for Energy Management of a Cascade Heating Centre

UNIT V: Neuro-Fuzzy Logic Control **9hours**

Optimization of membership function and rules base of fuzzy logic controller using neural networks – fuzzy neuron – adaptive fuzzy systems – case study

Text Books **Total No of Hours : 45**

1. Ali Zilouchian Mo Jamshidi, (2000) *Intelligent Control Systems Using Soft Computing Methodologies*.
2. Zimmermann H.J.(1996) *Fuzzy set theory and its applications*. Allied Publication Ltd.

References

1. Klir, G.J. and Yuan, B.B.(1997) *Fuzzy sets and fuzzy logic.* New Delhi: Prentice Hall of India.
2. Driankov, D. Hellendron, H. Reinfrank, M.(1996) *An Introduction to Fuzzy control.* New Delhi: Narosa publishing House.

BEE13E08 ELECTRIC TRACTION 3 0 0 3

OBJECTIVES:

- Familiarity in Traction drive and its services.
- Capable to estimate motor rating with reference to Indian standards.
- Capable to apply concepts in Electrical Machines.

UNIT I: Introduction **9 hours**

Basic drive components , classification and operating modes of electric drive, nature and type of mechanical loads, review of speed torque , characteristics of electric motors and load , joint speed torque characteristics. **Electric Braking:** Plugging , dynamic and regenerative braking of DC and AC motors.

UNIT II: Dynamics Of Electric Drives System **9 hours**

Equation of motion , equivalent system of motor load combination, stability considerations, electro mechanical transients during starting and braking , calculation of time and energy losses, optimum frequency of starting.

UNIT III: Traction Drive **9 hours**

Electric traction services, duty cycle of traction drives calculations of drive rating and energy consumption, desirable characteristics of traction drive and suitability of electric motors, control of traction drives. Energy Conservation in Electric Drive: Losses in electric drive system and their minimization energy, efficient operation of drives, load equalization.

UNIT IV: Estimation Of Motor Power Rating **9 hours**

Heating and cooling of electric motors, load diagrams, classes of duty, reference to India standards, estimation of rating of electric motors for continuous, short time and intermittent ratings.

UNIT V: Special Electric Drive **9 hours**

Servo motor drive, step motor drive, linear induction motor drive, permanent magnet motor drive. Selection of electric drive: Selection criteria of electric drive for industrial applications, case studies related to steel mills, paper mills, textile mills and machine tool etc.

Total No of Hours: 45

Text Books

1. Dubey, G.K. (1995) *Fundamentals of Electric Drive*. Narosa Publishing House.
2. Chilkin, M. *Electric Drive*. Mir Publications.

References

1. Pillai, S.K. *A first course on Electric Drive*. New age international publishers.
2. Dev, N.K. Sen, P.K. (1999) *Electric Drives*. Prentice Hall of India .
3. Vedam Subhramanyam, (1994) *Electric Drive : Concepts and Applications*. Tata McGraw Hill.

BEE13E09 NON–CONVENTIONAL SOURCES OF ENERGY 3 0 0 3

OBJECTIVES:

- Knowledge about the Renewable & non-renewable energy sources.
- Efficient utilization of the energy resources.
- Current status of the resources in our country.

UNIT I: Principles Of Solar Radiation **9 hours**

Role and potential of new and renewable source, the solar energy option, Environmental impact of solar power, physics of the sun, the solar constant, extraterrestrial and terrestrial solar radiation, solar radiation on titled surface, instruments for measuring solar radiation and sun shine, solar radiation data.

UNIT II: Solar Energy Collection **9 hours**

Flat plate and concentrating collectors, classification of concentrating collectors, orientation and thermal analysis, advanced collectors.

UNIT III : Solar Energy Storage and Applications **9 hours**

Different methods, Sensible, latent heat and stratified storage, solar ponds. SolarApplications- solar heating/cooling technique, solar distillation and drying, photovoltaic energy conversion.

UNIT IV: Wind Energy and Tidal Energy **9 hours**

Sources and potentials, horizontal and vertical axis windmills, performance characteristics, Betz criteria, Tidal energy: Energy from tides and waves – working principles of tidal plants – tidal power generations, Ocean energy.

UNIT-V: Bio-Mass and Geothermal Energy **9 hours**

Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of Bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking, I.C. Engine operation and economic aspects. Resources, types of wells, methods of harnessing the energy, potential in India.

Total No of Hours: 45

Text Books

1. Rai, G.D. *Non- Conventional Energy Sources*.
2. Ramesh & Kumar, Narosa, *Renewable Energy Technologies*.

References

1. Tiwari and Ghosal, Narosa, *Renewable Energy Resources*.
2. Ashok V Desai, *Non-Conventional Energy*. Wiley Eastern.
3. Mittal, K. Sukhame, *Non-Conventional Energy Systems. Wheeler and Solar Energy*.