FACULTY OF ENGINEERING AND TECHNOLOGY

REGULATIONS - 2016

CURRICULUM AND SYLLABUS

FROM

I TO VII SEMESTERS

FOR

B.E. – ELECTRICAL AND ELECTRONICS ENGINEERING

(PART TIME)

FACULTY OF ENGINEERING AND TECHNOLOGY

REGULATIONS-2016

CHOICE BASED CREDIT SYSTEM

CURRICULUM FROM I TO VII SEMESTERS FOR

B.E.ELECTRICAL AND ELECTRONICS ENGINEERING (PART TIME)

SEMESTER –I

Sl.No	Course Code	Course Title	Dept. Offering the course	L	T	P	C
	THEORY						
1.		Engineering Mathematics	Mathematics	3	1	0	4
2.		Environmental Sciences& Engineering	Chemistry	3	0	0	3
3.		Electron Devices	ECE	3	0	0	3
4.		Electric Circuit Analysis	EEE	3	1	0	4
	PRACTICAL						
5.		Electric Circuits Laboratory	EEE	0	0	3	2
		TOTAL		**12**	**2**	**3**	**16**

SEMESTER -II

Sl.No	Course Code	Course Title	Dept. Offering the course	L	T	P	C
	THEORY						
1.		Advanced Engineering Mathematics	Mathematics	3	1	0	4
2.		Electro Magnetic Theory	EEE	3	1	0	4
3.		Electrical Machines - I	EEE	3	0	0	3
4.		Measurement and Instrumentation	EEE	3	0	0	3
	PRACTICAL						
5.		Electrical Machines- I Laboratory	EEE	0	0	3	2
		TOTAL		**12**	**2**	**3**	**16**

SEMESTER –III

Sl.No	Course Code	Course Title	Dept. Offering the course	L	T	P	C
	THEORY						
1.		Electrical Machines – II	EEE	3	0	0	3
2.		Transmission & Distribution	EEE	3	0	0	3
3.		Electronic Circuits	ECE	3	0	0	3
4.		Digital Electronics	ECE	3	1	0	4
	PRACTICAL						
5.		Electrical Machines - II Laboratory	EEE	0	0	3	2
6.		Measurement and Instrumentation Laboratory	EEE	0	0	3	2
		TOTAL		**12**	**1**	**6**	**17**

SEMESTER -IV

Sl.No	Course Code	Course Title	Dept. Offering the course	L	T	P	C
	THEORY						
1.		Power Electronics	EEE	3	0	0	3
2.		Linear Integrated Circuits	ECE	3	0	0	3
3.		Design of Electrical Apparatus	EEE	3	1	0	4
4.		Protection and Switchgear	EEE	3	0	0	3
	PRACTICAL						
5.		Power Electronics Laboratory	EEE	0	0	3	2
6.		Digital Electronics Laboratory	ECE	0	0	3	2
		TOTAL		**12**	**1**	**6**	**17**

SEMESTER -V

Sl.No	Course Code	Course Title	Dept. Offering the course	L	T	P	C
	THEORY						
1.		Solid State Drives	EEE	3	0	0	3
2.		Power System Analysis	EEE	3	1	0	4
3.		Control Systems	EEE	3	1	0	4
4.		Mathematical Modeling and Simulation	EEE	3	1	0	4
	PRACTICAL						
5.		Control System Laboratory	EEE	0	0	3	2
6.		Power System Simulation Laboratory	EEE	0	0	3	2
		TOTAL		**12**	**3**	**6**	**19**

SEMESTER -VI

Sl.No	Course Code	Course Title	Dept. Offering the course	L	T	P	C
	THEORY						
1.		Microcontroller& Applications	ECE	3	0	0	3
2.		High Voltage Engineering	EEE	3	0	0	3
3.		Embedded Systems	ECE	3	0	0	3
4.		Elective-I		3	0	0	3
	PRACTICAL						
5.		Microcontroller Laboratory	ECE	0	0	3	2
6.		Solid State Drives Laboratory	EEE	0	0	3	2
		TOTAL		**12**	**0**	**6**	**16**

SEMESTER -VII

Sl.No	Course Code	Course Title	Dept. Offering the course	L	T	P	C
	THEORY						
1.		Electric Energy Generation, Utilization and Conservation	EEE	3	0	0	3
2.		Elective-II		3	0	0	3
3.		Elective-III		3	0	0	3
	PRACTICAL						
4.		Project Work & Viva Voce	EEE	0	0	12	6
		TOTAL		**9**	**0**	**12**	**15**

TOTAL CREDITS: 115

ELECTIVES

Sl.No	Course Code	Course Title	**Dept. Offering the course**	L	T	P	C
THEORY							
1.		Advanced Control System	EEE	3	0	0	3
2.		Advanced Topics in Power Electronics	EEE	3	0	0	3
3.		Artificial Intelligence and Expert System	EEE	3	0	0	3
4.		Biomedical Instrumentation	EEE	3	0	0	3
5.		CAD for Electrical Apparatus	EEE	3	0	0	3
6.		EHV AC & Direct Current Power Transmission	EEE	3	0	0	3
7.		Flexible AC Transmission System	EEE	3	0	0	3
8.		High Voltage Direct Current Transmission	EEE	3	0	0	3
9.		Information Security	CSE	3	0	0	3
10.		Intelligent Controllers	ECE	3	0	0	3
11.		Micro Electro Mechanical Systems	ECE	3	0	0	3
12.		Power Electronics for Renewable Energy System	EEE	3	0	0	3
13.		Power Quality	EEE	3	0	0	3
14.		Power System Dynamics	EEE	3	0	0	3
15.		Power system Planning and Reliability	EEE	3	0	0	3
16.		Power System Transients	EEE	3	0	0	3
17.		Robotics and Automation	ECE	3	0	0	3
18.		Special Electrical Machines	EEE	3	0	0	3
19.		VLSI Design Techniques	ECE	3	0	0	3
20.		Wind Energy Conversion Systems	EEE	3	0	0	3

YEAR	I	ENGINEERING MATHEMATICS	L	T	P	C
SEMESTER	I	(COMMON TO MECH,ECE,CSE,EEE, CIVIL, IT, MECHTRONICS, AERONAUCTICAL ,AUTOMOBILE BRANCHES)	3	1	0	4

UNIT – I MATRICES **9**

Characteristic equation – Eigen values and eigenvectors of a real matrix – Properties of eigenvalues and eigenvectors (Without proof) – Cayley-Hamilton theorem (excluding proof) – Orthogonal transformation of a symmetric matrix to diagonal form.

UNIT – II ORDINARY DIFFERENTIAL EQUATIONS **9**

Solutions of First and Second order linear ordinary differential equation with constant coefficients – Method of variation of parameters –Simultaneous first order linear equations with constant coefficients.

UNIT – III MULTIPLE INTEGRALS AND VECTOR CALCULUS **9**

Double integration - Cartesian and polar coordinates –Area as a double integral – Triple integration – volume as a triple integral- Directional derivatives – Gradient, Divergence and Curl – Irrotational and solenoidal- vector fields – vector integration.

UNIT – IV LAPLACE TRANSFORMS **9**

Laplace transform – transform of elementary functions – basic properties – derivatives and integrals of transforms – transforms of derivatives and integrals – initial and final value theorems – Transform of periodic functions.

UNIT – V APPLICATIONS OF LAPLACE TRANSFORMS **9**

Inverse Laplace transform – Convolution theorem – Initial and Final value theorem-Solution of linear ODE of second order with constant coefficients and first order simultaneous equation with constant coefficients using Laplace transforms.

Total hours : 60

Lecture Hours: 45

Tutorial Hours: 15

TEXT BOOKS

1. "Engineering Mathematics" by Department of Mathematics, VMU

2. Veerarajan, T., "Engineering Mathematics", Tata McGraw Hill Publishing Co., NewDelhi, 2006.

3. Prof.Dr.A .Singaravelu , Engineering Mathematics Volume I & Volume II by Meenakshi Publications.

REFERENCE BOOKS

1. Grewal, B.S., "Higher Engineering Mathematics" (36th Edition), Khanna Publishers, Delhi 2001.

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

3. Kandasamy .P., Thilagavathy. K., and Gunavathy. K., "Engineering Mathematics", Volumes I &

II (4th edition), S.Chand & Co., New Delhi., 2001.

YEAR	I	ENVIRONMENTAL SCIENCE AND ENGINEERING (Common to All Branches)	L	T	P	C
SEMESTER	I		3	0	0	3

UNIT – I INTRODUCTION TO ENVIRONMENTAL STUDIES AND NATURAL RESOURCES

10

Definition, scope and importance – need for public awareness- forest resources: use and over exploitation, deforestation, case studies. Timber extraction, mining, dams and their ground water, floods, drought, conflicts over water, dams-benefits and problems-mineral resources: use effects on forests and tribal people-water resources: use and over-utilization of surface and exploitation, environmental effects if extracting and using mineral resources, case studies-food resources: world food problems, changes caused by agriculture and overgrazing, effects of modem agriculture, fertilizer-pesticide problems, water logging, salinity, case studies-energy resources: growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. Case studies –land resources: land as a resource, land degradation, man induced landslides, soil erosion and desertification –role of an individual in conservation of natural resources-equitable use of resources for sustainable lifestyles. Field study of local area to document environmental assets-river / forest. / grassland / hill / mountain.

UNIT – II ECOSYSTEMS AND BIODIVERSITY 14

Concept of and ecosystem –structure and function of an ecosystem-producers, consumers and decomposers-energy flow in the ecosystem-ecological succession-food chains, food webs and ecological pyramids-introduction, types, characteristic features, structure and function of the (a)forest ecosystem (b). grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers oceans, estuaries)-introduction to biodiversity- definition: genetic, species and ecosystem diversity-biogeographical classification of India-value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values-biodiversity at global, national and local levels-India as a mega-diversity nation-hot-spots of biodiversity-threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts-endangered and endemic species of India –conservation of biodiversity: in-situ and ex-situ conservation of biodiversity. Field study of common plants, insects, birds Field study of simple ecosystems – pond, river, hill slopes, etc.

UNIT – III ENVIRONMENTAL POLLUTION 8

efinition-causes, effects and control measures of: (a) air pollution (b) water pollution (c) soil pollution (d) marine pollution (e) noise pollution (f) thermal pollution (g) nuclear hazards – solid waste management: caused, effects and control measures of urban and industrial wastes-role of an individual in prevention of pollution-pollution case studies – disaster management: floods, earthquake, cyclone and landslides. Field study of local polluted site-urban / rural / industrial / agriculture

UNIT – IV SOCIAL ISSUES AND THEIR ENVIRONMENT 7

From unsustainable to sustainable development-urban problems related to energy- water conservation, rain water harvesting, watershed management –resettlement and rehabilitation of people, its problems and concerns, case studies – environmental ethics: issues and possible solutions – climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies – wasteland reclamation-consumerism and waste products-environment protection act-air (prevention and control of pollution) act-water (prevention and control of pollution) act- wildlife protection act-forest conservation act-issues involved in enforcement of environmental legislation-public awareness.

UNIT – V HUMAN POPULATION AND THE ENVRONMENT 6

Population growth, variation among nations – population explosion – family welfare programme-environment and human health – human rights- value education- HIV/ AIDS – women and child welfare –role of information technology in environment and human health –case studies.

Total Hours : 45

TEXT BOOK:

1. Raman Sivakumar, Environmental Science and Engineering, Vijay Nicole imprints Pvt.Ltd.

REFERENCE BOOKS :

1. Bharucha Erach, The Biodiversity of India, publishing Pvt. Ahmedabad, India,
2. Trivedi R.K. Hand book of Environmental laws, Rules, Guidelines, Compliances and Standards, Vol. and II, Enviro Media.
3. Cunningham, W.P.Cooper, T.H.Gorhani, Environmental Encyclopedia, jaicao., House, Mumbai, 2001.
4. Weger K.D., Environmental Management, W.B. Saunders, Co., Philadelphia, USA., 1998.
5. Gilbert M.Masters, Introduction to Environmental Engineering and science, pearson Education Pvt., Ltd., Second Edition, 2004
6. Miller `T.G. Jr., Environmental Science, Wadsworth Publishing Co.
7. Townsend C., Harper J and Michael Begon, Essentials of Ecology, Blackwell Science Trivedi
8. R.K And P.K. Goel, Introduction to air pollution, Techno-Science publications.

YEAR	I	ELECTRIC CIRCUIT ANALYSIS	L	T	P	C
SEMESTER	I		3	1	0	4

AIM

- To study concepts of basic circuits, Network theorems, resonance and coupled circuits, balanced and unbalanced circuits and transient analysis of circuits.

OBJECTIVE:

- To understand basic circuit concepts.
- To study networks and solution of DC and AC circuits.
- To understand series and parallel resonance concepts and analysis of coupled circuits.
- To understand transient analysis of RL, RC and RLC circuits with DC and sinusoidal excitations
- To study protection of balanced and unbalanced loads and measurement of power and power factor in three phase circuits.

UNIT - I BASIC CIRCUIT ANALYSIS 12

Ohm's law, Kirchoff's laws. DC and AC circuits. Resistors in series and parallel circuits. Mesh current and node voltage method of analysis for DC and AC circuits (AC circuits at elementary level only)

UNIT – II NETWORK REDUCTION AND NETWORK THEOREMS FOR DC AND AC CIRCUITS 12

Network reduction : Voltage and current division-Source Transformation-Star, delta conversion, The venin's Theorem and Norton's Theorem-Superposition Theorem-Maximum power transfer Theorem.

UNIT – III RESONANCE AND COUPLED CIRCUITS 12

Series and Parallel resonance- their frequency response - Quality factor and Bandwidth - Self and Mutual inductance- Co-efficient of coupling- Tuned circuits- Single Tuned circuits and double Tuned circuits.

UNIT – IV TRANSIENT RESPONSE OF DC AND AC CIRCUITS. 12

Transient response of RL, RC, and RLC circuits using Laplace Transform for DC input and AC sinusoidal inputs only.

UNIT – V ANALYSIS OF THREE PHASE CIRCUITS 12

Three phase balanced and unbalanced voltage sources- Analysis of three phase 3 wire and 4 wire circuits with star and delta connected loads- balanced and unbalanced phasor diagram of voltages and currents - Power and power factor measurements in three phase circuits.

TOTAL: 60

TEXT BOOKS:

1. Electric Circuit Theory, Dr.M.Arumugam, N.Premkumaran, 6th Edition, Khanna publishers, New Delhi - 6.
2. Electric Circuit Analysis, Sudhakar.A and Shyam Mohan.SP, 2nd Edition,2009, Tata Mc-Graw Hill Publications, New Delhi.

REFERENCES:

1. Engineering Circuit Analysis, W.H.Hayt & J.K.Kemmerly and Steven M.Durbin, 7th Edition, 2007, Tata Mc-Graw Hill Publications, New Delhi.
2. Circuit Theory, A.Chakabarthi, 5th Edition, 2006, Dhanpatrai & Co, New Delhi.

YEAR	I	ELECTRON DEVICES	L	T	P	C
SEMESTER	I		3	0	0	3

AIM

The purpose of this course is to provide a basis for understanding the characteristics, operation and limitations of various semiconductor devices.

OBJECTIVES

1. To understand the basics of electrons and to find the motion of charges in electrostatic and magnetic fields.
2. To understand the basics and characteristics of a Semiconductor and its types in Equilibrium and Non-Equilibrium conditions.
3. To understand the working of PN junction diodes and special purpose diodes.
4. To understand the basic operations of BJT and its characteristics.
5. To understand the Constructional features working and characteristics of FET, UJT and SCR

UNIT – I ELECTRON BALLISTICS AND INTRINSIC SEMICONDUCTORS 9

Force on charge in electric field - Motion of Charge in uniform and time varying electric fields - Force on a moving charge in a magnetic field - calculation of cyclotron frequency - calculation of electrostatic and magnetic deflection sensitivity.

Energy band structure of conductors, semiconductors and insulators - Density distribution of available energy states in semiconductors - Fermi- Diac probability distribution function at different temperatures - Thermal generation of carriers - Calculation of electron and hole densities in intrinsic semiconductors - Intrinsic concentration - Mass Action Law.

UNIT – II EXTRINSIC SEMICONDUCTOR AND PN JUNCTIONS 9

N and P type semiconductors and their energy band structures - Law of electrical neutrality - Calculation of location of Fermi level and free electron and hole densities in extrinsic semiconductors - Mobility, drift current and conductivity - Diffusion current - Continuity equation - Hall effect. Band structure of PN Junction - Current Component in a PN Junction - Derivation of diode equation - Temperature dependence of diode characteristics.

UNIT – III SWITCHING CHARACTERISTICS OF PN JUNCTION AND SPECIAL DIODES 9

Calculation of transition and diffusion capacitance - Varactor diode - charge control description of diode - switching characteristics of diode - Mechanism of avalanche and Zener breakdown - Temperature dependence of breakdown voltages - Backward diode - Tunneling effect in thin barriers Tunnel diode - Photo diode - Light emitting diodes.

UNIT – IV BIPOLAR JUNCTION TRANSISTORS AND FIELD EFFECT TRANSISTORS 9

Construction of PNP and NPN transistors - BJT current components - Emitter to collector and base to collector current gains - Base width modulation CB and CE characteristics - Breakdown characteristics - Ebers - Moll model - Transistor switching times.

Construction and Characteristics of JFET - Relation between Pinch off Voltage and drain current - Derivation. MOSFETS - Enhancement and depletion types.

UNIT – I METAL SEMICONDUCTOR CONTACTS AND POWER CONTROL DEVICE 9

Metal Semiconductor Contacts - Energy band diagram of metal semiconductor junction Schottky diode and ohmic contacts. Power control devices: Characteristics and equivalent circuit of UJT -intrinsic stand off ratio. PNPN diode - Two transistor model, SCR, Triac, Diac.

TOTAL HOURS : 45

TEXT BOOKS:

1. Jacob Millman & Christos C.Halkias, ‘‘Electronic Devices and Circuits” Tata McGraw-Hill,1991 .

REFERENCES:

1. Nandita Das Gupta and Amitava Das Gupta, Semiconductor Devices - Modelling and Technology, Prentice Hall of India, 2004.
2. Donald A.Neaman,” Semiconductor Physics and Devices” 3rd Ed., Tata McGraw-Hill 2002.
3. S.M.Sze, Semiconductor Devices - Physics and Technology, 2nd edn. John Wiley, 2002.
4. Ben G.Streetman and Sanjay Banerjee, Solid State Electronic Devices, Pearson Education 2000.
5. Anokh Singh, Principles of Communication Engineering, S.Chand & Co, 1994
6. V.K.Mehta,”Principles of Electronics’’S.Chand&Co,2002

YEAR	I	Practicals ELECTRIC CIRCUITS LAB	L	T	P	C
SEMESTER	I		0	0	3	2

1. Verification of Kirchhoff's Law.
2. Verification of The venin's Theorem.
3. Verification of Norton's Theorem.
4. Verification of super position Theorem.
5. Verification of compensation Theorem.
6. Verification of Reciprocity and Maximum Power Transfer Theorem.
7. Series Resonance Circuits
8. Parallel Resonance Circuits.
9. Transients in RLC Circuits.
10. Series AC Circuits and Phasor Diagram.

YEAR	I	ADVAVCED ENGINEERING MATHEMATICS	L	T	P	C
SEMESTER	II	(COMMON TO MECH,ECE,CSE,EEE, CIVIL, IT, MECHTRONICS, AERONAUCTICAL ,AUTOMOBILE BRANCHES)	3	1	0	4

UNIT – I PARTIAL DIFFERENTIAL EQUATIONS **9**

Formation - Solutions of standard types of first order equations - Lagrange's Linear equation - Linear partial differential equations of second and higher order with constant coefficients.

UNIT – II FOURIER SERIES **9**

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

UNIT – III BOUNDARY VALUE PROBLEMS **9**

Classification of second order linear partial differential equations - Solutions of one - dimensional wave equation, one-dimensional heat equation

UNIT – IV FOURIER TRANSFORMS **9**

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

UNIT – V Z - TRANSFORM **9**

Z-Transform – Elementary Properties – Inverse Z-Transform – Convolution Theorem – Formation of Difference Equations – Solution of Difference Equations using Z-Transform.

Total hours: 45

TEXT BOOKS:

1. Kreyszig, E., " Advanced Engineering Mathematics " (8th Edition), John Wiley and Sons, (Asia) Pte Ltd.,Singapore, 2000.
2. Grewal, B.S., " Higher Engineering Mathematics " (35th Edition), Khanna Publishers, Delhi 2000.
3. Prof.Dr.A .Singaravelu, Transform and Partial Differential Equations by Meenakshi Publications.

REFERENCES:

1. Kandasamy, P., Thilagavathy, K., and Gunavathy, K., " Engineering Mathematics ", Volumes II & III (4th Revised Edition), S. Chand & Co., New Delhi, 2001.
2. Narayanan, S., Manicavachagom Pillay, T.K., Ramanaiah, G., " Advanced Mathematics for Engineering Students ", Volumes II & III (2ndEdition), S.Viswanathan (Printers & Publishers, Pvt, Ltd.) 1992.
3. Venkataraman, M.K. " Engineering Mathematics " Volumes III - A & B, 13th Edition National Publishing Company, Chennai, 1998.
4. Shanmugam, T.N. : http://www.annauniv.edu/shan/trans.htm

YEAR	I	ELECTROMAGNETIC THEORY	L	T	P	C
SEMESTER	II		3	0	0	3

AIM

- To study the theory and designing equations of Electrostatics and Magnetostatics.

OBJECTIVES

- To impart knowledge on basic concepts of electromagnetic fields .
- To understand the Law of electrostatics.
- To gain knowledge about the concepts of Magneto statics.
- To gain knowledge about the perception of electromagnetic fields.
- To understand the generation and parameters of electromagnetic waves .

UNIT – I INTRODUCTION **8**

Sources and effects of electromagnetic fields – Vector fields – Different co-ordinate systems Divergence theorem – Stoke's theorem.

UNIT – II ELECTROSTATICS **10**

Coulomb's Law – Electric field intensity – Field due to point and continuous charges – Gauss's law and application – Electrical potential – Electric field and equipotential plots – Electric field in free space, conductors, dielectric – Dielectric polarization, Electric field in multiple dielectrics – boundary conditions, Poisson's and Laplace's equations – Capacitance-energy density – Dielectric strength.

UNIT – III MAGNETOSTATICS 9

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

UNIT – IV ELECTRODYNAMIC FIELDS 8

Faraday's laws, induced emf – Transformer and motional EMF, Maxwell's equations (differential and integral forms) – Displacement current – Relation between field theory and circuit theory.

UNIT – V ELECTROMAGNETIC WAVES 9

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

L = 45 T = 15 Total = 60

TEXT BOOKS

1. John.D.Kraus, „Electromagnetics", McGraw Hill book Co., New York, Fourth Edition, 1991.

2. William .H.Hayt, „Engineering Electromagnetics", Tata McGraw Hill edition, 2001.

REFERENCE BOOKS

1. Joseph. A.Edminister, „Theory and Problems of Electromagnetics", Second edition, Schaum Series, Tata McGraw Hill, 1993.
2. I.J. Nagrath, D.P. Kothari, „Electric Machines", Tata McGraw Hill Publishing Co Ltd, Second Edition, 1997.
3. Kraus and Fleish, „Electromagnetics with Applications", McGraw Hill International Editions, Fifth Edition, 1999.

YEAR	I	ELECTRICAL MACHINES - I	L	T	P	C
SEMESTER	II		3	0	0	3

AIM

- To study the theory, operation and performance of DC machines and Transformer.

OBJECTIVES

- To impart knowledge on basic concepts of rotating machines.
- To understand the principle of operation and performance of DC generator.
- To gain knowledge about construction, principle of operation and performance of DC motor.
- To gain knowledge about the construction, principle of operation and performance of Transformer.
- To understand the Performance constraints of DC machines by appropriate tests.

UNIT – I BASIC CONCEPTS OF ROTATING MACHINES 8

Principles of electromechanical energy conversion – Single and multiple excited systems – m.m.f of distributed A.C. windings – Rotating magnetic field – Generated voltage – Torque in round rotor machine.

UNIT – II DC GENERATORS 8

Constructional details – emf equation – Methods of excitation – Self and separately excited generators – Characteristics of series, shunt and compound generators – Armature reaction and commutation – Parallel operation of DC shunt and compound generators.

UNIT – III DC MOTORS 9

Principle of operation – Back emf and torque equation – Characteristics of series, shunt and compound motors – Starting of DC motors – Types of starters – Speed control of DC series and shunt motors.

UNIT – IV TRANSFORMERS 12

Constructional details of core and shell type transformers – Types of windings – Principle of operation – emf equation – Transformation ratio – Transformer on no-load – Parameters referred to HV / LV windings – Equivalent circuit – Transformer on load – Regulation – Parallel operation of single phase transformers – Auto transformer – Three phase transformers – Vector group.

UNIT –V TESTING OF DC MACHINES AND TRANSFORMERS 8

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 – All day efficiency.

Note : Unit5 may be covered along with Unit 2,3,and 4.

L = 45 T = 15 Total = 60

TEXT BOOKS

1. D.P. Kothari and I.J. Nagrath, „Electric Machines", Tata McGraw Hill Publishing Company Ltd, 2002.

2. P.S. Bimbhra, „Electrical Machinery", Khanna Publishers, 2003.

REFERENCE BOOKS

1. A.E. Fitzgerald, Charles Kingsley, Stephen.D.Umans, „Electric Machinery", Tata McGraw Hill publishing Company Ltd, 2003.
2. J.B. Gupta, „Theory and Performance of Electrical Machines, S.K.Kataria and Sons, 2002.
3. K. Murugesh Kumar, „Electric Machines, Vikas publishing house Pvt Ltd, 2002.

YEAR	I	MEASUREMENTS AND INSTRUMENTATION	L	T	P	C
SEMESTER	II		3	0	0	3

AIM

- To study the concepts of measurements and construction with operation of Electrical and Electronics Instruments.

OBJECTIVES

- To converse knowledge on basic functional elements and Performance characteristics of Instruments.
- To understand the construction and principle operation of Electrical and Electronics instruments.
- To gain knowledge about the construction and performance of signal conditioning circuits.
- To gain knowledge about the construction and principle operation of storage and display devices.
- To understand the classification and selection of transducers.

UNIT – I INTRODUCTION **6**

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

UNIT – II ELECTRICAL AND ELECTRONICS INSTRUMENTS **12**

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.

UNIT – III SIGNAL CONDITIONING CIRCUITS **9**

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.

UNIT – IV STORAGE AND DISPLAY DEVICES **8**

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

UNIT – V TRANSDUCERS **10**

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.

Total Hours = 45

TEXT BOOKS

1. Doebeling, E.O., 'Measurement Systems – Application and Design', McGraw Hill Publishing Company, 1990.
2. H.S.Kalsi, „Electronic 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

YEAR	I	Practicals ELECTRICAL MACHINES LAB - I	L	T	P	C
SEMESTER	I		0	0	3	2

1. Open circuit and load characteristics of D.C separately and self excited shunt generator

2. Load characteristics of D.C. compound generator with differential and cumulative connection

3. Load characteristics of D.C. shunt and compound motor

4. Load characteristics of D.C series motor

5. Swinburnes test and speed control of D.C shunt motor

6. Hopkinsons test on D.C motor – generator set

7. Load test on single-phase transformer and three phase transformer connections

8. Open circuit and short circuit tests on single phase transformer

9. Sumpners test on transformers

10. Separation of no-load losses in single phase transformer

P = 45 Total = 45

YEAR	II	ELECTRICAL MACHINES-II	L	T	P	C
SEMESTER	III		3	0	0	3

AIM

- To study the theory, operation and performance of AC machines.

OBJECTIVES

- To impart knowledge on construction and performance of salient and non – salient type synchronous generators.
- To understand the principle of operation and performance of synchronous motor.
- To gain knowledge about construction, principle of operation and performance of induction motor.
- To gain knowledge about the starting and speed control methods of three-phase induction motors.
- To understand the Construction, principle of operation and performance of single phase induction motors and special machines.

UNIT I SYNCHRONUS GENERATOR 9

Construction - types of rotor - EMF equation - synchronous reactance - synchronous impedance- armature reaction - voltage regulation - EMF,MMF,ZPF and ASA methods -synchronizing - parallel operation –salient pole synchronous machines- two reaction theory - determination of $X_{d\ and}X_q$using slip test - operating characteristics - capability curves.

UNIT IISYNCHRONOUS MOTOR 9

Principle of operation - starting methods - torque equation - synchronous motor on no load and load - operation of synchronous motor at constant load - variable excitation - V curve and inverted V curve – hunting.

UNIT III THREE PHASE INDUCTION MOTOR 9

Construction and types of rotor - principle of operation - slip-torque equation -equivalent circuit - slip torque characteristics - condition for maximum torque - losses and efficiency - load test - no load and blocked rotor tests - circle diagram – cogging and crawling - separation of no load losses - double cage rotors - induction generator - synchronous induction motor.

UNIT IV STARTING AND SPEED CONTROL OF THREE PHASE INDUCTION MOTOR 9

Need for starting - types of starters - stator resistance and reactance starters, rotor resistance starter, auto transformer and star-delta starters - speed control - change of voltage - change of number of poles - change of frequency - cascade connection - slip power recovery scheme.

UNIT VSINGLE PHASE INDUCTION MOTOR AND SPECIAL MACHINES 9

Construction of single phase induction motor - double revolving field theory - equivalent circuit - load characteristics - starting methods of single phase induction motor - variable reluctance motor - stepper motor - hysteresis motor - AC series motor -repulsion motor - linear induction motor - permanent magnet DC and AC motors.

TOTAL HOURS: 45

TEXT-BOOK

1. Nagrath I.J and Kothari D.P, "Electrical machines", T.M.H publishing co-Ltd, New delhi,1997
2. B.L .Theraja and A.K Theraja, "A text book of Electrical Technology-volume-II", McGraw Hill, Newyork, 1995.

REFERENCE BOOK

1. Syed A.Narser, "Electrical Machines and Power System-volume-II", McGraw Hill, Newyork, 1995
2. J.B Gupta, "Theory and performance of Electrical Machines", S.K Kataria and sons, Delhi.
3. Fitzgerald , A.E. Charles Kingsley Jr.. Stephen D. Umans , "Electric Machinery ".McGrawHill Book Company , 1992.

YEAR	II	TRANSMISSION & DISTRIBUTION	L	T	P	C
SEMESTER	III		3	0	0	3

AIM

- To become familiar with the function of different components used in Transmission and Distribution levels of power systems and modeling of these components.

OBJECTIVES

- To understand structure of electric power systems, its various operating voltages.
- To study transmission line parameters for different systems and corona effect.
- To understand modeling and performance of different transmission lines.
- To study different types of insulators and constructional features of HT & LT cables.
- To understand classification and functions of major components of substations.

UNIT I INTRODUCTION **9**

Structure of electric power system – different operating voltages of generation, transmission and distribution –advantage of higher operating voltage for AC transmission. An introduction to HVDC and EHV AC transmission. FACTS Devices Mechanical design of transmission line between towers – sag and tension calculations using approximate equations taking into account the effect of ice and wind.

UNIT II TRANSMISSION LINE PARAMETERS **9**

Parameters resistance, inductance and capacitance calculations – single and three phase transmission lines – single and double circuits - solid, stranded and bundled conductors - symmetrical and unsymmetrical spacing - transposition of lines – concepts of GMR and GMD - Skin and Proximity effects - interference with neighbouring communication circuits – Corona discharge - characteristics – critical voltage and loss. (Simple diagrams of typical towers and conductors for 400, 220 ,110,66 and 33 kV operations)

UNIT IIIMODELLING AND PERFORMANCE OF TRANSMISSION LINES **9**

Transmission line classification – short line, medium line and long line – equivalent circuits – Ferranti effect – surge impedance, attenuation constant and phase constant – voltage regulation and transmission efficiency – real and reactive power flow in lines – power circle diagrams – shunt and series compensation. An introduction to power angle diagram – surge – impedance loading, load ability limits based on thermal loading; angle and voltage stability considerations.

UNIT IV INSULATORS AND CABLES **9**

Classification of insulators for transmission and distribution purpose – voltage distribution in insulator string and grading – improvement of string efficiency. Underground cables – constructional features of LT and HT cables – insulation resistance, capacitance, dielectric stress and grading – tan δ and power loss – thermal characteristics.

UNIT V SUBSTATION , GROUNDING SYSTEM AND DISTRIBUTION SYSTEM **9**

Classification functions and major components of substations. Bus-bar arrangements – substation bus schemes – single bus, double bus with double breaker, double bus with single breaker, main and transfer bus, ring bus, breaker- and - a half with two main buses, double bus-bar bypass isolators. Importance of earthing in a substation. Qualitative treatment to neutral grounding and earthing practises in substations. Feeders, distributors and service mains. DC distributor – 2 - wire and 3 - wire, radial and ring main distribution. AC distribution - single phase and three phase 4 -wire distribution.

TOTAL HOURS : 45

TEXT BOOKS

1. B.R.Gupta, 'Power System Analysis and Design', S.Chand, New Delhi, 2003.
2. S.N. Singh, 'Electric Power Generation, Transmission and Distribution', Prentice Hall of India Pvt. Ltd, New Delhi, 2002.

REFERENCE BOOKS

1. Luces M.Fualkenberry ,Walter Coffer, 'Electrical Power Distribution and Transmission', Pearson Education, 1996.
2. Hadi Saadat, 'Power System Analysis,' Tata McGraw Hill Publishing Company', 2003.
3. Central Electricity Authority (CEA), 'Guidelines for Transmission System Planning', New Delhi.
4. 'Tamil Nadu Electricity Board Handbook', 2003.

YEAR	II	ELECTRONIC CIRCUITS	L	T	P	C
SEMESTER	III		3	0	0	3

AIM

- The aim of this course is to introduce to the students the rectifiers, power supplies, basics of biasing transistor circuits, low frequency amplifiers, multi stage amplifiers, power amplifiers, tuned amplifiers, feedback amplifiers and oscillators.

OBJECTIVES

- To study the biasing circuits and analyze the small signal BJT amplifiers
- To understand the working and to find the efficiency of different types of large signal amplifiers
- To understand the basic concept and working of various types of feedback amplifiers and oscillators.
- To understand the working of types of tuned amplifiers and multi vibrators and their analysis.

UNIT I BIASING CIRCUITS AND SMALL SIGNAL MODELS 9

Biasing circuits: DC load line and bias point – BJT biasing circuits – FET biasing circuits. Small-signal models: AC load line, BJT models and parameters – hybrid equivalent model – hybrid π model, FET small-signal model and parameters.

UNIT II SMALL SIGNAL AMPLIFIERS - ANALYSIS AND FREQUENCY RESPONSE 9

BJT amplifiers: CE, CB and CC amplifiers – multistage amplifiers - differential amplifier – designing BJT amplifier networks.(Analysis using hybrid –π model) FET amplifiers: CS, CG and CD amplifiers –designing FET amplifier networks Frequency response: low frequency response of BJT and FET amplifiers – Miller effect capacitance – high frequency response of BJT and FET amplifiers.

UNIT III FEEDBACK AND OSCILLATOR CIRCUITS 9

Feedback circuits: concept of feedback – effects of negative feedback – feedback connection types – practical feedback circuits – phase and frequency considerations – designing feedback amplifier circuits – Applications of feedback circuits. Oscillator circuits: oscillator principles – LC oscillators – RC oscillators – crystal oscillators – designing oscillator circuits – Applications of oscillators in real time circuits.

UNIT IV POWER AMPLIFIERS AND TUNED AMPLIFIERS 9

Power amplifiers: definitions and amplifier types – Q point placement – maximum dissipation hyperbola – Class A amplifier – Class B and Class AB push-pull amplifiers – Class C amplifiers – Amplifier distortions – heat sink – designing power amplifier circuits. Tuned amplifiers: need for tuned circuits – single tuned – double tuned – synchronously tuned amplifiers – impedance matching to improve gain – design of basic tuned amplifier – Real Time Applications of amplifiers.

UNITV SOLID STATE SWITCHING CIRCUITS 9

Types of waveforms – transistor switching times – multivibrators – astablemultivibrator – monostablemultivibrator – bistablemultivibrator – schmitt trigger – design of multivibrators and Schmitt trigger – Applications of switching circuits.

TOTAL HOURS: 45

TEXT BOOKS

1. Robert L. Boylestad and Louis Nashelsky, “Electronic Devices and Circuit Theory”, Pearson Education, 9th Edition, 2009.
2. David A Bell, “Fundamentals of Electronic Devices and Circuits”, Oxford University Press, 2009.
3. David A. Bell, “Solid State Pulse Circuits”, Oxford University Press, 2007.

REFERENCES

1. Jacob Millman, Christos C Halkias, SatyabrataJit, “Electron Devices and Circuits”, Tata McGraw Hill, 2010.
2. Thomas L. Floyd, “Electronic Devices”, 9th edition, Pearson Education, 2011.
3. Albert P. Malvino, David J. Bates, “Electronic Principles”, 7th edition, Tata McGraw Hill, 2007.

YEAR	II	DIGITAL ELECTRONICS	L	T	P	C
SEMESTER	III		3	1	0	4

AIM

- The Aim of this course is to develop a strong foundation in analysis and design of digital electronics.

OBJECTIVES

- Understand the basic concepts.
- Understand concepts of logic gates constructional features.
- To understand the concepts of gate-level minimization & combinational logic.
- To analyze synchronous sequential logic.

UNIT I NUMBER SYSTEM **9**

Digital System, Binary Numbers, Number-Base Conversions, Octal & Hexadecimal Numbers, Complements of Numbers, Signed Binary Numbers, Binary Codes, Binary Storage And Registers, Binary Logic

UNIT II BOOLEAN ALGEBRA, LOGIC GATES & GATE –LEVEL MINIMIZATION **9**

Introduction, Boolean algebra, basic theorem & properties of Boolean algebra, Boolean functions, canonical & standard forms, logic operations, logic gates, integrated circuits, map method, four variable K-maps, product of sums simplification, don't care conditions, NAND & NOR implementations, Exclusive-OR Function, Hardware Description Language.

UNIT III COMBINATIONAL LOGIC **9**

Introduction, Combinational Circuits, Analysis Procedure, Design Procedure ,Binary Adder-Subractor , Decimal Adder, Binary Multiplier, Magnitude Comparator, Decoders, Encoders , Multiplexers , HDL Models Of Combinational Circuits.

UNIT IV SYNCHRONOUS SEQUENTIAL LOGIC, REGISTER & COUNTERS **9**

Sequential circuits, storage elements: latches, flip flops, analysis of closed sequential circuits, synthesizable HDL Models of sequential circuits, state reduction assignment, design procedure, shift registers, ripple counters, synchronous counters, HDL for registers and Counters.

UNIT V DESIGN AT THE REGISTER TRANSFER LEVEL **9**

Register Transfer Level Notation, Register Transfer Level In HDL, ASM, Sequential Binary Multiplier, Control Logic, HDL Description Of Binary Multiplier, Design With Multiplexers, Race Free Design, Latch Free Design.

LECTURE HOURS : 45
TUTORIAL HOURS : 15
TOTAL HOURS : 60

TEXT BOOKS

1. Morris Mano, "Digital Design(with an introduction to the verilog HDL)", Prentice-Hall of India, (UNITS-I,II,III,IV,V)

REFERENCE BOOKS

1. William I. Fletcher, “An Engineering Approach to Digital Design ", Prentice-Hall of India, 1980
2. Floyd T.L., “Digital Fundamentals ", Charles E. Merrill publishing Company, 1982.
3. Tokheim R.L., “Digital Electronics - Principles and Applications ", Tata McGraw Hill, 1999.
4. Jain R.P., “Modern Digital Electronics ", Tata McGraw Hill, 1999.

YEAR	II	ELECTRICAL MACHINES – II LABORATORY	L	T	P	C
SEMESTER	III		0	0	3	2

1. **Regulation of 3-phase alternator by EMF and MMF methods.**
   Aim: To predetermine the regulation of 3-phase alternator by EMF and MMF methods.
2. **Regulation of 3-phase alternator by ZPF and ASA method.**
   Aim: To predetermine the regulation of 3-phase alternator by ZPF and ASA methods.
3. **Slip test on 3-phase alternator.**
   Aim: To predetermine the regulation of 3-phase alternator by conducing slip test.
4. **Load characteristics of 3-phase alternator by bus bar loading**
   Aim: To synchronize 3-phase alternator with bus bar and determine its load characteristics.
5. **V and inverted V curve of synchronous motors.**
   Aim: To draw the V and inverted V curves of synchronous motor.
6. **Load test on 3-phase induction motor (s).**
   Aim: To conduct load test on 3-phase squirrel cage induction motor and determine its performance characteristics.
7. **No load and blocked rotor test on 3-phase induction motor.**
   Aim: To conduct no load and blocked rotor tests on 3 phase squirrel cage induction motor and obtain the parameters of the equivalent circuit.
8. **Study of Synchronous induction motor.**
   Aim: To study the operation of Synchronous induction motor.
9. **Study of induction motor starters.**
   Aim: To study the various induction motor starters
10. **Separation of losses in three-phase induction motor.**
    Aim: To determine the no load losses in three-phase induction motor.
11. **Load test on 1-phase induction motor.**
    Aim: To conduct load test on single phase induction motor and determine its performance characteristics.
12. **Equivalent circuit and pre – determination of performance characteristics of single-phase induction motor.**
    Aim: To conduct no load and blocked rotor tests on single phase induction motor and determine the parameters of equivalent circuit.

TOTAL HOURS: 45

REFERENCE BOOKS

1. Laboratory reference manual.

YEAR	II	MEASUREMENTS AND INSTRUMENTATION LABORATORY	L	T	P	C
SEMESTER	III		0	0	3	2

AIM

- To acquire skills on using Measuring devices and Instruments.

OBJECTIVES:

- To understand the operation of AC and DC Bridges
- To calibrate the different types of meters and special instruments

LIST OF EXPERIMENTS

1. Study of temperature measuring transducers (Thermocouples).
2. Study of displacement and pressure transducers (LVDT).
3. AC Bridges.
4. DC Bridges.
5. Instrumentation amplifiers..
6. A/D and D/A converters.
7. Study of Transients.
8. Torque and angle measurement.
9. Calibration of Single phase Energy meter.
10. Calibration of Three phase Energy meter.
11. Measurement of Three phase power and power factor.

TOTAL HOURS : 45

REFERENCE BOOKS

1. Laboratory reference manual.

SEMESTER -IV

YEAR	II	POWER ELECTRONICS	L	T	P	C
SEMESTER	IV		3	0	0	3

AIM

- To understand the various applications of electronic devices for conversion, control and conditioning of the electrical power.

OBJECTIVES

- To get an overview of different types of power semiconductor devices and their switching characteristics.
- To understand the operation, characteristics and performance parameters of controlled rectifiers.
- To study the operation, switching techniques and basics topologies of DC-DC switching regulators.
- To learn the different modulation techniques inverters and to understand harmonic reduction methods.
- To study the operation of AC voltage controller and Matrix converters.

UNIT I POWER SEMI-CONDUCTOR DEVICES 9

Overview of switching devices – Driver and snubber circuit of SCR TRIAC, GTO, IGBT, MOSFET – Computer simulation of PE circuits.

UNIT II PHASE CONTROLLED CONVERTERS 9

2 pulse / 3 pulse and 6 pulse converters – Effect of source inductance – performance parameters – Reactive power control of converters – Dual converters.

UNIT III DC TO DC CONVERTERS 9

Stepdown and stepup chopper – Forced commutation techniques – Time ratio control and current limit control – Switching mode regulators Buck, Boost, Buck-Boost – concept of resonant switching.

UNIT IV INVERTERS 9

Single phase and three phase [120^o & 180^o mode] inverters – PWM techniques – Sinusoidal PWM, Modified sinusoidal PWM and multiple PWM – Voltage and harmonic control – Series resonant inverter – current source inverter.

UNIT V AC TO AC CONVERTERS 9

Single phase AC voltage controllers – Multistage sequence control – single phase and three phase cycloconverter – power factor control – Matrix converters.

TOTAL HOURS : 45

TEXT BOOKS

1. Rashid M.H., "Power Electronics Circuits, Devices and Applications", Prentice Hall India, 3rd Edition, New Delhi, 2004.
2. Ned Mohan, T.M.Undeland, W.P.Robbins, "Power Electronics: Converters, applications and design", John wiley and Sons, 3rd Edition, 2006.

REFERENCES

1. Cyril.W.Lander, "Power Electronics", McGraw Hill International, Third Edition, 1993.
2. P.S.Bimbra "Power Electronics", Khanna Publishers, third Edition 2003.
3. Philip T.Krein, "Elements of Power Electronics" Oxford University Press, 2004 Edition.

YEAR	II	LINEAR INTEGRATED CIRCUITS	L	T	P	C
SEMESTER	IV		3	0	0	3

AIM

- To provide the basic concepts in the design of electronic circuits using linear integrated circuits and their applications in the processing of analog signals.

OBJECTIVES

- To introduce the basics of Integrated Circuits and its fabrication.
- To familiarize with operational amplifiers and its Characteristics.
- To introduce the applications of Operational Amplifier
- To Introduce about the regulator and filters.
- To introduce ADC/ DAC and PLL.

UNIT I INTEGRATED CIRCUIT FABRICATION 9

Classifications of ICs – IC chip size and Circuit Complexity – Fundamentals of Monolithic IC Technology – Basic Planar Process – Fabrication of Typical Circuit – Active and Pasive Components of ICs – Fabrication of FET – Thick and Thin Film Technology – Technology Trends.

UNIT II OPERATIONAL AMPLIFIER AND ITS CHARACTERISTICS 9

Basic Information of operational Amplifier – Ideal Operational Amplifier - Operational Amplifier Internal Circuits – Examples of IC Op Amps – FET Operational Amplifiers – DC Characteristics – AC Characteristics – Analysis of Data Sheets of an Op Amp.

UNIT III OPERATIONAL AMPLIFIER APPLICATIONS 9

Basic Op Amp Applications – Instrumentation Amplifiers – AC Amplifiers – V to I and I to V Converters – Op Amp Circuits Using Diodes – Sample and Hold Circuits – Log/Antilog Amplifiers – Adder/ Subtractor – Multiplier and Divider – Differentiator and Integrator – Operational Trans conductance Amplifier – Comparators – Multivibrators – Square, Triangular and Sawtooth wave Generators.

UNIT IV REGULATORS AND FILTERS 9

Series Op Amp Regulators – IC Voltage Regulators – 723 General Purpose Regulators – Switching regulators – RC Active Filters – Transformation – State variable Filter – Switched Capacitor Filters – Active Filters using OTA's.

UNIT V D/A AND A/D CONVERTERS, TIMERS AND PLL 9

Timer – Description of Functional Diagram – Monostable and Astable Operation – Schmitt Trigger – PLL – Basic Principles – Phase Detectors/ Comparators – Voltage Controlled Oscillator – Low Pass Filter – Monolithic PLL – PLL Applications – Basic DAC Techniques – A–D Converters – DAC/ ADC Specifications.

LECTURE HOURS : 45
TUTORIAL HOURS : 15
TOTAL HOURS : 60

TEXT BOOK

1. D. Roy Choudhury, Shail B. Jain, “Linear Integrated Circuits”, New Age International Publishers, 3rd Edition 2007.

REFERENCE BOOKS

1. Segio Franco, “Design with Operational Amplifiers and Analog Integrated Circuits”, McGraw Hill, 2008.
2. Ramakant A. Gayakwad, “OP – AMP and Linear ICs”, Prentice Hall, 1994.
3. Botkar K. R., “Integrated Circuits”, Khanna Publishers, 1996.
4. Gray and Mayer, “Analysis and design of Analog Integrated Circuits”, Wiley International, 1995.

YEAR	II	DESIGN OF ELECTRICAL APPARATUS	L	T	P	C
SEMESTER	IV		3	1	0	4

UNIT I INTRODUCTION 9

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

UNIT II DC MACHINES 9

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 – Armature design – Design of commutator and brushes.

UNIT III TRANSFORMERS 9

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 – Design of chokes – Design of welding Transformers – Design of CTs & PTs.

UNIT IV INDUCTION MOTORS 9

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.

UNIT V SYNCHRONOUS MACHINES 9

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.

TOTAL HOURS: 45

TEXT 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.

YEAR	II	PROTECTION & SWITCHGEAR	L	T	P	C
SEMESTER	IV		3	0	0	3

AIM

To understand the various protection schemes in electrical system, theory of arc interruption and operation of various circuit breakers.

OBJECTIVE

- To study the basic principles, construction and operation of various protection relays.
- To understand the protection schemes of various electrical equipments and application of CTS and PTS.
- To study the theory of arc phenomena and arc interruption.
- To understand construction, operation and capacitive merits of various types of circuit breakers.
- To study protection schemes against over voltages.

UNIT I RELAYS -PRINCIPLES &OPERATION 9

Need for protection – relay terminology – definitions – zones of protection - essential qualities of protective relays. Over current relays directional, distance and differential, under frequency, negative sequence relays - static relays – microprocessor-based relays.

UNIT IIAPPARATUS PROTECTION 9

Apparatus Protection - generator and Transformer Protection, Protection of bus bars, transmission lines, CT's & PT's and their application in protective schemes.

UNIT III THEORY ARC QUENCHING 9

Theory of arcing and arc quenching – RRRV – Current Chopping and Capacitive Current breaking – D.C. circuit breaking.

UNIT IV CIRCUIT BREAKERS 9

Switchgear – fault clearing and interruption of current - various types of circuit breakers - selection of circuit breakers - testing of circuit breakers- intelligent circuit breakers

UNIT V PROTECTION AGAINST OVERVOLTAGES 9

Protection against over voltages due to lightning and switching - arcing grounds - Peterson coil - ground wires - surge absorber and diverters Power system earthing – neutral earthing - basic ideas of insulation coordination

TOTAL HOURS : 45

TEXT BOOKS

1. Veerappan.N and Krishnamurthi .S.R,' Power Systems Switch Gear and Protection' , S.Chand Edition 2009.
2. Ravindranath, B and Chander, N, 'Power System Protection and Switchgear', Wiley Eastern Ltd., 1977.
3 .Chakrabarti .A, Soni .M.L, Gupta .P.V, 'A text book on power system Engineering', Dhanpat rai & Co. pvt. Ltd., 1998.

REFERENCE BOOKS

1. Wadhwa, C.L., 'Electrical Power Systems', New Age International (P) Ltd., Publishers, 1995.

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

YEAR	II	POWER ELECTRONICS LABORATORY	L	T	P	C
SEMESTER	IV		0	0	3	2

AIM:

- To study the characteristics of switching devices and its applications in rectifier, inverter, chopper, resonant converter and drives.

LIST OF EXPERIMENTS:

1. Characteristics of SCR& TRIAC

2. Characteristics of MOSFET and IGBT

3. AC to DC Half & fully controlled converter

4. IGBT based choppers

5.Voltage Commutated Chopper

6. IGBT based PWM inverter

7. Resonant dc to dc converter

8. AC Voltage Controller

9.Single Phase Cyclo-converter

10.Converter fed DC Motor Drive.

11. Inverter fed Induction Motor Drive.

TOTAL HOURS: 45

REFERENCE BOOKS

1. Laboratory reference manual.

YEAR	II	DIGITAL ELECTRONICS LABORATORY	L	T	P	C
SEMESTER	IV		0	0	3	2

AIM

- To provide the knowledge of design and implementation of digital circuits using logic gates and flip flops.

OBJECTIVES

- Designing the basic digital circuits like adders, subtractors, code converters, magnitude converters using logic gates and counters using flip flops.

LIST OF EXPERIMENTS

1. Design and implementation of Adders using logic gates
2. Design and implementation of Subtractors using logic gates
3. Design and implementation of BCD to Excess -3 code converter using logic gates
4. Design and implementation of Binary to Gray code converter using logic gates
5. Design and implementation of 4 bit BCD adder using IC 7483
6. Design and implementation of 2 Bit Magnitude comparator using logic gates

TOTAL HOURS: 45

REFERENCE BOOKS

1. Laboratory reference manual.

SEMESTER –V

YEAR	III	SOLID STATE DRIVES	L	T	P	C
SEMESTER	V		3	0	0	3

AIM

- To study and understand the operation of electrical machines controlled by a power electronic converter and to introduce the controller design concepts.

OBJECTIVES

- To understand steady state operation and transient dynamics of a motor load system.
- To study and analyze the operation of the converter / chopper fed dc drive, both qualitatively and quantitatively.
- To analyze and design the current and speed controllers for a closed loop solid state DC motor drive.
- To study and understand the operation and performance of AC Induction motor drives.
- To study and understand the operation and performance of AC Synchronous motor drives.

UNIT I DRIVE CHARACTERISTICS 9

Equations governing motor load dynamics - steady state stability - Multi quadrant dynamics - Acceleration, deceleration, starting and stopping - load torque characteristics of various drives.

UNIT II CONVERTER / CHOPPER FED DC MOTOR DRIVE 9

Steady state analysis of the single and three phase fully controlled converter fed separately excited D.C motor drive - Continuous and discontinuous conduction Time ratio and current limit control - 4 quadrant operation of converter.

UNIT III DESIGN OF CONTROLLERS FOR DRIVES 9

Transfer function for DC motor, load and converter – Closed loop control with current and speed feedback - Armature voltage control and field weakening mode control, Design of controllers: Current controller and speed controller - Converter selection and characteristics - Use of simulation software package.

UNIT IV INDUCTION MOTOR DRIVES 9

Stator voltage control – energy efficient drive - v/f control, constant air-gap flux – field weakening mode - voltage/current fed inverters - Block diagram of vector control - closed loop control.

UNIT V SYNCHRONOUS MOTOR DRIVES 9

V/f control and self-control of synchronous motor – Marginal angle control and power factor control - Permanent magnet synchronous motor Black diagram of closed loop control.

LECTURE HOURS : 45
TUTORIAL HOURS : 15
TOTAL HOURS : 60

TEXT BOOKS

1. Gopal K.Dubey, "Fundamentals of Electrical Drives", Narosa Publishing House, 1992.
2. Bimal K.Bose. "Modern Power Electronics and AC Drives", Pearson Education, 2002.

REFERENCES

1. S.K.Pillai, "A First course on Electrical Drives", Wiley Eastern Limited, 1993.
2. Murphy J.M.D and Turnbull, "Thyristor Control of AC Motor", Pergamon Press, Oxford 1988.
3. Gopal K.Dubey, "Power semiconductor controlled Drives:, Prentice Hall Inc., New Jersey, 1989.
4. R.Krishnan, "Electric Motor & Drives: Modeling, Analysis and Control", Prentice hall of India, 2001.

YEAR	III	POWER SYSTEM ANALYSIS	L	T	P	C
SEMESTER	V		3	1	0	4

AIM

- To understand the necessity and to become familiar with the modelling of power system and components. And to apply different methods to analyse power system for the purpose of system planning and operation.

OBJECTIVES

- To model the power system under steady state operating condition.
- To study the power flow models and apply efficient numerical methods to solve the power flow problem.
- To model and analyse the power systems under abnormal (or) fault conditions.
- To model & analyse the transient behaviour of power system when it is subjected to a fault.
- To the study the Importance of stability analysis in power system planning

UNIT I INTRODUCTION **9**

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. Simple building algorithms for the formation of Y-Bus matrix and Z-Bus matrix.

UNIT II POWER FLOW ANALYSIS **9**

Importance of power flow analysis in planning and operation of power systems. Statement of power flow problem - classification of buses into P-Q buses, P-V (voltage controlled) buses and slack bus. Development of Power flow model in complex variables form and polar variables form. Iterative solution using Gauss-Seidel method including Q-limit check for voltage controlled buses – algorithm and flow chart. Iterative solution using Newton-Raphson (N-R) method (polar form) including Q-limit check and bus switching for voltage-controlled buses - Jacobian matrix elements – algorithm and flow chart. Development of Fast Decoupled Power Flow (FDPF) model and iterative solution – algorithm and flowchart; Comparison of the three methods.

UNIT III FAULT ANALYSIS – BALANCED FAULTS **9**

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.

UNIT IV FAULT ANALYSIS – UNBALANCED FAULTS **9**

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.).

UNIT V STABILITY ANALYSIS 9

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 - equal area criterion - determination of critical clearing angle and time by using modified Euler method and Runge-Kutta second order method. Algorithm and flow chart.

LECTURE HOURS : 45
TUTORIAL HOURS : 15
TOTAL HOURS : 60

TEXT BOOKS

1. Hadi Saadat, 'Power System Analysis', Tata McGraw Hill Publishing Company, New Delhi, 2002.
2. Olle. I. Elgerd, 'Electric Energy Systems Theory – An Introduction', Tata McGraw Hill Publishing Company Limited, New Delhi, Second Edition, 2003.

REFERENCES

1. P. Kundur, 'Power System Stability and Control, Tata McGraw Hill, Publications,1994.
2. John J. Grainger and W.D. Stevenson Jr., 'Power System Analysis', McGraw Hill International Book Company, 1994.
3. I.J. Nagrath and D.P. Kothari, 'Modern Power System Analysis', Tata McGraw-Hill Publishing Company, New Delhi, 1990.
4. .K.Nagasarkar and M.S. Sukhija Oxford University Press, 2007

YEAR	III	CONTROL SYSTEMS	L	T	P	C
SEMESTER	V		3	1	0	4

AIM

- To provide sound knowledge in the basic concepts of linear control theory and design of control system.

OBJECTIVE

- To understand the methods of representation of systems and to desire their transfer function models.
- To provide adequate knowledge in the time response of systems and steady state error analysis
- To accord basic knowledge in obtaining the open loop & closed–loop frequency responses of systems.
- To understand the concept of stability of control system and methods of stability analysis.
- To study the three ways of designing compensation for a control system

UNIT I SYSTEMS AND THEIR REPRESENTATION 12

Basic elements in control systems – Open and closed loop systems – Electrical analogy of mechanical and thermal systems – Transfer function – Synchros – AC and DC servomotors – Block diagram reduction techniques – Signal flow graphs.

UNIT II TIME RESPONSE 9

Time response – Time domain specifications – Types of test input – I and II order system response – Error coefficients – Generalized error series – Steady state error – P, PI, PID modes of feedback control.

UNIT III FREQUENCY RESPONSE 9

Frequency response – Bode plot – Polar plot – Determination of closed loop response from open loop response – Correlation between frequency domain and time domain specifications.

UNIT IV STABILITY OF CONTROL SYSTEM 9

Characteristics equation – Location of roots in S plane for stability – Routh Hurwitz criterion – Root locus construction – Effect of pole, zero addition – Gain margin and phase margin –Nyquist stability criterion.

UNIT V COMPENSATOR DESIGN 6

Performance criteria – Lag, lead and lag-lead networks – Compensator design using bode plots.

LECTURE HOURS : 45
TUTORIAL HOURS : 15
TOTAL HOURS : 60

TEXT BOOKS

1. I.J. Nagrath and M. Gopal, ‘Control Systems Engineering’, New Age International Publishers, 2003.
2. Benjamin C. Kuo, Automatic Control systems, Pearson Education, New Delhi, 2003.

REFERENCES

1. K. Ogata, ‘Modern Control Engineering’, 4th edition, PHI, New Delhi, 2002.
2. Norman S. Nise, Control Systems Engineering, 4th Edition, John Wiley, New Delhi, 2007.
3. Samarajit Ghosh, Control systems, Pearson Education, New Delhi, 2004
4. M. Gopal, ‘Control Systems, Principles and Design’, Tata McGraw Hill, New Delhi, 2002.

YEAR	III	MATHEMATICAL MODELLING AND SIMULATION	L	T	P	C
SEMESTER	V		3	1	0	4

UNIT I INTRODUCTION **9**

Introduction to SCILAB – Constants – Data types – SCILAB Syntax – Data type related functions – Overlaoading.

UNIT II GRAPHICAL ANALYSIS USING SCILAB **9**

The media – global plot parameters – 2D and 3D plotting – examples – printing graphics and exporting to Latex.

UNIT III SCILAB PROGRAMMING **9**

Linear algebra – Polynomial and rational function manipulation – Sparse matrices – random numbers – cumulative distribution functions and their inverse – building interface programs – inter SCI – dynamic linking – static linking.

UNIT IV SCILAB TOOLS **9**

Systems and control toolbox – improper systems – system operation – control tools classical control – state space control – model reduction – identification – linear matrix inequalities – integrating ODEs – integrating DAEs.

UNIT V APPLICATIONS **9**

Resistive circuits – inductive and capacitive circuits – transients – steady state analysis – logics circuits – electronic devices - DC machines

TOTAL HOURS : 45

TEXT BOOKS

1. Claude Gomez Engineering and Scientific Computing with SCILAB, Birkhauser publications

REFERENCE BOOKS

1. Simulation of ODE / PDE models with MATLAB, OCTAVE AND SCILAB : Scitific And Engineering Applications, A. Vande Wouwer, P. Saucez, C.V. Fernandez 2014 Isbn: 978-3319067896
2. http:// www.scilab.org/

YEAR	III	CONTROL SYSTEMS LABORATORY	L	T	P	C
SEMESTER	V		0	0	3	2

1. **Transfer function of self and separately excited DC Generator.**
   Aim : To determine the transfer function of self and separately excited DC generator.

2. **Transfer function of Armature and Field controlled DC Motor.**
   Aim : To determine the transfer function of armature and field controlled DC motor.

3. **Transfer function of AC Servomotor.**
   Aim : To derive the transfer function of the given A.C Servomotor and experimentally determine the transfer function parameters.
4. **Frequency response of Lag, Lead & Lag – Lead networks.**
   Aim : To obtain the Frequency response of Lag, Lead & Lag – Lead networks.
5. **Study of Synchros and DC Stepper Motor**
   Aim : To study the working of Synchros & stepper motor
6. **Transfer function of Ward – Leonard method of speed control of DC motor.**
   Aim : To determine the transfer function parameters of Ward – Leonard method of speed control of DC motor.
7. **Study of DC Position Control system and study of various transducers**
   Aim : To study the DC position control system and draw the error characteristics between set point and error and to study the various Transducers.
8. **Study of P, PI and PID Controllers (First Order).**
   Aim : To determine the Time Response characteristics of the controllers.
9. **Analog and simulation of type – o and type – 1 systems**
   Aim: To simulate the time response characteristics of I order and II order, type 0 and type-1 systems.
10. **Stability analysis of Linear Systems**
    Aim : To analyse the stability of linear systems using Bode / Root locus / Nyquist plot.
11. **Digital simulation of first order systems**
    Aim : To digitally simulate the time response characteristics of first -order system
12. **Digital simulation of second order systems**
    Aim : To digitally simulate the time response characteristics of second -order system

TOTAL HOURS: 45

REFERENCE BOOKS

1. Laboratory reference manual.

YEAR	III	POWER SYSTEM SIMULATION LABORATORY	L	T	P	C
SEMESTER	V		0	0	3	2

AIM

- To acquire software development skills and experience in the usage of standard packages necessary for analysis and simulation of power system required for its planning, operation and control.

OBJECTIVES

- To develop simple C/MATLAB programs for the following basic requirements:
- Formation of bus admittance and impedance matrices and network solution.
- Power flow solution of small systems using simple method, Gauss-Seidel P.F. method.
- Unit Commitment and Economic Dispatch.
- To acquire experience in the usage of standard packages for the following analysis / simulation / control functions.

LIST OF EXPERIMENTS

1. Computation of Parameters and Modelling of Transmission Lines
2. Formation of Network Matrices and Solution of Networks.
3. Power Flow Analysis - I: Solution of Power Flow and Related Problems Using Gauss-Seidel Method.
4. Power Flow Analysis II: Solution of Power Flow and Related Problems Using Newton-Raphson and Fast-Decoupled Methods.
5. Short Circuit Analysis.
6. Transient and Small Signal Stability Analysis: Single-Machine Infinite Bus System.
7. Transient Stability Analysis of Multimachine Power Systems.
8. Electromagnetic Transients in Power Systems.
9. Load – Frequency Dynamics of Single and Two-Area Power Systems.
10. Unit Commitment and Economic Dispatch in Power Systems.

TOTAL HOURS: 45

REFERENCE BOOKS

1. Laboratory reference manual.

YEAR	III	MICROCONTROLLER & APPLICATIONS	L	T	P	C
SEMESTER	VI		3	0	0	3

AIM

- To provide the knowledge about the processors and controllers and its functioning

OBJECTIVES

- To learn the concepts of microprocessors.
- To get knowledge in interfacing devices.
- To know the concepts of microcontroller and its applications.
- To develop skill in simple program writing.

UNIT I INTEL 8086 MICROCPROCESSOR 9

Architecture of 8086-Register organization – Signal Description of 8086 - 8086 Instructions set – Addressing modes – Assembler directives and operators- simple programs.

.

UNIT II PERIPHERAL INTERFACING 9

Programmable Peripheral Interface 8255 – Programmable Communication Interface 8251 USART – Programmable Interrupt Controller 8259A - Programmable Interval Timer 8253 – Keyboard/Display Controller 8279 – A-to-D converter – D-to-A converter.

UNIT III INTEL 8051 MICROCONTROLLER 9

Introduction to 8 bit microcontroller – architecture of 8051- Signal descriptions of 8051- Role of PC and DPTR- Flags and PSW- CPU registers- Internal RAM & ROM- Special Function Register- Counter & Timers- Serial Communication.

UNIT IV ASSEMBLY LANGUAGE PROGRAM OF INTEL 8051 9

Interrupt- Addressing Mode- Data Transfer Instruction- Arithmetic Instruction- Logical Instruction- Jump Loop & Call Instruction- I/O Port Programming.

UNIT V INTERFACING AND APPLICATION OF INTEL 8051 9

LCD Interfacing - A/D and D/A Interfacing- Sensor Interfacing- Relays and Optoisolators- Stepper Motor Interfacing- DC Motor Interfacing.

LECTURE HOURS : 45
TUTORIAL HOURS : 15
TOTAL HOURS : 60

TEXTBOOKS

1. Krishna Kant, "Microprocessors and Microcontrollers Architecture, programming and system Design using 8085, 8086, 8051 and 8096". PHI2007. (Unit I & II).
2. Muhammad Ali Mazidi and JanicaGilliMazidi, The 8051 microcontroller and embedded systems, Pearson Education, 5th Indian reprint, 2003. (Unit III to V)

REFERENCE BOOKS

1. Rafiquzzaman M. – Microprocessors – Theory and Applications Intel and Motorola, PHI Pvt. Ltd., New Delhi 2001.
2. Douglas V.Hall – Microprocessors and Interfacing programming and hardware, Tata McGraw Hill Edition 1997.
3. A.K Roy, K.M Bhurchandi, Intel Microprocessors Architecture, Programming and Interfacing McGraw Hill International Edition – 2001

YEAR	III	HIGH VOLTAGE ENGINEERING	L	T	P	C
SEMESTER	VI		3	0	0	3

AIM

- To expose the students to causes and various types of over voltage Transients in Power system and its effects on power system.
- To understand the Generation of over voltages in Laboratory.
- To know about the Testing of power apparatus and system.

OBJECTIVES

- To understand the various types of over voltages in power system and protection.
- Generation of over voltages in laboratories.
- Measurement of overvoltage.
- Nature of Breakdown mechanism in Solids.
- Testing of Power apparatus and insulation coordination.

UNIT I OVER VOLTAGES AND INSULATION COORDINATION 6

Natural causes of over voltages-Lightning phenomena-Over voltages due to switching surges - System faults and other abnormal conditions-Principles of insulation co-ordination.

UNIT II ELECTRICAL BREAKDOWN IN GASES AND SOLIDS 12

Classical gas laws- Ionization and decay process- Secondary effects- Paschen's law-Streamer theory-Breakdown in non-uniform fields and corona discharges- Electromechanical breakdown-Thermal breakdown- Breakdown in composite dielectrics.

UNIT III GENERATION OF HIGH VOLTAGE AND HIGH CURRENT 9

Generation of high DC voltage, alternating voltage , impulse voltage and impulse currents.

UNIT IV MEASUREMENT OF HIGH VOLTAGE AND HIGH CURRENT 9

Measurement of high voltages and high currents - Digital techniques in high voltage measurement.

UNIT V HIGH VOLTAGE TESTING 9

High voltage testing of electrical power apparatus - Power frequency, Impulse voltage and DC, International and Indian Standards.

TOTAL HOURS : 45

TEXT BOOKS

1. M. S. Naidu and V. Kamaraju, ‘High Voltage Engineering’, Tata McGraw Hill,1995.
2. Kuffel,E and Zaengl, W.S, ‘High Voltage Engineering Fundamentals’, Pergamon Press, Oxford , Londan,1986

REFERENCE BOOKS

1. Kuffel, E and Abdullah..M, ‘High Voltage Engineering Fundamentals’, Pergamon Press, Oxford ,Londan,1970.
2. Gallghar, P.J and Pearmain,A.J., ‘High Voltage Measurement’,Testing and Design,John Wiley and Sons, Newyork,1982

YEAR	III	EMBEDDED SYSTEMS	L	T	P	C
SEMESTER	VI		3	0	0	3

AIM

- To learn the basic concepts of embedded systems and its applications.

OBJECTIVES

- To introduce students to the embedded systems, its hardware and software.
- To introduce devices and buses used for embedded networking.
- To explain programming concepts and embedded programming in C and C++
- To introduce the software development tools in embedded systems.
- To introduce the concepts of Real Time Operating System.

UNIT I INTRODUCTION TO EMBEDDED SYSTEMS 9

Definition –Processor Embedded into a System – Embedded Hardware Units and Devices in system –Embedded Software in a System – Examples of Embedded system –System on Chip (Soc) and Use of VLSI Design Technology – Complex Design and Processors – Design Process – Formalizations of System Design – Design Process and Design Examples – Classifications of Embedded Systems.

UNIT II DEVICES AND BUSES FOR DEVICES NETWORK 9

Device I/O Types and Examples – Serial Communication Devices – Parallel Devices Ports – Sophisticated Interfacing Features in Devices Ports – Wireless Devices – Timer and Counting Devices – Watchdog Timer – Real Time Clock – Networked Embedded Systems – Serial Bus Communication Protocols – Parallel Bus Device Protocol – Parallel Communication Network Using ISA, PCI, PCI-X, cPCI and advanced buses.

UNIT III PROGRAMMING CONCEPTS AND EMBEDDED PROGRAMMING IN C, C++ 9

Programming in assembly language (ALP) vs. High Level Language - C Program Elements, Macros and functions -Use of Pointers - NULL Pointers - Use of Function Calls – Multiple function calls in a Cyclic Order in the Main Function Pointers – Function Queues and Interrupt Service Routines Queues Pointers – Concepts of EMBEDDED PROGRAMMING in C++ - Objected Oriented Programming – Embedded Programming in C++, 'C' Program compilers – Cross compiler– Optimization of memory codes.

UNIT IVSOFTWARE DEVELOPMENT AND TOOLS 9

Embedded system evolution trends. Round - Robin, robin with Interrupts, function-One-Scheduling Architecture, Algorithms. Introduction to-assembler-compiler-cross compilers and Integrated Development Environment (IDE). Object Oriented Interfacing, Recursion, Debugging strategies, Simulators.

UNIT V REAL TIME OPERATING SYSTEMS 9

Task and Task States, tasks and data, semaphores and shared Data Operating system Services-Message queues-Timer Function-Events-Memory Management, Interrupt Routines in an RTOS environment, basic design Using RTOS.

TOTAL HOURS : 45

TEXT BOOKS:

1. Rajkamal, Embedded Systems Architecture, Programming and Design, TATA McGraw-Hill, Second Edition, Sixth reprint Oct. 2010
2. David E Simon, "An embedded software primer ", Pearson education Asia, Eighth Impression, 2009.

REFERENCE BOOKS:

1. Steve Heath, Embedded Systems Design, Second Edition-2003, Newnes,
2. Wayne Wolf, Computers as Components; Principles of Embedded Computing System Design – Harcourt India, Morgan Kaufman Publishers, 2008.
3. Frank Vahid and Tony Givargis, "Embedded Systems Design – A unified Hardware /Software Introduction", John Wiley, 2006.

YEAR	III	MICROCONTROLLER LABORATORY	L	T	P	C
SEMESTER	VI		0	0	3	2

AIM

- To provide the knowledge of assembly language programming of microprocessors and microcontrollers and interfacing peripheral devices with microprocessors.

OBJECTIVE

- To write the assembly language program for 8085, 8086 and 8051.
- To write the programs for communication between microprocessor and peripheral devices.
- To interface ADCs, DACs with microprocessor and learn the real time applications like stepper motor control, key board etc

LIST OF EXPERIMENTS

1. 8085 & 8086 Assembly Language Program (ALP) for Arithmetic Operations.
2. 8051 Assembly Language Program (ALP) for Arithmetic Operations.
3. 8051 Assembly Language Program (ALP) for Logical Operations.
4. 8051 Assembly Language Program (ALP) for Bit Manipulation Operations.
5. 8051 Assembly Language Program (ALP) for arrange the numbers in Ascending and Descending order.
6. 8051 Assembly Language Program (ALP) for Interrupt & UART Operations.
7. Interfacing an ADC to 8051 Controller.
8. Interfacing DAC to 8051 Controller and generate Square, Triangular & Saw-tooth waveform.
9. Interfacing a Stepper motor to 8051 Controller and operate it in clockwise and anti-clockwise directions.
10. Interfacing a Keyboard & Display controller (8279) to 8051 Controller.

TOTAL HOURS: 45

REFERENCE BOOKS

1. Laboratory reference manual.

YEAR	III	SOLID STATE DRIVES LABORATORY	L	T	P	C
SEMESTER	VI		0	0	3	2

OBJECTIVES

- To study about different AC and DC drives.

LIST OF EXPERIMENTS:

1. Converter fed DC Motor Drive.
2. Inverter fed Induction Motor Drive.
3. V/F Control of VSI Fed Induction Motor.
4. Rotor Resistance Control of Induction Motor.
5. Simulation of PWM inverter fed single phase induction motor control
6. Simulation of PWM inverter fed three phase induction motor control
7. Simulation of CSI fed induction motor drive analysis
8. Simulation of VSI fed induction motor drive analysis
9. Simulation of PWM inverter fed three phase induction motor control

TOTAL HOURS: 45

REFERENCE BOOKS

1. Laboratory reference manual.

YEAR	IV	ELECTRIC ENERGY GENERATION, UTILIZATION AND CONSERVATION	L	T	P	C
SEMESTER	VII		3	0	0	3

AIM

To expose students to the main aspects of generation, utilization and conservation.

OBJECTIVES

(i)To impart knowledge on Generation of electrical power by conventional and non–conventional methods.

(ii) To understand the importance of Electrical energy conservation, energy auditing and power quality.

(iii)To learn the Principle and design of illumination systems and methods of heating and welding.

(iv)To understand the laws of illumination and the basic design of illumination schemes.

(v) Industrial applications of electric heating and welding.

UNIT I POWER GENERATION **9**

Review of conventional methods – thermal, hydro and nuclear based power generation. Non-conventional methods of power generation – fuel cells - tidal waves – wind – geothermal – solar - bio-mass - municipal waste. Cogeneration. Effect of distributed generation on power system operation.

UNIT II ECONOMIC ASPECTS OF GENERATION **9**

Economic aspects of power generation – load and load duration curves – number and size of units – cost of electrical energy – tariff. Economics of power factor improvement power capacitors – power quality.Importance of electrical energy conservation – methods – energy efficient equipments. Introduction to energy auditing.

UNIT III ILLUMINATION **9**

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 IV INDUSTRIAL HEATING AND WELDING **9**

Role electric heating for industrial applications – resistance heating – induction heating – dielectric heating - electric arc furnaces. Brief introduction to electric welding – welding generator, welding transformer and the characteristics.

UNIT V ELECTRIC TRACTION **9**

Merits of electric traction – requirements of electric traction system – supply systems – mechanics of train movement – traction motors and control – braking – recent trends in electric traction.

TOTAL HOURS : 45

TEXT BOOKS

1. C.L. Wadhwa, ‘Generation, Distribution and Utilization of Electrical Energy’, New Age International Pvt. Ltd, 2003.
2. B.R. Gupta, ‘Generation of Electrical Energy’, Eurasia Publishing House (P) Ltd, New Delhi, 2003.

REFERENCE BOOKS

1. H. Partab, ‘Art and Science of Utilisation of Electrical Energy’, Dhanpat Rai and Co, New Delhi, 2004.
2. E. Openshaw Taylor, ‘Utilization of Electrical Energy in SI Units’, Orient Longman Pvt. Ltd, 2003.
3. J.B. Gupta, ‘Utilization of Electric Power and Electric Traction’, S.K.Kataria and Sons, 2002.

YEAR	IV	PROJECT WORK & VIVA VOCE	L	T	P	C
SEMESTER	VII		0	0	12	6

OBJECTIVE

- The objective of the project work is to enable the students to form the groups of not more than 3 members on a project involving theoretical and experimental studies related to the branch of study.

- Formation of Group as follows
    - Group A : 8.5CGPA and above
    - Group B : 7 to 8.49 CGPA
    - Group C : 5 to 6.9 CGPA
    - Group A Student will have a choice to take 2 students from Group B&C

- Every project work shall have a guide who is the member of the faculty of the institution. Six periods per week shall be allotted in the time table and this time shall be utilized by the students to receive the directions from the guide, on library reading, laboratory work, computer analysis or field work as assigned by the guide and also to present in periodical seminars on the progress made in the project.

- The aim of the project work is to deepen comprehension of principles by applying them to a new problem which may be the design and manufacture of a device, a research investigation, a computer or management project or a design problem.

- The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department.

- Each student shall finally produce a comprehensive report covering background information, literature survey, problem statement, project work details and conclusion.

- This final report shall be typewritten form as specified in the guidelines.

- The continuous assessment shall be made as prescribed in the regulations

ELECTIVES

ELECTIVE	ADVANCED CONTROL SYSTEM	L	T	P	C
		3	0	0	3

UNIT I STATE VARIABLE ANALYSIS 9

Concept of state – State Variable and State Model – State models for linear and continuous time systems – Solution of state and output equation – controllability and\ observability - Pole Placement – State observer Design of Control Systems with observers.

UNIT II PHASE PLANE ANALYSIS **9**

Features of linear and non-linear systems - Common physical non-linearities – Methods of linearising non-linear systems - Concept of phase portraits – Singular points – Limit cycles – Construction of phase portraits – Phase plane analysis of linear and non-linear systems – Isocline method.

UNIT III DESCRIBING FUNCTION ANALYSIS **9**

Basic concepts, derivation of describing functions for common non-linearities – Describing function analysis of non-linear systems – Conditions for stability – Stability of oscillations.

UNIT IV STABILITY ANALYSIS **9**

Introduction – Liapunov's stability concept – Liapunov's direct method – Lure's transformation – Aizerman's and Kalman's conjecture – Popov's criterion – Circle criterion.

UNIT V OPTIMAL CONTROL **9**

Introduction -Decoupling - Time varying optimal control – LQR steady state optimal control – Optimal estimation – Multivariable control design.

Total Hours: 45

TEXT BOOKS

1. I.J. Nagrath and M. Gopal, 'Control Systems Engineering', New Age International Publishers, 2003.

2. Ashish Tewari, 'Modern control Design with Matlab and Simulink', John Wiley, New Delhi, 2002.

REFERENCE BOOKS

1. George J. Thaler, 'Automatic Control Systems', Jaico Publishers, 1993.

2. M.Gopal, Modern control system theory, New Age International Publishers, 2002.

3. Gene F. Franklin, J. David Powell and Abbasemami-Naeini, " Feedback Control of Dynamic Systems", Fourth edition, Pearson Education, Low price edition. 2002.

ELECTIVE	ADVANCED TOPICS IN POWER ELECTRONICS	L	T	P	C
		3	0	0	3

AIM

To study modern power electronic converters and its applications in electric power utility like low power SMPS and UPS technologies

OBJECTIVE

- To study the operation, switching techniques and basics topologies of DC-DC switching regulators
- To understand the operation, characteristics and performance parameters of switching mode power converters.
- To study the operation of resonant converters and concept of Zero voltage Switching.
- To learn the concept and operation of Inverters and different modulation techniques of pulse width modulated inverters and to understand harmonic reduction methods.
- To study the operation of various power electronics applications like UPS and filters.

UNIT I DC-DC CONVERTERS **9**

Principles of stepdown and stepup converters – Analysis and state space modeling of Buck, Boost, Buck- Boost and Cuk converters.

UNIT II SWITCHING MODE POWER CONVERTERS **9**

Analysis and state space modeling of flyback, Forward, Luo, Half bridge and full bridge converters- control circuits and PWM techniques.

UNIT III RESONANT CONVERTERS **9**

Introduction- classification- basic concepts- Resonant switch- Load Resonant converters- ZVS , Clamped voltage topologies- DC link inverters with Zero Voltage Switching- Series and parallel Resonant inverters- Voltage control .

UNIT IV DC-AC CONVERTERS **9**

Single phase and three phase inverters, control using various (sine PWM, SVPWM and advanced modulation) techniques, various harmonic elimination techniques- Multilevel inverters-Concepts - Types: Diode clamped- Flying capacitor- Cascaded types- Applications.

UNIT V POWER CONDITIONERS, UPS & FILTERS **9**

Introduction- Power line disturbances- Power conditioners –UPS: offline UPS, Online UPS, Applications – Filters: Voltage filters, Series-parallel resonant filters, filter without series capacitors, filter for PWM VSI, current filter, DC filters – Design of inductor and transformer for PE applications – Selection of capacitors.

TOTAL HOURS: 45

TEXT BOOKS:

1. Ned Mohan, Tore.M.Undeland, William.P.Robbins, Power Electronics converters, Applications and design- Third Edition- John Wiley and Sons- 2006

2. M.H. Rashid – Power Electronics circuits, devices and applications- third edition Prentice Hall of India New Delhi, 2007.

REFERENCES:

1. M.H. Rashid – Power Electronics handbook, Elsevier Publication, 2001.
2. Kjeld Thorborg, "Power Electronics – In theory and Practice", Overseas Press, First Indian Edition 2005.
3. Philip T Krein, " Elements of Power Electronics", Oxford University Press

ELECTIVE	ARTIFICIAL INTELLIGENCE & EXPERT SYSTEMS	L	T	P	C
		3	0	0	3

UNIT I INTRODUCTION 9

Introduction to AI and problem solving concepts: Definition- pattern recognition-production systems – problem and production system characteristics – two-pail problem-analysis of AI techniques – criteria for success

UNIT II - REPRESENTATION 9

Knowledge representation – formal and non-formal logic: Representation evaluation criteria - level of representation -formal logic schemes -resolutions -predicate and prepositional logic - conversion to clause form -semantic networks-frames-scripts-production system

UNIT III- PROBLEM SOLVING 9

Problem solving strategies dealing with uncertainty: Defining the problem – control strategies – exhaustive search – generate and test-space transformation models- forward versus backward reasoning -matching – weak methods – hill climbing -breadth and depth first searches – search algorithms.

UNIT IV- EXPERT SYSTEM 9

Expert system development process and knowledge acquisition: Definition – analysis of expert system problem solving – role and analysis of knowledge – architecture of the expert system – problem selection – formalization -implementation –evaluation.

UNIT V- KNOWLEDGE ACQUISITION 9

Knowledge acquisition techniques- cognitive behavior – knowledge representation development. Expert system tools: Expert system shells -narrow tools -large hybrid expert system tools -PC based expert system tools knowledge acquisition tools.

TOTAL HOURS: 45

REFERENCES

1. Introduction to AI & Expert System – D. W. Patterson, Prentice hall of India
2. Principles of Artificial Intelligence& Expert Systems Development – Davi W.Rolston, Tata McGraw Hill
3. Artificial Intelligence – Elaine Rich, McGraw Hill
4. Principles of Artificial Intelligence – Nils J. Nilsson, Springer Verlag Introduction to Artificial Intelligence – Charnaik & McDermott, Addison Wesley

ELECTIVE	BIOMEDICAL INSTRUMENTATION	L	T	P	C
		3	0	0	3

AIM

The course is designed to make the student acquire an adequate knowledge of the physiological systems of the human body and relate them to the parameters that have clinical importance. The fundamental principles of equipment that are actually in use at the present day are introduced.

OBJECTIVE:

To provide an acquaintance of the physiology of the heart, lung, blood circulation and circulation respiration , Methods of different transducers used.

To introduce the student to the various sensing and measurement devices of electrical origin.

To provide the latest ideas on devices of non-electrical devices.

To bring out the important and modern methods of imaging techniques.

To provide latest knowledge of medical assistance / techniques and therapeutic equipments.

UNIT I PHYSIOLOGY AND TRANSDUCERS **9**

Cell and its structure – Resting and Action Potential – Nervous system: Functionalorganisation of the nervous system – Structure of nervous system, neurons - synapse –transmitters and neural communication – Cardiovascular system – respiratory system –Basic components of a biomedical system - Transducers – selection criteria – Piezoelectric, ultrasonic transducers - Temperature measurements - Fibre optic temperaturesensors.

UNIT II ELECTRO – PHYSIOLOGICAL MEASUREMENTS **9**

Electrodes –Limb electrodes –floating electrodes – pregelled disposable electrodes -Micro, needle and surface electrodes – Amplifiers: Preamplifiers, differential amplifiers,chopper amplifiers – Isolation amplifier.ECG – EEG – EMG – ERG – Lead systems and recording methods – Typicalwaveforms.Electrical safety in medical environment: shock hazards – leakage current-Instrumentsfor checking safety parameters of biomedical equipments

UNIT III NON-ELECTRICAL PARAMETER MEASUREMENTS **9**

Measurement of blood pressure – Cardiac output – Heart rate – Heart sound – Pulmonary function measurements – spirometer – Photo Plethysmography, BodyPlethysmography – Blood Gas analysers : pH of blood –measurement of blood pCO_2,pO_2, finger-tip oxymeter - ESR, GSR measurements .

UNIT IV MEDICAL IMAGING **9**

Radio graphic and fluoroscopic techniques – Computer tomography – MRI –Ultrasonography – Endoscopy – Thermography – Different types of biotelemetrysystems and patient monitoring – Introduction to Biometric systems

UNIT V ASSISTING AND THERAPEUTIC EQUIPMENTS **9**

Pacemakers – Defibrillators – Ventilators – Nerve and muscle stimulators – Diathermy – Heart – Lung machine – Audio meters – Dialysers – Lithotripsy

TOTAL HOURS: 45

TEXT BOOKS

1. R.S.Khandpur, 'Hand Book of Bio-Medical instrumentation', Tata McGraw Hill Publishing Co Ltd., 2003.

2. Leslie Cromwell, Fred J.Weibell, Erich A.Pfeiffer, 'Bio-Medical Instrumentation and Measurements', II edition, Pearson Education, 2002 / PHI.

REFERENCE BOOKS

1. M.Arumugam, 'Bio-Medical Instrumentation', Anuradha Agencies, 2003.
2. L.A. Geddes and L.E.Baker, 'Principles of Applied Bio-Medical Instrumentation', John Wiley & Sons, 1975.
3. J.Webster, 'Medical Instrumentation', John Wiley & Sons, 1995.
4. C.Rajarao and S.K. Guha, 'Principles of Medical Electronics and Bio-medical Instrumentation', Universities press (India) Ltd, Orient Longman ltd, 2000.

ELECTIVE	CAD FOR ELECTRICAL APPARATUS	L	T	P	C
		3	0	0	3

AIM

To introduce the basics of Computer Aided Design technology for the design of Electrical Machines.

OBJECTIVE

At the end of this course the student will be able to

1. Learn the importance of computer aided design method.
2. Understand the basic electromagnetic field equations and the problem formulation for CAD applications.
3. Become familiar with Finite Element Method as applicable for Electrical Engineering.
4. Know the organization of a typical CAD package.
5. Apply Finite Element Method for the design of different Electrical apparatus.

UNIT I INTRODUCTION **9**

Conventional design procedures – Limitations – Need for field analysis based design – Review of Basic principles of energy conversion – Development of Torque/Force.

UNIT II MATHEMATICAL FORMULATION OF FIELD PROBLEMS **9**

Electromagnetic Field Equations – Magnetic Vector/Scalar potential – Electrical vector Scalar potential – Stored energy in Electric and Magnetic fields – Capacitance - Inductance- Laplace and Poisson's Equations – Energy functional.

UNIT III PHILOSOPHY OF FEM **9**

Mathematical models – Differential/Integral equations – Finite Difference method – Finite element method – Energy minimization – Variational method- 2D field problems –Discretisation – Shape functions – Stiffness matrix – Solution techniques.

UNIT IV CAD PACKAGES **9**

Elements of a CAD System –Pre-processing – Modelling – Meshing – Material properties- Boundary Conditions – Setting up solution – Post processing.

UNIT V DESIGN APPLICATIONS **9**

Voltage Stress in Insulators – Capacitance calculation - Design of Solenoid Actuator – Inductance and force calculation – Torque calculation in Switched Reluctance Motor.

TOTAL HOURS: 45

TEXT BOOKS

1. S.J Salon, 'Finite Element Analysis of Electrical Machines', Kluwer Academic Publishers, London, 1995.
2. Nicola Bianchi, 'Electrical Machine Analysis using Finite Elements', CRC Taylor& Francis, 2005.

REFERENCES

1. Joao Pedro, A. Bastos and Nelson Sadowski, 'Electromagnetic Modeling by Finite Element Methods', Marcell Dekker Inc., 2003.
2. P.P.Silvester and Ferrari, 'Finite Elements for Electrical Engineers', Cambridge University Press, 1983.
3. D.A.Lowther and P.P Silvester, 'Computer Aided Design in Magnetics', Springer Verlag, New York, 1986.
4. S.R.H.Hoole, 'Computer Aided Analysis and Design of Electromagnetic Devices',Elsevier, New York, 1989.
5. User Manuals of MAGNET, MAXWELL & ANSYS Software

ELECTIVE	EHV AC & DIRECT CURRENT POWER TRANSMISSION	L	T	P	C
		3	0	0	3

AIM:

i) To study the different types of AC and DC links with its advantages and applications
ii) To study the different compensation techniques
iii) To study the concept of travelling waves, types of over voltage in the transmission line
iv) To study the different components used in EHV system

UNIT-I

Constitution of EHV AC and DC links, Kinds of DC links, limitations and advantages of AC and DC transmission principal, application of AC and DC transmission , trends EHV AC and DC transmission, power-handling capacity converter analysis Garentz circuit, Firing control, overlapping.

UNIT-II

Extra long distance lines, voltage profile of loaded and unloaded line along the line, compensation of lines, series and shunt compensation, shunt reactors, Tuned power lines, problem of extra compensation lines, FACT concept and application.

UNIT-III

Travelling waves on transmission system, Their shapes, attenuation and distortion, effect of junction and termination on propagation of traveling waves, over voltage in transmission system, lighting, switching and temporary over voltage: control of lighting and switching over voltage.

UNIT-IV

Components of EHV dc system, converter circuits, rectifier and inverter valves, Reactive power requierments, harmonic generation, adverse effects, classification, Remidial measures to suppress, ,filters, Ground return,converter faults& protection harmonics misoperation, commutation failure, Multi-terminal D,C. lines.

UNIT-V

Control of EHV DC system desired features of control ,control charactteristics, constants current control, constant extinction angle control, lgnition angle control, parallel operation of HVAC & DC system, problems and advantage

TEXT BOOKS

1. Rakesh Das Begmudre, Extra High Voltage AC Transmission Engineering, Wiley Estern Limited.
2. K.R. Padiyar, HVDC Power Transmission System, Wiley Estern Limited.

REFERENCE BOOK

1. E.W. Kimbark. EHV-AC and HVDC Transmission Engineering & Practice, Khanna Publishers.

ELECTIVE	FLEXIBLE AC TRANSMISSION SYSTEMS	L	T	P	C
		3	0	0	3

AIM:

i) To study the different methods used to control the reactive power in transmission line

ii) To study the compensation technique for reactive control using static var compensator with its application

iii) To study about working principle, Different modes of operation and applicatiotns of thyristors controlled series capacitor

iii) To study the different voltage source converters based FACTS controllers

iv) To study the coordination of FACTS controller using different techniques

1. INTRODUCTION **9**

Reactive power control in electrical power transmission lines –Uncompensated transmission line - series compensation – Basic concepts of static Var Compensator (SVC) – Thyristor Switched Series capacitor (TCSC) – Unified power flow controller (UPFC).

2. STATIC VAR COMPENSATOR (SVC) AND APPLICATIONS 9

Voltage control by SVC – Advantages of slope in dynamic characteristics – Influence of SVC on system voltage – Design of SVC voltage regulator –Modelling of svc for power flow and transient stability – Applications: Enhancement of transient stability – Steady state power transfer – Enhancement of power system damping – Prevention of voltage instability.

3. **THYRISTOR CONTROLLED SERIES CAPACITOR (TCSC) AND APPLICATIONS** **9**

Operation of the TCSC – Different modes of operation – Modelling of TCSC – Variable reactance model – Modelling for Power Flow and stability studies. Applications: Improvement of the system stability limit – Enhancement of system damping-SSR Mitigation.

4. VOLTAGE SOURCE CONVERTER BASED FACTS CONTROLLERS 9

Static Synchronous Compensator (STATCOM) – Principle of operation – V-I Characteristics. Applications: Steady state power transfer-Enhancement of transient stability - Prevention of voltage instability. SSSC-operation of SSSC and the control of power flow –Modelling of SSSC in load flow and transient stability studies. Applications: SSR Mitigation-UPFC and IPFC

5. CO-ORDINATION OF FACTS CONTROLLERS 9

Controller interactions – SVC – SVC interaction – Co-ordination of multiple controllers using linear control techniques – Control coordination using genetic algorithms.

TOTAL HOURS: 45

TEXT BOOKS:

1. K.R.Padiyar," FACTS Controllers in Power Transmission and Distribution", New Age International(P) Limited, Publishers, New Delhi, 2008
2. R.Mohan Mathur, Rajiv K.Varma, "Thyristor – Based Facts Controllers for Electrical Transmission Systems", IEEE press and John Wiley & Sons, Inc

REFERENCES

1. R.Mohan Mathur, Rajiv K.Varma, "Thyristor – Based Facts Controllers for Electrical Transmission Systems", IEEE press and John Wiley & Sons, Inc.

2. Narain G. Hingorani, "Understanding FACTS -Concepts and Technology of Flexible AC Transmission Systems", Standard Publishers Distributors, Delhi- 110 006

3. K.R.Padiyar," FACTS Controllers in Power Transmission and Distribution", New Age International(P) Limited, Publishers, New Delhi, 2008

4. A.T.John, "Flexible A.C. Transmission Systems", Institution of Electrical and Electronic Engineers (IEEE), 1999.

5. V.K.Sood, HVDC and FACTS controllers – Applications of Static Converters in Power System, APRIL 2004 , Kluwer Academic Publishers.

ELECTIVE	HIGH VOLTAGE DIRECT CURRENT TRANSMISSION	L	T	P	C
		3	0	0	3

AIM

To develop the skills in the area of HVDC power transmission with the analysis of HVDC converters.

OBJECTIVE

- **i)** To understand the concept, planning of DC power transmission and comparison with power transmission.
- **ii)** To analyze HVDC converters
- **iii)** To study about the multi-terminal DC systems.
- **iv)** To analyze the power flow in AC/DC systems
- **v)** To learn about HVDC simulation tools.

1. DC POWER TRANSMISSION TECHNOLOGY **6**

Introduction - Comparison of AC and DC transmission – Application of DC transmission – Description of DC transmission system - Planning for HVDC transmission – Modern trends in DC transmission – DC breakers – Cables, VSC based HVDC.

2. ANALYSIS OF HVDC CONVERTERS AND HVDC SYSTEM CONTROL **12**

Pulse number, choice of converter configuration – Simplified analysis of Graetz circuit - Converter bridge characteristics – characteristics of a twelve pulse converter detailed analysis of converters.

General principles of DC link control – Converter control characteristics – System control hierarchy - Firing angle control – Current and extinction angle control – Generation of harmonics and filtering - power control – Higher level controllers.

3. MULTITERMINAL DC SYSTEMS **9**

Introduction – Potential applications of MTDC systems - Types of MTDC systems - Control and protection of MTDC systems - Study of MTDC systems.

4. POWER FLOW ANALYSIS IN AC/DC SYSTEMS **9**

Per unit system for DC Quantities - Modelling of DC links - Solution of DC load flow - Solution of AC-DC power flow - Case studies.

5. SIMULATION OF HVDC SYSTEMS **9**

Introduction – System simulation: Philosophy and tools – HVDC system simulation – Modeling of HVDC systems for digital dynamic simulation – Dynamic in traction between DC and AC systems.

TOTAL HOURS: 45

TEXT BOOK

1. K.R.Padiyar, , “HVDC Power Transmission Systems”, New Age International (P) Ltd., New Delhi, 2002
2. J.Arrillaga, , “High Voltage Direct Current Transmission”, Peter Pregrinus, London,1983.

REFERENCE

1.Edward Wilson Kimbark, " Direct current Transmission", Vol.I, Wiley interscience, New York,London, Sydney,1971.

2. . Kundur, "Power System Stability and Control", McGraw-Hill, 1993.

3. Erich Uhlmann, " Power Transmission by Direct Current", BS Publications, 2004.

4. V.K.Sood,HVDC and FACTS controllers – Applications of Static Converters in

ELECTIVE	INFORMATION SECURITY	L	T	P	C
		3	0	0	3

AIM

To study the critical need for ensuring Information Security in Organizations

OBJECTIVES

1. To understand the basics of Information Security
2. To know the legal, ethical and professional issues in Information Security
3. To know the aspects of risk management
4. To become aware of various standards in this area
5. To know the technological aspects of Information Security

UNIT 1 **INTRODUCTION** 9

History, What is Information Security?, Critical Characteristics of Information, NSTISSC Security Model, Components of an Information System, Securing the Components, Balancing Security and Access, The SDLC, The Security SDLC

UNIT II SECURITY INVESTIGATION 9

Need for Security, Business Needs, Threats, Attacks, Legal, Ethical and Professional Issues

UNIT III SECURITY ANALYSIS 9

Risk Management: Identifying and Assessing Risk, Assessing and Controlling Risk

UNIT IV LOGICAL DESIGN 9

Blueprint for Security, Information Security Poicy, Standards and Practices, ISO 17799/BS 7799, NIST Models, VISA International Security Model, Design of Security Architecture, Planning for Continuity

UNIT V PHYSICAL DESIGN 9

Security Technology, IDS, Scanning and Analysis Tools, Cryptography, Access Control Devices, Physical Security, Security and Personnel

TOTAL HOURS: 45

TEXT BOOK

1. Michael E Whitman and Herbert J Mattord, “Principles of Information Security”, Vikas Publishing House, New Delhi, 2003

REFERENCES

1. Micki Krause, Harold F. Tipton, “ Handbook of Information Security Management”, Vol 1-3 CRC Press LLC, 2004.

2. Stuart Mc Clure, Joel Scrambray, George Kurtz, “Hacking Exposed”, Tata McGraw-Hill, 2003
3. Matt Bishop, “ Computer Security Art and Science”, Pearson/PHI, 2002.

ELECTIVE	INTELLIGENT CONTROLLERS	L	T	P	C
		3	0	0	3

UNIT I INTRODUCTION 9

Approaches to intelligent control. Architecture for intelligent control. Symbolic reasoning system, rule-based systems, the AI approach. Knowledge representation. Expert systems.

UNIT II ARTIFICIAL NEURAL NETWORKS **9**

Concept of Artificial Neural Networks and its basic mathematical model, McCulloch Pitts neuron model, simple perceptron, Adaline and Madaline, Feed-forward Multilayer Perceptron. Learning and Training the neural network. Data Processing: Scaling, Fourier transformation, principal-component analysis and wavelet transformations. Hopfield network, Self-organizing network and Recurrent network. Neural Network based controller

UNIT III GENETIC ALGORITHM **9**

Basic concept of Genetic algorithm and detail algorithmic steps, adjustment of free parameters. Solution of typical control problems using genetic algorithm. Concept on some other search techniques like tabu search and ant-colony search techniques for solving optimization problems.

UNIT IV FUZZY LOGIC SYSTEM **9**

Introduction to crisp sets and fuzzy sets, basic fuzzy set operation and approximate reasoning.

Introduction to fuzzy logic modeling and control. Fuzzification, inferencing and defuzzification. Fuzzy knowledge and rule bases. Fuzzy modeling and control schemes for nonlinear systems. Self-organizing fuzzy logic control. Fuzzy logic control for nonlinear time-delay system.

UNIT V APPLICATIONS **9**

GA application to power system optimisation problem, Case studies: Identification and control of linear and nonlinear dynamic systems using Matlab-Neural Network toolbox. Stability analysis of Neural-Network interconnection systems. Implementation of fuzzy logic controller using Matlab fuzzy-logic toolbox. Stability analysis of fuzzy control systems.

TOTAL HOURS: 45

TEXT BOOKS

1. Padhy.N.P.(2005), Artificial Intelligence and Intelligent System, Oxford University Press.
2. KOSKO,B. "Neural Networks And Fuzzy Systems", Prentice-Hall of India Pvt. Ltd., 1994.

ELECTIVE	MICRO ELECTRO MECHANICAL SYSTEMS	L	T	P	C
		3	0	0	3

AIM

The aim of this course is to educate the student to understand the fundamentals of Micro Electro Mechanical Systems (MEMS)

OBJECTIVES

To integrate the knowledge of semiconductors and solid mechanics to fabricate MEMS devices.

To understand the rudiments of Micro fabrication techniques. To identify and understand the various sensors and actuators

To study the different materials used for MEMS

To Study the applications of MEMS to disciplines beyond Electrical and Mechanical engineering.

UNIT I INTRODUCTION 9

Intrinsic Characteristics of MEMS – Energy Domains and Transducers- Sensors and Actuators – Introduction to Microfabrication - Silicon based MEMS processes – New Materials – Review of Electrical and Mechanical concepts in MEMS – Semiconductor devices – Stress and strain analysis – Flexural beam bending- Torsional deflection.

UNIT II SENSORS AND ACTUATORS-I 9

Electrostatic sensors – Parallel plate capacitors – Applications – Interdigitated Finger capacitor – Comb drive devices – Thermal Sensing and Actuation – Thermal expansion – Thermal couples – Thermal resistors – Applications – Magnetic Actuators – Micromagnetic components – Case studies of MEMS in magnetic actuators.

UNIT III SENSORS AND ACTUATORS-II 9

Piezoresistive sensors – Piezoresistive sensor materials - Stress analysis of mechanical elements –Applications to Inertia, Pressure, Tactile and Flow sensors – Piezoelectric sensors and actuators –piezoelectric effects – piezoelectric materials – Applications to Inertia , Acoustic, Tactile and Flow sensors.

UNIT IV MICROMACHINING 9

Silicon Anisotropic Etching – Anisotrophic Wet Etching – Dry Etching of Silicon – Plasma Etching –Deep Reaction Ion Etching (DRIE) – Isotropic Wet Etching – Gas Phase Etchants – Case studies -Basic surface micromachining processes – Structural and Sacrificial Materials – Acceleration of sacrificial Etch – Striction and Antistriction methods – Assembly of 3D MEMS – Foundry process

UNIT V POLYMER AND OPTICAL MEMS 9

Polymers in MEMS– Polimide - SU-8 - Liquid Crystal Polymer (LCP) – PDMS – PMMA – Parylene –Fluorocarbon - Application to Acceleration, Pressure, Flow and Tactile sensors- Optical MEMS –Lenses and Mirrors – Actuators for Active Optical MEMS.

TOTAL HOURS: 45

TEXT BOOK:

1. Chang Liu, 'Foundations of MEMS', Pearson Education Inc., 2006.

REFERENCES:

1. Nadim Maluf, " An introduction to Micro electro mechanical system design", Artech House, 2000.
2. Mohamed Gad-el-Hak, editor, " The MEMS Handbook", CRC press Baco Raton, 2000
3. Tai Ran Hsu, "MEMS & Micro systems Design and Manufacture" Tata McGraw Hill, New Delhi, 2002.
4. Julian w. Gardner, Vijay k. varadan, Osama O.Awadelkarim,micro sensors mems and smart devices, John Wiley & son LTD,2002
5. James J.Allen, micro electro mechanical system design, CRC Press published in 2005

ELECTIVE	POWER ELECTRONICS FOR RENEWABLE ENERGY SYSTEM	L	T	P	C
		3	0	0	3

1. INTRODUCTION 9

Environmental aspects of electric energy conversion: impacts of renewable energy generation on environment (cost-GHG Emission) - Qualitative study of different renewable energy resources: Solar, wind, ocean, Biomass, Fuel cell, Hydrogen energy systems and hybrid renewable energy systems.

2. ELECTRICAL MACHINES FOR RENEWABLE ENERGY CONVERSION **9**

Review of reference theory fundamentals-principle of operation and analysis: IG, PMSG, SCIG and DFIG.

3. POWER CONVERTERS **9**

Solar: Block diagram of solar photo voltaic system -Principle of operation: line commutated converters (inversion-mode) - Boost and buck-boost converters- selection Of inverter, battery sizing, array sizing Wind: three phase AC voltage controllers- AC-DC-AC converters: uncontrolled rectifiers, PWM Inverters, Grid Interactive Inverters-matrix converters.

4. ANALYSIS OF WIND AND PV SYSTEMS **9**

Stand alone operation of fixed and variable speed wind energy conversion systems and solar system-Grid connection Issues -Grid integrated PMSG and SCIG Based WECSGrid Integrated solar system

5. HYBRID RENEWABLE ENERGY SYSTEMS **9**

Need for Hybrid Systems- Range and type of Hybrid systems- Case studies of Wind PV Maximum Power Point Tracking (MPPT).

TOTAL HOURS: 45

REFERENCES:

1. Rashid .M. H “power electronics Hand book”, Academic press, 2001.
2. Rai. G.D, “Non conventional energy sources”, Khanna publishes, 1993.
3. Rai. G.D,” Solar energy utilization”, Khanna publishes, 1993.
4. Gray, L. Johnson, “Wind energy system”, prentice hall linc, 1995.
5. Non-conventional Energy sources B.H.Khan Tata McGraw-hill Publishing Company, New Delhi

ELECTIVE	POWER QUALITY	L	T	P	C
		3	0	0	3

AIM:

To study the various issues affecting power quality, their production, monitoring and suppression.

OBJECTIVES:

i. To study the production of voltages sags, overvoltage's and harmonics and methods of control.
ii. To study various methods of power quality monitoring.

UNIT I INTRODUCTION TO POWER QUALITY 9

Terms and definitions: Overloading - under voltage - over voltage. Concepts of transients - short duration variations such as interruption - long duration variation such as sustained interruption. Sags and swells - voltage sag - voltage swell - voltage imbalance - voltage fluctuation - power frequency variations. International standards of power quality. Computer Business Equipment Manufacturers Associations (CBEMA) curve.

UNIT II VOLTAGE SAGS AND INTERRUPTIONS 9

Sources of sags and interruptions - estimating voltage sag performance. Thevenin's equivalent source - analysis and calculation of various faulted condition. Voltage sag due to induction motor starting. Estimation of the sag severity - mitigation of voltage sags, active series compensators. Static transfer switches and fast transfer switches.

UNIT III OVERVOLTAGES 9

Sources of over voltages - Capacitor switching – lightning - ferro resonance. Mitigation of voltage swells - surge arresters - low pass filters - power conditioners. Lightning protection – shielding - line arresters - protection of transformers and cables. An introduction to computer analysis tools for transients, PSCAD and EMTP.

UNIT IV HARMONICS 9

Harmonic sources from commercial and industrial loads, locating harmonic sources. Power system response characteristics - Harmonics Vs transients. Effect of harmonics - harmonic distortion -voltage and current distortion - harmonic indices - inter harmonics – resonance. Harmonic distortion evaluation - devices for controlling harmonic distortion - passive and active filters. IEEE and IEC standards.

UNIT V POWER QUALITY MONITORING 9

Monitoring considerations - monitoring and diagnostic techniques for various power quality problems - modeling of power quality (harmonics and voltage sag) problems by mathematical simulation tools - power line disturbance analyzer – quality measurement equipment - harmonic / spectrum analyzer - flicker meters - disturbance analyzer. Applications of expert systems for power quality monitoring.

TOTAL HOURS: 45

TEXT BOOK:

1. Roger. C. Dugan, Mark. F. McGranagham, Surya Santoso, H.Wayne Beaty, 'Electrical Power Systems Quality' McGraw Hill,2003.(For Chapters1,2,3, 4 and 5)

REFERENCES:

1. G.T. Heydt, 'Electric Power Quality', 2nd Edition. (West Lafayette, IN, Stars in a Circle Publications, 1994). (For Chapter 1, 2, 3 and 5)

2. M.H.J Bollen, 'Understanding Power Quality Problems: Voltage Sags and Interruptions', (New York: IEEE Press, 1999). (For Chapters 1, 2, 3 and 5)

3. J. Arrillaga, N.R. Watson, S. Chen, 'Power System Quality Assessment', (New York: Wiley, 1999). (For Chapters 1, 2, 3, 4 and 5)

4. PSCAD User Manual

ELECTIVE	POWER SYSTEM DYNAMICS	L	T	P	C
		3	0	0	3

AIM

To become familiar with the modelling of components and system for carrying out transient and dynamic stability analysis of large scale power system.

OBJECTIVES

1. To study detailed modeling of synchronous machine and its excitation and speed-governing controllers.
2. To study transient stability simulation of multi machine power system.
3. To study small signal stability analysis of a single-machine infinite bus system with excitation system and power system stabilizer.

INTRODUCTION **9**

Concept and importance of stability in power system operation and design; distinction between transient and dynamic stability; complexity of stability problem in large system: Need for reduced models; stability of interconnected systems.

MACHINE MODELLING **9**

Park's transformation; flux linkage equations, current space model, per unit conversion, normalizing the equations, equivalent circuit, flux linkage state space model, sub transient and transient inductances and time constants. Simplified models (one axis and constant flux linkage), steady state equations and phasor diagrams.

MACHINE CONTROLLERS **9**

Exciter and voltage regulators, function of excitation systems, types of excitation systems, typical excitation system configuration, block diagram and state space representation of IEEE type 1 excitation system, saturation function, stabilizing circuit. Function of speed governing systems, block diagram and state space representation of IEEE mechanical hydraulic governor and electrical hydraulic governors for hydro turbines and steam turbines.

TRANSIENT STABILITY **9**

State equation for multimachine simulation with one axis model, transient stability simulation of multimachine power system with one axis machine model including excitation system and speed governing system using R-K method of fourth order (Gill's technique), power system stabilizer.

DYNAMIC STABILITY **9**

System response to small disturbances: Linear model of the unregulated synchronous machine and its modes of oscillation, regulated synchronous machine, distribution of power impact, linearization of the load equation for the one machine problem – Simplified linear model, effect of excitation on dynamic stability, approximate system representation; supplementary stabilizing signals, dynamic performance measure, small signal performance measures.

TOTAL HOURS: 45

TEXT BOOKS

1. P.M. Anderson and A.A.Fouad, *Power System Control and Stability* Galgotia Publications, New Delhi, 2003.
2. P.Kundur, *Power System Stability and Control*, McGraw Hill Inc., USA, 1994.

REFERENCE BOOK

1. M.A.Pai and W.Sauer, *Power System Dynamics and Stability*, Pearson Education Asia, India, 2002.

ELECTIVE	POWER SYSTEM PLANNING AND RELIABILITY	L	T	P	C
		3	0	0	3

AIM:

To make students become familiar with power system operation and the various control actions to be implemented on the power system for reliability

OBJECTIVES:

i) To introduce the students ves of power system
ii) To make the students learn the reliability stability analysis of generation in power system
iii) To make the students learn the reliability stability analysis of transmission in power system
iv) To familiarize the students with the planning of expansion of power system
v) To introduce the students with the overview of planning of distribution system

UNIT I LOAD FORECASTING **9**

Objectives of forecasting - Load growth patterns and their importance in planning - Load forecasting Based on discounted multiple regression technique-Weather sensitive load forecasting-Determination of annual forecasting-Use of AI in load forecasting.

UNIT II GENERATION SYSTEM RELIABILITY ANALYSIS **9**

Probabilistic generation and load models- Determination of LOLP and expected value of demand not served –Determination of reliability of iso and interconnected generation systems.

UNIT III TRANSMISSION SYSTEM RELIABILITY ANALYSIS **9**

Deterministic contingency analysis-probabilistic load flow-Fuzzy load flow probabilistic transmission system reliability analysis-Determination of reliability indices like LOLP and expected value of demand not served.

UNIT IV EXPANSION PLANNING **9**

Basic concepts on expansion planning-procedure followed for integrate transmission system planning, current practice in India-Capacitor placer problem in transmission system and radial distributions system.

UNIT V DISTRIBUTION SYSTEM PLANNING OVERVIEW **9**

Introduction, sub transmission lines and distribution substations-Design primary and secondary systems-distribution system protection and coordination of protective devices.

TOTAL HOURS: 45

TEXT BOOKS

1.Roy Billinton and Allan Ronald, “Power System Reliability.”
2.J.Endreny,”Reliability modeling in electric power systems”John Wiley & sons

REFERENCES

1. Proceeding of work shop on energy systems planning & manufacturing CI.
2. R.L .Sullivan, “ Power System Planning”,.
3. 4. Turan Gonen, Electric power distribution system Engineering ‘McGraw Hill,1986

ELECTIVE	POWER SYSTEM TRANSIENTS	L	T	P	C
		3	0	0	3

AIM

To review the over voltages (or) surges due to the phenomena of switching operations and lighting discharge. Also to study propagation, reflection and refraction of these surges on the equipments their impact on the power system grid.

OBJECTIVES

(i)To study the generation of switching transients and their control using circuit – theoretical concept.

(ii)To study the mechanism of lighting strokes and the production of lighting surges.

(iii)To study the propagation, reflection and refraction of travelling waves.

(iv)To study the impact of voltage transients caused by faults, circuit breaker action, load rejection on integrated power system.

(v)To study the over voltages faults and switching surges on integrated system.

UNIT I INTRODUCTION AND SURVEY 9

Review and importance of the study of transients - causes for transients. RL circuit transient with sine wave excitation - double frequency transients – basic transforms of the RLC circuit transients. Different types of power system transients - effect of transients on power systems – role of the study of transients in system planning.

UNIT II SWITCHING TRANSIENTS 9

Over voltages due to switching transients - resistance switching and the equivalent circuit for interrupting the resistor current - load switching and equivalent circuit - waveforms for transient voltage across the load and the switch - normal and abnormal switching transients. Current suppression - current chopping - effective equivalent circuit. Capacitance switching - effect of source regulation - capacitance switching with a restrike, with multiple restrikes. Illustration for multiple restriking transients – ferro resonance.

UNIT III LIGHTNING TRANSIENTS 9

Review of the theories in the formation of clouds and charge formation - rate of charging of thunder clouds – mechanism of lightning discharges and characteristics of lightning strokes – model for lightning stroke - factors contributing to good line design – protection using ground wires - tower footing resistance - Interaction between lightning and power system.

UNIT IV TRAVELING WAVES ON TRANSMISSION LINE COMPUTATION OF TRANSIENTS 9

Computation of transients - transient response of systems with series and shunt lumped parameters and distributed lines. Traveling wave concept - step response - Bewely's lattice diagram - standing waves and natural frequencies - reflection and refraction of travelling waves.

UNIT V TRANSIENTS IN INTEGRATED POWER SYSTEM 9

The short line and kilometric fault - distribution of voltages in a power system – Line dropping and load rejection - voltage transients on closing and reclosing lines – over voltage induced by faults - switching surges on integrated system. Qualitative application of EMTP for transient computation.

TOTAL HOURS : 45

TEXT BOOKS

1. Allan Greenwood, 'Electrical Transients in Power Systems', Wiley Interscience, New York, 2nd edition 1991.

2. R.D.Begamudre, 'Extra High Voltage AC Transmission Engineering', Wiley Eastern Limited, 1986.

REFERENCE BOOKS

1. M.S.Naidu and V.Kamaraju, 'High Voltage Engineering', Tata McGraw Hill, 2nd edition, 2000.

ELECTIVE	ROBOTICS AND AUTOMATION	L	T	P	C
		3	0	0	3

AIM

To provide comprehensive knowledge of robotics in the design, analysis and control point of view.

OBJECTIVES

To study the various parts of robots and fields of robotics.

To study the various kinematics and inverse kinematics o robots.

To study the Euler, Lagrangian formulation of Robot dynamics.

To study the trajectory planning for robot.

To study the control of robots for some specific applications.

UNIT I BASIC CONCEPTS 9

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

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, fiber optic and tactile sensors.

UNIT III MANIPULATORS, ACTUATORS AND GRIPPERS 9

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

Solution of inverse kinematics problem – multiple solution jacobian work envelop – hill climbing techniques – robot programming languages

UNIT V CASE STUDIES 9

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

TOTAL HOURS : 45

TEXT BOOKS

1. Mikell P. Weiss G.M., Nagel R.N., Odraj N.G., Industrial Robotics, McGraw-Hill Singapore, 1996.

2. Ghosh, Control in Robotics and Automation: Sensor Based Integration, Allied Publishers, Chennai, 1998.

REFERENCES

1. Deb.S.R., Robotics technology and flexible Automation, John Wiley, USA 1992.

2. Asfahl C.R., Robots and manufacturing Automation, John Wiley, USA 1992.

3. Klafter R.D., Chimielewski T.A., Negin M., Robotic Engineering – An integrated approach, Prentice Hall of India, New Delhi, 1994.

4. Mc Kerrow P.J. Introduction to Robotics, Addison Wesley, USA, 1991.

5. Issac Asimov I Robot, Ballantine Books, New York, 1986.

ELECTIVE	SPECIAL ELECTRICAL MACHINES	L	T	P	C
		3	0	0	3

OBJECTIVES:

(i) Provide the concept of construction, operating principle and characteristics of synchronous reluctance motor, stepper motor and switched reluctance motor..

(ii) Give basic knowledge about the principle of operation, analysis, emf and torque equation, and control of permanent magnet synchronous motors and brushless DC motors

UNIT I SYNCHRONOUS RELUCTANCE MOTORS 9

Constructional features – Types – Axial and Radial flux motors – Operating principles – Variable Reluctance and Hybrid Motors – SYNREL Motors – Voltage and Torque Equations - Phasor diagram - Characteristics.

UNIT II STEPPING MOTORS 9

Constructional features – Principle of operation – Variable reluctance motor – Hybrid motor – Single and multi stack configurations – Torque equations – Modes of excitations – Characteristics – Drive circuits – Microprocessor control of stepping motors – Closed loop control.

UNIT III SWITCHED RELUCTANCE MOTORS 9

Constructional features – Rotary and Linear SRMs - Principle of operation – Torque production – Steady state performance prediction- Analytical method -Power Converters and their controllers – Methods of Rotor position sensing – Sensorless operation – Closed loop control of SRM - Characteristics.

UNIT IV PERMANENT MAGNET BRUSHLESS D.C. MOTORS 9

Permanent Magnet materials – Magnetic Characteristics – Permeance coefficient - Principle of operation – Types – Magnetic circuit analysis – EMF and torque equations – Commutation - Power controllers – Motor characteristics and control.

UNIT V PERMANENT MAGNET SYNCHRONOUS MOTORS 9

Principle of operation – Ideal PMSM – EMF and Torque equations – Armature reaction MMF – Synchronous Reactance – Sinewave motor with practical windings - Phasor diagram Torque/speed characteristics - Power controllers - Converter Volt-ampere requirements.

TOTAL HOURS: 45

TEXT BOOKS

1. T.J.E. Miller, 'Brushless Permanent Magnet and Reluctance Motor Drives', Clarendon Press, Oxford, 1989.

2. T. Kenjo, 'Stepping Motors and Their Microprocessor Controls', Clarendon Press London, 1984.

REFERENCE BOOKS

1. R.Krishnan, 'Switched Reluctance Motor Drives – Modeling, Simulation, Analysis, Design and Application', CRC Press, New York, 2001.

2. P.P. Aearnley, ‘Stepping Motors – A Guide to Motor Theory and Practice’, Peter Perengrinus, London, 1982.

3. T. Kenjo and S. Nagamori, ‘Permanent Magnet and Brushless DC Motors’, Clarendon Press, London, 1988.

ELECTIVE	VLSI DESIGN TECHNIQUES	L	T	P	C
		3	0	0	3

AIM:

To learn about the VLSI technology

OBJECTIVES:

To study the MOS transistor and technology
To study the stick diagram characteristics
To study the circuit characterization
To study the VLSI components

To study the verilog language

UNIT I MOS TRANSISTOR THEORY AND PROCESS TECHNOLOGY 9

NMOS and PMOS transistors - Threshold voltage - Body effect - Design equations - Second ordereffects - MOS models and small signal AC characteristics - Basic CMOS technology.

UNIT II INVERTERS AND LOGIC GATES 9

NMOS and CMOS Inverters - Stick diagram - Inverter ratio - DC and transient characteristics - switching times - Super buffers - Driving large capacitance loads - CMOS logic structures - Transmission gates - Static CMOS design - Dynamic CMOS design.

UNIT III CIRCUIT CHARACTERISATION AND PERFORMANCE ESTIMATION 9

Resistance estimation - Capacitance estimation - Inductance - Switching characteristics – Transistorsizing - Power dissipation and design margining - Charge sharing - Scaling.

UNIT IV VLSI SYSTEM COMPONENTS CIRCUITS AND SYSTEM LEVELPHYSICAL DESIGN 9

Multiplexers - Decoders - comparators - Priority encoders - Shift registers - Arithmetic circuits - Ripple carry adders - Carry look ahead adders - High-speed adders - Multipliers- Physical design -Delay modelling - Cross talk - Floor planning - Power distribution - Clock distribution - Basics ofCMOS testing.

UNIT V VERILOG HARDWARE DESCRIPTION LANGUAGE 9

Overview of digital design with Verilog HDL - Hierarchical modeling concepts - Modules and portdefinitions - Gate level modeling - Data flow modeling - Behavioral modeling - Task & functions -Test Bench.

TOTAL HOURS: 45

TEXT BOOKS:

1. Neil H.E. Weste, Kamran Eshraghian, “Principles of CMOS VLSI Design”, PearsonEducation ASIA, 2nd edition, 2000.
2. Samir Palnitkar, “Verilog HDL”, Pearson Education, 2nd Edition, 2004.

REFERENCES:

1. Pucknell, “Basic VLSI Design”, Prentice Hall of India Publication, 1995.
2. Eugene D. Fabricius, “Introduction to VLSI Design”, McGraw Hill International Editions,1990.
3. Bhasker J., “A Verilog HDL Primer”, 2nd Edition, B.S. Publications, 2001.
4. John P. Uyemura, “Introduction to VLSI Circuits and Systems”, John Wiley & Sons, Inc.,2002.

ELECTIVE	WIND ENERGY CONVERSION SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVE:

(i)To learn the types of renewable energy sources

(ii)To study the application of electrical machines in renewable energy conversion (iii)To study the application of semi conductor devices in renewable energy conversion (iv)To analyze the grid integrated renewable energy.

(v)To introduce the hybrid renewable energy systems

UNIT I INTRODUCTION 9

Components of WECS-WECS schemes-Power obtained from wind-simple momentum theory-Power coefficient-Sabinin's theory-Aerodynamics of Wind turbine

UNIT II WIND TURBINES 9

HAWT-VAWT-Power developed-Thrust-Efficiency-Rotor selection-Rotor design considerations-Tip speed ratio-No. of Blades-Blade profile-Power Regulation-yaw control-Pitch angle control-stall control-Schemes for maximum power extraction.

UNIT III FIXED SPEED SYSTEMS 9

Generating Systems- Constant speed constant frequency systems -Choice of Generators-Deciding factors-Synchronous Generator-Squirrel Cage Induction Generator- Model of Wind Speed- Model wind turbine rotor - Drive Train model-Generator model for Steady state and Transient stability analysis.

UNIT IV VARIABLE SPEED SYSTEMS 9

Need of variable speed systems-Power-wind speed characteristics-Variable speed constant frequency systems synchronous generator- DFIG- PMSG -Variable speed generators modeling - Variable speed variable frequency schemes.

UNIT V GRID CONNECTED SYSTEMS 9

Stand alone and Grid Connected WECS system-Grid connection Issues-Machine side & Grid side controllers-WECS in various countries

TOTAL HOURS : 45

REFERENCE BOOKS

1. L.L.Freris "Wind Energy conversion Systems", Prentice Hall, 1990
2. Ion Boldea, "Variable speed generators", Taylor & Francis group, 2006.
3. E.W.Golding "The generation of Electricity by wind power", Redwood burn Ltd., Trowbridge,1976.
4. S.Heir "Grid Integration of WECS", Wiley 1998.